Courses and Degrees
1975-76
COURSES
AND DEGREES
1975-76

[While every effort is made to ensure the accuracy of the information available at the time copy is prepared for this Bulletin, the University reserves the right to make changes at any time without prior notice.]
# University Calendar

## Autumn Quarter, 1975

<table>
<thead>
<tr>
<th>Month</th>
<th>Day(s)</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept.</td>
<td>29–30</td>
<td>Monday–Tuesday Registration</td>
</tr>
<tr>
<td>Oct.</td>
<td>1</td>
<td>Wednesday Instruction begins</td>
</tr>
<tr>
<td>Oct.</td>
<td>2</td>
<td>Thursday Conferring of degrees</td>
</tr>
<tr>
<td>Oct.</td>
<td>5</td>
<td>Sunday Matriculation Sunday</td>
</tr>
<tr>
<td>Oct.</td>
<td>21</td>
<td>Tuesday Last day for registration</td>
</tr>
<tr>
<td>Oct.</td>
<td>28</td>
<td>Tuesday Last day for filing advanced degree applications: A.M., M.S., Engineer for April conferral; Ph.D. for June</td>
</tr>
<tr>
<td>Nov.</td>
<td>27–30</td>
<td>Thursday–Sunday Thanksgiving Recess</td>
</tr>
<tr>
<td>Dec.</td>
<td>1</td>
<td>Monday Last day for filing A.B. and B.S. applications for January conferral</td>
</tr>
<tr>
<td>Dec.</td>
<td>12</td>
<td>Friday Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations</td>
</tr>
<tr>
<td>Dec.</td>
<td>15–19</td>
<td>Monday–Friday End-quarter examinations</td>
</tr>
</tbody>
</table>

## Winter Quarter, 1976

<table>
<thead>
<tr>
<th>Month</th>
<th>Day(s)</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>5</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>Jan.</td>
<td>6</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>Jan.</td>
<td>8</td>
<td>Thursday Conferring of degrees</td>
</tr>
<tr>
<td>Jan.</td>
<td>13</td>
<td>Tuesday Last day for filing Fellowship and Graduate Scholarship applications</td>
</tr>
<tr>
<td>Jan.</td>
<td>26</td>
<td>Monday Last day for registration</td>
</tr>
<tr>
<td>Feb.</td>
<td>2</td>
<td>Friday Last day for filing A.B. and B.S. applications for April and June conferral</td>
</tr>
<tr>
<td>Feb.</td>
<td>2</td>
<td>Monday Last day for filing advanced degree applications: A.M., M.S., Engineer for June conferral; Ph.D. for September</td>
</tr>
<tr>
<td>Feb.</td>
<td>16</td>
<td>Monday Observance of Washington's Birthday (Holiday)</td>
</tr>
<tr>
<td>March</td>
<td>7</td>
<td>Sunday Observance of Founders' Day</td>
</tr>
<tr>
<td>March</td>
<td>12</td>
<td>Friday Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations</td>
</tr>
<tr>
<td>March</td>
<td>15–19</td>
<td>Monday–Friday End-quarter examinations</td>
</tr>
</tbody>
</table>

## Spring Quarter, 1976

<table>
<thead>
<tr>
<th>Month</th>
<th>Day(s)</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>March</td>
<td>29</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>March</td>
<td>30</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>April</td>
<td>1</td>
<td>Thursday Conferring of degrees</td>
</tr>
<tr>
<td>April</td>
<td>15</td>
<td>Thursday Last day for filing Undergraduate Scholarship applications, matriculated undergraduates</td>
</tr>
<tr>
<td>April</td>
<td>19</td>
<td>Monday Last day for registration</td>
</tr>
<tr>
<td>April</td>
<td>26</td>
<td>Monday Last day for filing advanced degree applications: A.M., M.S., Engineer for September conferral; Ph.D. for January</td>
</tr>
<tr>
<td>May</td>
<td>17</td>
<td>Monday Last day for filing Ph.D. Dissertations</td>
</tr>
<tr>
<td>May</td>
<td>31</td>
<td>Monday Observance of Memorial Day (Holiday)</td>
</tr>
<tr>
<td>June</td>
<td>2</td>
<td>Wednesday Last day for filing A.M., M.S., Engineer theses</td>
</tr>
<tr>
<td>June</td>
<td>4–9</td>
<td>Friday–Wednesday End-quarter examinations</td>
</tr>
<tr>
<td>June</td>
<td>12</td>
<td>Saturday Senior Class Day</td>
</tr>
<tr>
<td>June</td>
<td>13</td>
<td>Sunday Commencement</td>
</tr>
</tbody>
</table>

## Summer Quarter, 1976

<table>
<thead>
<tr>
<th>Month</th>
<th>Day(s)</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>21</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>June</td>
<td>22</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>July</td>
<td>4</td>
<td>Sunday Independence Day (Holiday, Monday, July 5)</td>
</tr>
<tr>
<td>Aug.</td>
<td>13–14</td>
<td>Friday–Saturday Eight-week term examinations</td>
</tr>
<tr>
<td>Aug.</td>
<td>14</td>
<td>Saturday Eight-week term closes</td>
</tr>
<tr>
<td>Aug.</td>
<td>31</td>
<td>Tuesday Quarter closes</td>
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Leland and Jane Stanford founded Stanford University in 1885 to honor the memory of their only child, Leland, Jr., who had died of typhoid fever just before reaching college age. Their magnificent gift, completed over several decades marked by the death of Senator Stanford in 1893 and of Mrs. Stanford in 1905, included the 8,800-acre Palo Alto Farm that became the University campus, the Inner and Outer Quadrangles and other buildings, and approximately $20,000,000 in endowment.

But to these material riches must be added their enlightened concept of the purposes to be served by the new University.

The Stanfords were a young couple of modest means when they settled in California in the 1850's. Their life was one of practical hard work leading eventually to great wealth when Senator Stanford became one of the builders of the first transcontinental railroad. So it is no wonder that their early thoughts were for a university "where boys and girls can... grapple successfully with the practicalities of life." But after they talked with the presidents of Harvard, Cornell, MIT, and Johns Hopkins, their sights were lifted.

In the Founding Grant the objectives of the University were stated to be "to qualify students for personal success and direct usefulness in life; and to promote the public welfare by exercising an influence in behalf of humanity and civilization, teaching the blessings of liberty regulated by law, and inculcating love and reverence for the great principles of government...." The Grant further called for "a University of high degree," offering "Studies and exercises directed to the cultivation and engagement of the mind."

The brilliant young president of the University of Indiana, David Starr Jordan, was chosen by the Stanfords to be the first president of their university. In a long letter setting forth educational ideals to Jordan, Senator Stanford emphasized the need for study of literature, music, and the arts along with the sciences, mathematics, and law. "The imagination needs to be cultivated and developed to assure success in life," he wrote.

The University opened October 1, 1891, with dedication ceremonies in the Inner Quad. There were 559 in the first student body, many more than had been expected, and the original faculty of 17 was expanded to 29 for the second year. From the beginning, Stanford was coeducational and, like Johns Hopkins and Cornell, followed the German model of providing graduate as well as undergraduate instruction and stressing research along with teaching. Dr. Jordan installed the major subject system at the outset, and English was the only required entrance subject.

By 1916 the 125 Academic Council members were organized into 26 departments, each independent of the others. Ray Lyman Wilbur, who became the University's third President, undertook the arduous, ten-year job of organizing the departments into schools. Several regroupings occurred thereafter, but since 1948 the School organization has been as follows: Earth Sciences, Education, Engineering, Graduate School of Business, Humanities and Sciences, Law, and Medicine.

Within the seven Schools there are 70 departments. In addition there are 27 institutes, centers, programs, and laboratories that are not organized within the Schools. Some of the major ones are the Hoover Institution on War, Revolution, and Peace, the Food Research Institute, the Program in Human Biology, the Center for Research in International Studies, the W. W. Hansen Laboratories of Physics, and the Stanford Linear Accelerator Center.

The University does not use any racial, religious, ethnic, geographic, or sex-related quotas in admissions. Enrollment in 1974-75 totaled approximately 11,400, of whom 6,500 were undergraduates and 4,900 graduates. The University awarded 4,080 degrees during 1973-74, of which 1,725 were baccalaureate and 2,255 advanced.

Stanford early acquired a reputation as a strong regional institution, especially at the undergraduate level, but it was not until the mid-1950's, during the administration of President J. E. Wallace Sterling, that national and international status as a major teaching
and research university was achieved. Geography, demography, and the federal government's recognition of its stake in graduate education, based on wartime experience, were contributing factors. In 1930 Stanford granted 41 Ph.D. degrees. By 1950 the number was 100, and in 1974 it was 510.

Since 1957 Stanford has moved from thirteenth to third in the overall excellence of its graduate programs in the humanities, sciences, and engineering, according to surveys of the American Council on Education. Its education, business, engineering, and medical schools were each ranked among the top three nationally in a 1974 survey of deans. Stanford ranked second only to MIT as the choice of National Science Foundation scholars in 1974-75.

A measure of undergraduate distinction is found in the increase in applicants, now running at about ten applicants for each one admitted to the freshman class. Forty-two Stanford students have been elected Rhodes Scholars since World War II, two in 1974. Less than one percent of the freshman class is suspended for academic causes, and more than three-fourths of graduating seniors attend graduate or professional schools.

Among the approximately 1,000 faculty members who make up the Academic Council there are seven Nobel laureates, 13 Pulitzer Prize winners, 48 members of the National Academy of Sciences, 94 members of the American Academy of Arts and Sciences, 15 members of the National Academy of Engineering, and five members of the National Academy of Education. Faculty in 30 departments out of 32 judged were rated "Strong and distinguished" in the most recent rating of graduate programs published by the American Council on Education.
This section describes requirements for degrees which apply to all students at Stanford University. Special departmental or school requirements are described in the section on the school or department itself.

Candidates may be presented for graduation in January, April, June, and September, but all diplomas are awarded in June. No degree will be conferred upon any person who has not spent at least three quarters in resident study at the University. No honorary degrees are given.

UNDERGRADUATE DEGREES

The undergraduate curriculum at Stanford allows considerable flexibility. The student plans an individual program of study, in consultation with his or her faculty adviser. The first two years may be spent primarily in pursuing a liberal education, or the student may begin specializing early, carrying both major and general courses over the four years. A variety of majors is offered, and within most majors there is considerable latitude. Honors programs are offered in a number of departments or cooperatively among several departments. These permit individualized study for the very capable student. Students whose academic goals cannot be met in a standard, departmental major may propose an individually designed program as described elsewhere in this bulletin (see Individually Designed Majors).

Entering freshmen may be allowed up to 45 units of credit toward graduation for superior work completed in high school. Such advanced credit will be awarded on the basis of scores achieved on College Board Advanced Placement Examinations, subject to University approval, or on departmental placement tests administered after the student arrives on campus.

Good English is required in all University course work, and is one consideration in grading. The expectation that students will express themselves literately and effectively in speech and writing is held by all instructors and forms the rationale for the Writing Requirement described below.

GENERAL REQUIREMENTS

Writing Requirement — Each candidate for the Bachelor's degree must complete, ordinarily in the freshman year, two quarters of instruction in written composition, or an equivalent. This requirement may be met by courses in written composition offered by the English Department or other appropriate courses designated by the Advisory Committee on the Writing Requirement.

Students scoring 4 or 5 on the CEEB advanced placement test in English literature are automatically exempted from the writing requirement. In addition, students whose score on the CEEB achievement test in English composition is 700 or above may also be exempted from the requirement upon taking and passing a test designed for this purpose. Students demonstrating sufficient skill in writing in the first quarter may be exempted from the second quarter on certification by the instructor. These automatic exemptions apply only to freshmen; transfer students will be individually informed of their status vis-à-vis the Requirement at matriculation.

Distribution Requirement — Every candidate for the Bachelor's degree must complete at least three courses, each of at least three units, in all three of the following broad areas: (a) humanities and fine arts, (b) social sciences, and (c) mathematics, natural sciences, and technology. Students attending Stanford Overseas Studies Centers can work toward meeting this distribution requirement in humanities and fine arts and in social sciences, but courses meeting the requirement in mathematics, natural sciences, and technology are not ordinarily offered at the Centers. Some courses may be used toward satisfying the requirement in more than one area, and it is the student's responsibility to obtain such information in advance from the Academic Information Center, insofar as it affects his or her program. Neither extradepartmental courses (e.g. Undergraduate Specials, SWOPSIS, SCIRE) nor Directed Reading nor Individual Work may apply toward fulfilling Writing or Distribution requirements nor may units received for advanced placement tests.
Fulfillment of the Writing and Distribution Requirements is the student's responsibility, and students should confirm their status at the Academic Information Center two or three quarters before graduation.

**MAJOR REQUIREMENTS**

The selection of a major may be made by a student at any time and **must** be made no later than the beginning of the junior year.

The school or department offering a major has the authority to prescribe not more than 60 units in the major subject (exclusive of elementary courses which may have been offered for entrance). The school or department shall also recommend such other courses as may be considered desirable and shall exercise an advisory supervision over the student’s curriculum from quarter to quarter. It shall be considered a general principle of University policy, to be departed from only in exceptional cases, that at least 90 of the 180 units required for the degree be taken outside the major field of study.

In applied science the school may prescribe as much of the entire 180 units as it shall deem essential to the technical or professional requirements of the major subject.

Within these limitations the work is elective, and students may freely choose any course which previous studies have prepared them to undertake.

**BACHELOR OF ARTS OR BACHELOR OF SCIENCE**

The degree of Bachelor of Arts (A.B.) or the degree of Bachelor of Science (B.S.) is conferred upon the candidates recommended by the Subcommittee on Academic Standing, Petitions, and Exceptions who have:

1. Applied in advance for graduation and who have fulfilled the following requirements. (See deadlines in **Time Schedule** calendar.)
2. Completed 180 (quarter) units of University work.
3. Completed Writing and Distribution requirements.
4. Completed curriculum requirements of the major department and received the recommendation of that department. (Curriculum and other special requirements are listed under each department in **Courses and Degrees**.)
5. Completed at least 45 units (including the last 15) at Stanford. (In special cases, students who have obtained at least 135 units in resident work and have completed major and Writing/Distribution requirements may petition for a waiver of the last 15 quarter units work-in-residence requirement.)
6. Completed three quarters in resident study.

An undergraduate is limited to a total of twelve (12) courses or thirty-six (36) units of Undergraduate Specials and Student Center for Innovation in Research and Education (SCIRE) courses combined to count toward graduation. SCIRE courses may total twenty-seven (27) of these thirty-six (36) units. There is no limit for either Undergraduate Special or SCIRE courses per quarter. An undergraduate is also limited to a total of twelve (12) units of Physical Education activity courses and twenty-four (24) units of ensemble Music courses to count toward graduation. There is no limit for either of these per quarter.

Candidates who fulfill these requirements in the Schools of Earth Sciences and Engineering, or the Departments of Biological Sciences, Chemistry, Mathematics, Physical Sciences, Physics, and Statistics in the School of Humanities and Sciences, or Physiology in the School of Medicine receive the degree of Bachelor of Science; candidates who fulfill these requirements in other schools or departments receive the degree of Bachelor of Arts.

If a student fails to meet requirements, he or she must reapply to graduate.

The degree is conferred at the end of the quarter in which the requirements are met, but diplomas are issued and commencement exercises are held only in June.

**SECOND BACHELOR DEGREE**

The holder of a Bachelor of Arts degree from Stanford may apply to the Subcommittee on Academic Standing, Petitions, and Exceptions for admission to candidacy of a Bachelor of Science degree, and the holder of a Bachelor of Science degree may apply for candidacy for a Bachelor of Arts degree. Application must be filed prior to entry into the Graduate Division, and the recommendation of the major school or department to be entered is required. A student ap-
proved for this program may reregister as an undergraduate and will be subject to the usual rules and regulations affecting undergraduates. Specific requirements may be obtained at the Registrar's Office.

COTERMINAL A.B. AND B.S. DEGREE PROGRAMS

A Stanford undergraduate may work simultaneously toward an A.B. and a B.S. degree. A statement of intention should be filed in the Recorder's Office, Room 130, Old Union, during the student's tenth or eleventh quarter. This statement should be in the form of a petition and should have the favorable recommendation of the appropriate representatives of the two departments in which the student expects to receive degrees.

In order to qualify for both degrees a student must (1) complete the stated University requirements and the departmental requirements for each degree; and (2) complete 15 full-time quarters, or three full-time quarters after completing 180 units.

COTERMINAL BACHELOR'S AND MASTER'S DEGREES

In University Division, the coterminal plan makes it possible for a student to take some graduate level courses that apply toward a Master's degree in the fourth year and to defer some undergraduate requirements to the fifth year, thus earning a Bachelor's degree and a Master's degree simultaneously.

To qualify for both degrees, a student must:

1. Petition for admission to the program after the beginning of the eighth quarter of undergraduate work and before the end of the eleventh quarter. This petition is to be signed by the department(s) in which he or she seeks the two degrees.

2. Include in the petition a listing of the program from the current quarter through the final quarter, showing all courses and units by quarter.

3. Complete fifteen full-time quarters or the equivalent, or three full-time quarters after completing 180 units.

4. Complete, in addition to the 180 units required for the Bachelor's degree, the number of units required by his or her department for the Master's degree (not fewer than the University minimum of 36 units) as shown on the formal application for Master's candidacy.

5. Apply for each degree at the appropriate time and complete the requirements for each degree.

A student should count only on personal sources or loans for financial assistance in the last year of a coterminal program. University graduate fellowships or assistantships are rarely given to students in this program. Undergraduate fellowships are reserved for students in the first four years of study at Stanford. Further, most private and federal graduate fellowships require the applicant to have received the baccalaureate degree.

For further information, students in the School of Engineering are advised to go to the office of the Dean of the School of Engineering. Students in other areas should submit their petitions to the Graduate Study Office (118 Old Union).

ADVANCED DEGREES

General University requirements for advanced degrees are stated in terms of time devoted to graduate study, as measured by full tuition or partial tuition registrations, rather than in terms of units of credit.

If any of the work done at Stanford is on a part-time registration, its equivalence to full-time study is determined by tuition payments.

For each advanced degree there is a minimum requirement of one academic year (three quarters—at least 36 quarter units) of work as a graduate student at Stanford. The final units of credit toward any advanced degree must be earned at Stanford.

In addition each student should consult his or her major department and examine its section in this bulletin regarding specific departmental requirements for advanced degrees. Opportunities for advanced study of a single region or other special interests involving more than one department are described under Graduate Division Special Programs.

Candidacy for A.M., M.S., Engineer, and Ph.D. degrees must be approved by the University Committee on Graduate Studies. Candidacy is valid for five years from date of such approval (if it has not been terminated earlier by the major department because of unsatisfactory progress) and may be renewed by the submission and approval of
a new application, or extended upon the recommendation of the major department. All applications or petitions to the University Committee on Graduate Studies must be submitted to the major department for approval before being filed with the Graduate Study Office, Room 118, Old Union, Stanford University, Stanford, California 94305.

Advanced degree candidates are reminded that in addition to conventional registration for half or full tuition, two other forms of registration are open to eligible graduate students:

1. **Terminal Graduate Registration (TCR)** for University services only, at much reduced tuition but with no course credit.

2. **Unit Basis Registration** when only a few units or a fractional amount of tuition remain to complete the student's advanced degree requirements. Eligibility for these forms of registration can be determined by the student at the Graduate Study Office.

MASTER OF ARTS OR MASTER OF SCIENCE

Upon recommendation to the Senate of the Academic Council by the faculty of the major department and the University Committee on Graduate Studies, the degree of Master of Arts (A.M.) or Master of Science (M.S.) is conferred on candidates who have satisfactorily completed at least one academic year (three quarters) of work as a graduate student at this University, presented an acceptable thesis (unless this requirement is waived), and fulfilled such other requirements as may be prescribed by the school or department concerned. In no case will the degree be conferred unless the candidate has registered at Stanford for at least three quarters and has paid the equivalent of three full quarters of full tuition as a graduate. A longer period of residence will be necessary for students who are inadequately prepared or who devote less than the normal amount of time to their studies.

The University minimum unit requirement for the A.M. or M.S. is 36 quarter units earned at Stanford as a graduate. Most departments require more. At the discretion of a major department, this University minimum requirement of 36 graduate units at Stanford may be reduced to 30 on condition that at least 6 quarter units earned elsewhere as a graduate be validated by the department as the equivalent of specific Stanford courses. Such courses must be reported on the application for candidacy, with the name and number of each Stanford course, the number of Stanford units given for it, and the method of validation. In any case, the minimum residence requirement for the A.M. and M.S. shall remain unchanged—registration at Stanford as a graduate during at least three quarters and the payment of the equivalent of at least three full quarters' tuition at Stanford as a graduate. Students are reminded that payment for a minimum of 12 units is considered full tuition during Autumn, Winter, and Spring Quarters, but that payment for a minimum of 15 units is considered full tuition during Summer Quarter.

Admission to candidacy is granted by the University Committee on Graduate Studies on the basis of an application, approved in writing by the school or department in which the candidate proposes to take the degree. This application should be filed with the Graduate Study Office not later than the fourth week of the quarter preceding the final quarter of candidacy. (The application should be submitted to the major department early enough to allow for departmental consideration before the University deadline. The required time varies with departments.) When granted, candidacy is valid for five years (if it has not been terminated earlier by the major department because of unsatisfactory progress), after which it may be renewed by the approval of a new application by the major department and the University Committee, or extended upon the recommendation of the major department.

If a thesis is a degree requirement, three bound copies, each bearing the approval of the instructor under whose supervision it was prepared, must be submitted to the Graduate Study Office on or before the last day of instruction in the final quarter of candidacy. If this date falls on Saturday, the deadline will be the following Monday. These copies are to be typed (or reproduced by an approved method) on paper of standard size and weight, with title and signature pages in the form prescribed by the University Committee on Graduate Studies. Upon acceptance, two copies are placed in the University Library, and the third copy is sent to the major department. Directions for the
preparation and submission of theses are available in the Graduate Study Office, Room 120, Old Union.

MASTER OF BUSINESS ADMINISTRATION

Upon recommendation to the Senate of the Academic Council by the faculty of the Graduate School of Business and the University Committee on Graduate Studies, the degree of Master of Business Administration (M.B.A.) is conferred on candidates who have satisfied the requirements laid down by the faculty of the Graduate School of Business and the University. (Full particulars concerning these requirements will be found in the Graduate School of Business Bulletin.)

ENGINEER

General Regulations—Upon recommendation to the Senate of the Academic Council by the faculty of the major department and the University Committee on Graduate Studies, the degree of Engineer is conferred on candidates who have satisfactorily completed six quarters of approved work as a graduate (of which a minimum of three quarters—36 quarter units—must be in residence at Stanford), presented an acceptable thesis, and fulfilled such other requirements as may be prescribed by the major school or department. A longer period of residence will be necessary for candidates who are inadequately prepared or who devote less than the normal amount of time to their studies.

Admission to Candidacy — Admission to candidacy for the degree of Engineer is granted by the University Committee on Graduate Studies on the basis of an application formally approved by the student’s major department and filed with the Graduate Study Office not later than the fourth week of the quarter preceding the final quarter of candidacy. (The application should be submitted to the major department early enough to allow for departmental consideration before the University deadline. The required time varies with departments.) Candidacy, when granted by the University Committee, is valid for five years (if it has not been terminated earlier by the major department because of unsatisfactory progress) and may be renewed by the approval of a new application by the major department and the University Committee, or extended upon the recommendation of the major department.

Thesis—Three bound copies of the thesis, bearing the approval of the instructor under whose supervision it was prepared, must be submitted to the Graduate Study Office on or before the last day of instruction in the final quarter of candidacy. If this date falls on Saturday, the deadline will be the following Monday. These copies are to be typed (or reproduced by an approved method) on paper of standard size and weight, with title and signature pages in the form prescribed by the University Committee on Graduate Studies, and suitably bound. Upon acceptance, two copies are placed in the University Library, and the third copy is sent to the major department. Directions for the preparation and submission of theses are available in the Graduate Study Office, Room 120, Old Union.

MASTER OF FINE ARTS

General Regulations—Upon recommendation to the Senate of the Academic Council by the faculty of the major department and the University Committee on Graduate Studies, the degree of Master of Fine Arts (M.F.A.) is conferred on candidates who have satisfactorily completed at least the minimum number of quarter units of graduate work required by the major department (of which a minimum of three quarters—36 quarter units—must be in residence at Stanford as a graduate) and fulfilled such other requirements as may be prescribed by the major department. At least two academic years are necessary for the completion of the degree work.

MASTER OF JURISPRUDENCE

The Master of Jurisprudence (J.M.) is a nonprofessional degree. Its requirements include successful completion of the first year of law school plus an additional academic year of full-time law study. The J.M. degree terminates a course of study at the Law School. Candidates may elect to take the degree in the early spring of their second year. Holders of the J.M. degree who at a later date wish to apply for admission to complete the J.D. program may do so, but readmission is not automatic.
DOCTOR OF EDUCATION

Upon recommendation to the Senate of the Academic Council by the faculty of the School of Education and the University Committee on Graduate Studies, the degree of Doctor of Education (Ed.D.) is conferred on candidates who have satisfied the requirements laid down by the faculty of the School of Education and the University. At the announced time in the quarter at the end of which the degree is to be conferred, the candidate must deposit with the School of Education three copies of the dissertation, four copies of an approved abstract of the dissertation (maximum length 600 words), and one signed copy of a publication agreement. The candidate will be charged a fee to cover cost of microfilming the dissertation, binding three copies of the dissertation (including one copy for the candidate), and publishing the abstract. This fee is payable at the Cashier's office on or before the last day of instruction in the final quarter of candidacy.

(Further information concerning these requirements will be found elsewhere in this bulletin and may be secured from the School of Education Doctoral Study Office, Room e24.)

DOCTOR OF MUSICAL ARTS

Upon recommendation to the Senate of the Academic Council by the faculty of the Department of Music and the University Committee on Graduate Studies, the degree of Doctor of Musical Arts (D.M.A.) is conferred on candidates who have satisfied the requirements laid down by the faculty of the Department of Music and the University. This degree offers advanced professional training in composition, performance (including conducting), or music education parallel to the musicological studies leading to the Ph.D. degree in music. A minimum of three years of graduate study (or two years following a Master's degree) is required of each candidate. A final project appropriate to the area of concentration is also required.

Further information concerning the requirements will be found in this bulletin and may be obtained from the office of the Chairman of the Department of Music.

DOCTOR OF JURISPRUDENCE

Upon recommendation to the Senate of the Academic Council by the faculty of the School of Law and the University Committee on Graduate Studies, the degree of Doctor of Jurisprudence (J.D.) is conferred on candidates who have received the degree of Bachelor of Arts, or its equivalent, from this University or from some other institution of recognized collegiate rank, and who have satisfactorily completed courses in law aggregating the number of units required under the current Faculty Regulations of the School of Law after devoting not less than three academic years thereto, and who otherwise have satisfied the requirements of the University and of the School of Law.

MASTER OF THE SCIENCE OF LAW

Admission to candidacy for the degree of Master of the Science of Law (J.S.M.) is granted only to students who are eligible for admission to the School of Law in regular standing and who have completed, with grades acceptable to this faculty, the work for the first professional degree in law at this University, or at some other university law school of recognized standing in which the work for the first degree in law covers a period of not less than six years of combined academic and law study, and who otherwise satisfy the requirements of the University and of the School of Law.

The degree of Master of Laws is conferred upon students so admitted to candidacy upon the completion, with distinction, of one academic year (26 term units) of work in this School in accordance with the rules of the University and of the School of Law. Upon his or her admission to candidacy, each student must present for the approval of the School of Law Committee on Graduate Study the program which he or she wishes to pursue for this degree.

DOCTOR OF THE SCIENCE OF LAW

Admission to candidacy for the degree of Doctor of the Science of Law (J.S.D.) is granted only to those who hold a J.D. or its equivalent. Such candidacy is limited to students of exceptional distinction and promise.

The degree of Doctor of the Science of Law is conferred upon applicants so admitted to candidacy who spend one full academic year in residence and as a result of independent legal research present a thesis which is, in the opinion of the faculty of the School of Law, a contribution to knowledge.
Such work and thesis shall conform to the rules and regulations of the University and of the School of Law.

DOCTOR OF MEDICINE

Upon recommendation to the Senate of the Academic Council by the faculty of the School of Medicine and the University Committee on Graduate Studies, the degree of Doctor of Medicine (M.D.) is conferred on candidates who have satisfactorily completed the required curriculum in medicine. (Full information concerning requirements for the M.D. degree will be found in the School of Medicine Bulletin.)

DOCTOR OF PHILOSOPHY

General Regulations

Upon recommendation to the Senate of the Academic Council by the faculty of the major department and the University Committee on Graduate Studies, the degree of Doctor of Philosophy (Ph.D.) is conferred on candidates who have demonstrated substantial scholarship, high attainment in a particular field of knowledge, and ability to do independent investigation and present the results of such research.

Each candidate is required to complete a minimum of three years of graduate registration (nine full quarters, or part-time registrations equivalent thereto, as calculated on tuition payments). Acceptable work completed elsewhere as a graduate may be accepted in lieu of part of this requirement, up to a maximum of six full quarters. In any event, the requirements which must be completed as a graduate at Stanford are a minimum of 36 quarter units and a minimum of three full quarters (or the equivalent in part-time registrations as calculated on tuition payments). These minimum requirements will apply only if the candidate has earned no other advanced degree at Stanford and has completed at least two years of acceptable work elsewhere as a graduate.

Admission to Candidacy

When a student has completed the major department’s required preliminary procedures, the major department may certify him or her to the University Committee on Graduate Studies for admission to candidacy. If the student’s program includes a minor, certification by the minor department is also required. If the student offers no minor, his or her application must show at least three units of work taken (or to be taken) as a graduate under each of four or more Stanford faculty members. Application for admission to candidacy is made on Form G34, which must be filed with the Graduate Study Office (Room 118, Old Union) not later than the last day of class in the student’s sixth quarter of graduate registration at Stanford, summer quarters not included. Candidacy, when approved by the University Committee, is valid for five years (if it has not been terminated earlier by the major department because of unsatisfactory progress) and may be renewed by the submission and approval of a new application, or extended upon the recommendation of the major department.

Foreign Language Requirement

The requirement of the reading knowledge of one or more foreign languages is left to the option of individual departments or schools. A candidate who has a foreign language requirement must meet his or her department’s deadlines as shown on the back of his G34 form, “Completion of Requirements.” Date of fulfillment of the requirement should be noted on this form and the signature of the department chairman is needed to complete the report. No other language report need be submitted to the Graduate Study Office.

University Oral Examination

Recommendation for the degree will be made only after the University oral examination has been passed. When a candidate has been admitted to candidacy, and has shown special ability in his or her field of study and proved his or her capacity for independent investigation to the satisfaction of the schools or departments concerned, he or she may arrange through the Graduate Study Office for the University oral examination. This examination will not exceed three hours in length. It will not be held during the first two weeks in any quarter or after the last day of instruction in any quarter. The request for an oral examination must be submitted to the Graduate Study Office on Form G21 at least three weeks prior to the date proposed for the examination. The purpose of the examination is to test the candidate’s command of his or her fields of study and to confirm his or her fitness for scholarly pur-
DEGREES

suits. The examining committee is to be composed of (1) the chairman, appointed by the Dean of Graduate Studies, presiding, (2) four or more faculty members appointed by the Dean of Graduate Studies to represent the major and minor departments (upon the departments' recommendation), (3) any members of the Academic Council who may attend. On the favorable vote of three-fourths or more of the examining committee (including the presiding chairman), the candidate will be certified as having passed the examination.

Five members present and voting, including the chairman and representatives of both major and minor departments, will constitute a quorum.

Dissertation

Recommendation for the degree will be made only after the acceptance of a dissertation, which must be a contribution to knowledge and the result of independent work, expressed in satisfactory form. At an appropriate point in the preparation of the dissertation, the department chairman will take responsibility for appointing (on Form G81) a faculty reading committee consisting of the candidate's principal research adviser (who must be a member of the Academic Council), a second member from within the major department, and a third member chosen from the major or another department. At least one other member in addition to the principal adviser must belong to the Academic Council. In cases in which the dissertation topic makes advice from outside the department useful, the appointment of an appropriate outside reader should be made early, and he or she should be encouraged to follow and advise on the progress of the research. Each member of the reading committee will certify by signature on the final copies of the dissertation that he or she has read the dissertation, and that in his or her opinion it is of a scope and quality acceptable in fulfillment of this requirement for the degree. At least one member of the committee will read the dissertation in its final submitted form and so certify on Form G82.

Four copies of the dissertation must be submitted to the Graduate Study Office on or before the last day of instruction in the final quarter of candidacy if autumn, winter, or summer quarter; or by the end of the seventh week if the final quarter of candidacy is a spring quarter.

After its final acceptance, the dissertation will be microfilmed and bound at the direction of the Graduate Study Office. A negative microfilm copy of the dissertation will be kept on file by University Microfilms (in Ann Arbor, Michigan), from whom positive microfilm copies may be ordered. When bound, one copy will be sent to the author, two copies to the Stanford University Library, and one copy to the major department.

Directions regarding the preparation of the dissertation, title and signature pages, and the abstract may be obtained from the Graduate Study Office, Room 120, Old Union. The abstract (600 words or fewer in length) will be published in Dissertation Abstracts International by University Microfilms. The candidate will be charged a fee to cover the cost of microfilming the dissertation, binding four copies of the dissertation, and publishing the abstract. This fee is payable at the Cashier's office on or before the last day of instruction in the final quarter of candidacy.
COURSES OF INSTRUCTION
1975–1976

Note—Unless otherwise specified, courses numbered from 1 to 99 inclusive are primarily for first- and second-year undergraduates; from 100 to 199 inclusive, for third- and fourth-year undergraduates; from 200 to 499 inclusive, for graduate students.

SUMMER SESSION

Summer Sessions are eight weeks in length, except in certain schools that offer ten-week courses.

This bulletin includes, for the Summer Session, only those courses that can be tentatively scheduled at this time by each department. For the complete list of courses and faculty, requests should be made for the special Summer Session Bulletin to be issued in February.
GRADUATE SCHOOL OF BUSINESS


Dean: Arjay Miller

Associate Deans: Robert K. Jaedicke, James R. Miller, Samuel A. Pond.

Assistant Deans: David S. Gordon, Paul R. Johnson, William L. Lowe, Carol A. Marchick, Robert W. Simon, Gary G. Williams


The Graduate School of Business, since its founding in 1925, has provided graduate education for careers in business management, research, and teaching. The two-year Master of Business Administration degree program is designed for the student who seeks preparation for a professional career in management. No specific undergraduate major or courses are required for admission, although prospective applicants are encouraged to include one year of college level mathematics in their undergraduate programs.

Those interested in college teaching and research are served by the Doctor of Philosophy program.

For detailed information on programs, curricula, and faculty write to the Graduate School of Business, Stanford University, Stanford, California 94305, for its current bulletin.
SCHOOL OF EARTH SCIENCES

Dean: Richard H. Jahns
Associate Deans: Konrad B. Krauskopf, Fredrick C. Kruger, Ernest I. Rich

The School of Earth Sciences includes the Departments of Applied Earth Sciences, Geology, Geophysics, and Petroleum Engineering.

The aims of the School are threefold: (a) to train individuals for responsible positions in industry, government, education, and research in the fields of geology, paleontology, geochemistry, geophysics, petroleum engineering, hydrology, environmental studies, and exploration, evaluation, recovery, and management of earth resources; (b) to conduct original investigations including the development of new principles, techniques, and procedures for the discovery, technology of production, conservation, and utilization of the nation's mineral resources; (c) to give general instruction in the earth sciences as part of a well-rounded education.

UNDERGRADUATE PROGRAM

Faculty Advisor—A student may enter the School of Earth Sciences when he or she selects one of the Earth Sciences fields for his or her major program. Upon entering the School, a student should report to the chairman of his or her department, who will designate a member of the faculty to act as his or her advisor. The advisor will aid the student in the selection of courses and will serve as consultant during his or her scholastic career. The advisor's approval of the study plan must be obtained before registration is completed at the beginning of each quarter.

Requirements—Specific requirements for the Bachelor of Science degree are listed under each department.

GRADUATE PROGRAM

The undergraduate curricula offered by the School of Earth Sciences are designed to give broad training, with emphasis on fundamental science. These curricula do not include sufficient specialization to prepare directly for professional work. The School offers graduate programs planned to prepare the student for responsible positions in industry, research, governmental work, and education. These programs lead to the advanced degrees of Master of Science, Engineer, and Doctor of Philosophy. Graduate degrees also are offered in special programs such as Hydrology, Mechanical Processes and Earth Materials, Environmental Earth Sciences, Economic Geology, and Mathematical Geology. See appropriate sections in this bulletin.

Admission to the Graduate Program—A student who wishes to enroll for graduate work in the School must be qualified for graduate standing in the University and in addition must be accepted by the School of Earth Sciences.

Faculty Advisor—Upon entering a graduate program the student should report to the head of his or her department, who will arrange with a member of the faculty to act as the student's advisor. The student, in consultation with the advisor, then arranges a course of study for the first quarter, and ultimately a complete plan of study for the degree sought.

Financial Aid—Scholarships, fellowships, and research grants are available to students in the School of Earth Sciences. Detailed information is available from the Dean's Office. Applications should be filed by January 15 for awards which become effective in autumn quarter for the following year.

Normally teaching assistantships are awarded to qualified students to assist in laboratory instruction.

SPECIAL PROGRAMS

PROGRAMS IN ECONOMIC GEOLOGY

The programs in Economic Geology are under the jurisdiction of the School Committee on Economic Geology whose responsibilities include admissions, assignment to departments, advising, counseling, and tracking of students whose expressed desires include activities in the broad areas of Economic Geology. Establishment of curricula designed for specific objectives (programs) within Economic Geology will also be within its charter.

Economic Geology spans department boundaries and hence students interested in these areas should direct their application
for admission or for information to the Chairman, Programs in Economic Geology, School of Earth Sciences, describing their interest as succinctly as possible.

Typical programs include:
- Ore Genesis
- Ore Deposits
- Mineral Exploration

**PROGRAM IN PETROLEUM EXPLORATION**

An interdepartmental program is available for students who plan to specialize in some branch of the broad field of exploration for petroleum and natural gas. Students interested in such a program should so inform the Chairman of the Department of Applied Earth Sciences, who will see that an advisor is appointed who can guide their choice of courses.

An undergraduate student in this program is normally expected to complete the Core Course Sequence of the Department of Geology, except for the courses in petrology (Geology 180 and 181). In addition he/she is advised to choose electives from the following list:

- Geol. 143. Principles of Paleontology  
  - Aut 5 units
- Geol. 190. Introduction to Probability and Statistics  
  - Win 3 units
- Geol. 193. Geomathematics II: Probability and Statistics  
  - Win 3 units
- Geol. 194. Geomathematics III: Numerical Methods  
  - Spr 3 units
- Geophys. 190. General Geophysics  
  - Aut 4 units
- Geophys. 191. Geophysical field techniques  
  - Spr 4 units
- Geophys. 192. Geologic Interpretation of Reflection Seismograms  
  - Win 3 units
- Geophys. 193. Elementary Seismology  
  - Aut 3 units
  - Spr 3 units
- AES 133. Remote Sensing  
  - Aut 3 units
  - Spr 3 units
- AES 192. Geomathematics I: Computer Applications in Geology and Applied Earth Sciences  
  - Aut 4 units
- PE 103. Survey of Energy Industries  
  - Aut 3 units
- PE 150A. Formation Evaluation  
  - Aut 3 units
- PE 150B. Formation Evaluation  
  - Win 3 units
- PE 151A. Underground Earth Fluids  
  - Aut 3 units
- PE 151B. Underground Fluid Behavior  
  - Win 3 units

For graduate work in petroleum exploration, students are advised to include courses from the above list and the following list in their programs:

- Geol. 253. Sedimentary Petrology  
  - Spr 4 units
- Geol. 255. Sedimentary Basins  
  - Aut 4 units
- Geophys. 271. Elastic Wave Propagation  
  - Win 3 units
- Geophys. 280. Data Analysis  
  - Spr 3 units
- Geophys. 284. Reflection Seismology  
  - Win 3 units
- AES 211. Fuel Resources—Development  
  - Win 4 units
- AES 290. Legal Aspects of Geology  
  - Aut 3 units
- AES 292. Geomathematics IV: Advanced Computer Applications in Geology and Applied Earth Sciences  
  - Win 4 units
- AES 388. Offshore Exploration Seminar  
  - Win 3 units
- AES 390. Geology of Energy Sources  
  - Win 2 units
- PE 287. Evaluation and Appraisal of Oil Properties  
  - Win 3 units
- PE 275. Fundamentals of Well-Test Analyses  
  - Win 3 units

**PROGRAM IN MATHEMATICAL GEOLOGY**

The graduate program in Mathematical Geology is intended to stimulate the application of mathematical methods in earth science teaching and research. It provides participating students with training in the application of useful mathematical tools to field, laboratory, and theoretical problems in geology and geophysics.

**MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY**

At the discretion of the Committee in Charge, students will be required to meet the basic requirements for the degree of Bachelor of Science in Geology at Stanford with emphasis placed upon field geology. Equivalent course work will be awarded graduate credits at the discretion of the Committee.

Each student is urged to develop capabilities in mathematical and statistical analysis, in computer technology, and in operations research. He or she must select an area of application in earth science as for example in rock mechanics, hydrogeology, sedimentation, tectonophysics, or paleontology. The remainder of the program can be devoted to obtaining the analytical capabilities and associated technical knowledge required for successful analytical work in the chosen area of earth science.

In addition to courses listed in other Schools, the following offerings in the School of Earth Sciences may be of interest:

- Appl. Earth Sci. 308. Rock Mechanics
- Geol. 190. Introduction to Probability and Statistics in Geology
- Geol. 214. Physical Processes in Geology
APPLIED EARTH SCIENCES

Emeriti: Welton J. Crook, Evan Just, Charles F. Park, Jr. (Professors)

Chairman: Irwin Remson

Associate Chairman: George A. Parks


Associate Professor: Arvid M. Johnson*

Acting Associate Professor: Robert N. Anderson

Assistant Professors: Marco T. Einaudi*, Bernard Hallet


The Department of Applied Earth Sciences programs are designed to develop scientific and technological competence in a variety of fields, including:

- Applied Geomathematics
- Economic Geology
  Students interested in aspects of Economic Geology should direct their attention to the description of the School of Earth Sciences Programs in Economic Geology, above.
- Engineering Geology
- Environmental Earth Sciences
- Environmental Geochemistry
- Extractive Metallurgy and Materials Processing
- Hydrogeology
- Land Resources Planning
- Metallurgy
- Mineral Economics
- Mineral Exploration
- Mining Engineering Management
- Ore Deposits

Petroleum Exploration (see also School Program in Petroleum Exploration, above)

Programs leading to the B.S., M.S., Engineer, and Ph.D. degrees are available with the "special field" designation of the program on the diploma. Moreover, a general degree in Applied Earth Sciences is available for students with specialized objectives consistent with the scope of the Department, e.g., petroleum geology, mineral industry management, etc. At the graduate level, the Department welcomes applicants from any scientific or engineering discipline who are interested in using their training in Applied Earth Sciences.

Detailed curricula for the B.S. and M.S. degrees are listed below for a few of the more commonly elected options.

UNDERGRADUATE PROGRAMS OF STUDY

Undergraduate curricula are arranged to stress basic science, basic engineering, and cultural education to provide the knowledge to meet new conditions in a rapidly changing world.

COURSES TAKEN BY ALL UNDERGRADUATES

<table>
<thead>
<tr>
<th>University Requirements</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing Requirement</td>
<td>6</td>
</tr>
<tr>
<td>Humanities and Fine Arts</td>
<td>9</td>
</tr>
<tr>
<td>Social Science</td>
<td>9</td>
</tr>
<tr>
<td>Mathematics, natural sciences, and technology (satisfied by Departmental requirements below)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

Environmental Earth Sciences

The undergraduate program of study in Environmental Earth Sciences is designed to be pre-professional. Former students have entered graduate programs of study in city and regional planning, engineering, landscape architecture, law, and science.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>University requirements</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>A.E.S. 130, 131, 132. Environmental Earth Sciences</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Biol. Sci. 1. Introductory Biology</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>One course in ecology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem. 31. Chemical Principles</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Chem. 33. Structure and Reactivity</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>(A Civ. Engr. course in Water Quality may replace one course in Chem.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civ. Engr. 170. Man and His Environment</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Comp. Sci. 105. Introduction to Computing or</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LAND RESOURCES PLANNING

The undergraduate program of study in Land Resources Planning is designed to prepare students for graduate study in city and regional planning, conservation, landscape architecture, law, resource management, and allied programs. It is not designed for students intending to enter graduate study in engineering or science.

Course No. Subject Units
University requirements 24
A.E.S. 130, 131, 132. Environmental Earth Sciences 15
Civ. Engr. 253 (or equiv.). Environmental and Urban Design Studio 3
Comp. Sci. 105. Introduction to Computing or A.E.S. 192—Computer Applications in Geology and Applied Earth Sciences 4
Econ. 1. Elementary Economics 5
Food Research Inst. 100. Human Geography 5
Geol. 1. Interpreting the Earth 5
Geol. 101. Framework of Geology 3
Geol. 102. Introduction to Field Geology 3
Human Biology 1. Evolution of Life and Emergence of Man 5
Math. 5, 6. Calculus and Probability 9
Two out of the following:
C.E. 150. Introduction to Urban Planning 6
C.E. 170. Man and His Environment
C.E. 171. Environmental Planning
One out of the following:
A.E.S. 133. Remote Sensing of the Environment
C.E. 130. Transportation
C.E. 270. Water Quality in Water Resource Development
Mech. Engr. 137. Air Pollution
Phys. Sci. 10. Introduction to Meteorology 80
Electives
Total 180

ORE DEPOSITS

The undergraduate program in Ore Deposits is designed to fit the B.S. graduate for professional experience and also is designed as a starting point in other graduate programs in the School.

Course No. Subject Units
University Requirements 24
Chem. 31. Chemical Principles 4
Chem. 33. Structure and Reactivity 4
Math. 41-43 or 10, 11, 21-23. Mathematics 15
Geol. 1, Interpreting the Earth, or Geol. 101. Framework of Geology 5
Total 42

Plus any 15 units of the following:
A.E.S. 101. Elements of Mining (Aut) 3
A.E.S. 150. Introduction to Mineral Extraction (Aut) 3
A.E.S. 215. Mineral Economics (Spr) 3
Geol. 151. Sedimentary Geology (Win) 4
Geol. 214. Physical Processes in Geology (Aut) 5
Geol. 231. Photogeology (Aut, given 75-76) 3
Geol. 232. Geomorphology (Win, given 76-77) 5
Geol. 250. Introduction to Marine Geology (Win, given 76-77) 5
Total 15

METALLURGY

Course No. Subject Units
University requirements 24
A.E.S. 173. Applied Chemical Kinetics and Diffusion 3
A.E.S. 203. Mineral Processing 3
A.E.S. 207. Metal Refining and Liquid Metals 3
A.E.S. 225. Surfaces and Interfaces, or 3
A.E.S. 227A. Problems in Applied Aqueous Thermodynamics 3
A.E.S. 214. Metallurgical Reaction Engineering 3
A.E.S. 101. Elements of Mining 3
A.E.S. 105. Extractive Process Metallurgy or A.E.S. 150. Introduction to Extraction Processes 3
A.E.S. 215. Mineral Economics 3
Chem. 31. Chemical Principles 4
Chem. 33. Structure and Reactivity 4
Chem. 171. Physical Chemistry 3
Comp. Sci. 106. Introduction to Computing 3
Engr. 50. Introductory Science of Materials 3
Geol. 1. Geoscience or Geol. 101. Framework of Geology 5
Geol. 161. Crystal Chemistry and Mineralogy or A.E.S. 284. Engineering Geology 4
Math. 10, 11, 21, 22, 23 or 41-43 15
Math. 130. Ordinary Differential Equations 3
Physics 51-56. Engineering Physics 14
Electives
(Electives in Materials Science and Earth Sciences are encouraged, but may be in any field.) 74
Total 180

Core:
A.E.S. 100. Industrial Report (A,W,S) 1
A.E.S. 120. Introduction to Ore Deposits (Aut) 3
A.E.S. 192. Geomath I: Computer Applications in Geology and Applied Earth Sciences (Aut) 4
Geol. 102. Introduction to Field Geology (Sum) 3
Geol. 103 A,B. Advanced Field Geology (Sum 8, 4) 12
Graduate Programs of Study

The Department of Applied Earth Sciences offers graduate programs designed to prepare students for careers focused on application of the earth sciences in mining, petroleum, and metallurgical industries, in government, in private practice, and in education. The programs lead to the advanced degrees, Master of Science, Engineer, and Doctor of Philosophy. Diplomas indicate the program, e.g., an M.S. earned in Extractive Metallurgy and Materials Processing leads to a diploma labeled M.S. in A.E.S.: Extractive Metallurgy and Materials Processing. Typical curricula are described below but individually tailored, interdisciplinary curricula are encouraged. The M.S. degree requires at least one year, the Engineer degree two years, and the Ph.D. degree at least three but normally not more than four years of graduate study.

The Department offers two basic program options for M.S. and Engineer degrees, one emphasizing management and the other emphasizing basic sciences and engineering. The management options include courses in the Graduate School of Business, the Department of Civil Engineering, and the Department of Industrial Engineering in order to complement technological competence with educational experience in some of the skills requisite for executive positions.

Candidates for the degree of Doctor of Philosophy in Applied Earth Sciences are normally those preparing for careers in education or basic research. Department programs at this level are very flexible but place emphasis on advanced study in the basic sciences and on creative research.

Graduate students must maintain a B average in the School of Earth Sciences and equivalent status in other schools.

The Honors Cooperative Program

A number of industrial firms, government laboratories, and other organizations participate in the Honors Cooperative Program (HCP), a plan which permits qualified professional employees to register for Stanford graduate courses on a part-time basis. The HCP is now augmented by the Stanford Instructional Television Network, a four-channel network which enables students to enjoy live lectures with talk-back privileges at their company plants.

Master of Science

The University’s requirements for M.S. degrees and M.S. theses are described in the section “Advanced Degrees” of this Bulletin. The student should be guided by the following additional Department requirements.

1. At least 45 units of course work are required, of which at least 6 but not more than 24 units must represent independent work on a comprehensive project or research program. Not more than 10 of the required 45 units may be undergraduate courses (numbered lower than 200) unless specified otherwise in a curriculum.

2. Students must complete one core curriculum from Group A and one of the options, either research or management, from Group B. Special core curricula may be formulated by the student in consultation with his or her research adviser. Special core curricula must be approved by the Curriculum Committee of the Department.


Curricula Recommended for the Master’s Degree

GROUP A

Applied Geomathematics

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 192.</td>
<td>Geomathematics I: Computer Applications in Geology and Applied Earth Sciences</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 292.</td>
<td>Geomathematics IV: Advanced Computer Applications in Geology and Applied Earth Sciences</td>
<td>4</td>
</tr>
<tr>
<td>Geol. 193.</td>
<td>Geomathematics II: Introduction to Probability and Statistics in Geology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 293.</td>
<td>Geomathematics V: Application of Probability and Statistics in Geology</td>
<td>3</td>
</tr>
<tr>
<td>Math. 101.</td>
<td>Linear Algebra and Differential Equations</td>
<td>3</td>
</tr>
</tbody>
</table>
Math. 102. Linear Algebra and Differential Equations II 3
Statistics 116. Theory of Probability 4
Geophys. 190. General Geophysics 4
Geophys. 280. Data Analysis 3

Total .......................................... 31

Engineering Geology

All students in the Engineering Geology Program are expected to have taken courses approximately equivalent to those of the Undergraduate Core Sequence in Geology as well as Geol. 222—Geomorphology; Geoph. 190—General Geophysics; and either Geol. 214—Physical Processes in Geology or Engr. 11—Statics.

The following courses must be taken for credit:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 284.</td>
<td>Engineering Geology</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 285.</td>
<td>Engineering Geologic Mapping</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 286.</td>
<td>The Practice of Engineering Geology</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 386A.</td>
<td>Seminar in Engineering Geology</td>
<td>1</td>
</tr>
<tr>
<td>A.E.S. 386B.</td>
<td>Seminar in Engineering Geology</td>
<td>1</td>
</tr>
<tr>
<td>Geol. 230.</td>
<td>Hydrogeology</td>
<td>5</td>
</tr>
<tr>
<td>Geophys. 270.</td>
<td>Environmental Seismology</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 190.</td>
<td>Geotechnical Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Total .......................................... 30

In addition, three of the following courses must be audited or taken for credit:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 203.</td>
<td>Environmental Fluid Mechanics II</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 207.</td>
<td>Open channel hydraulics and sedimentation problems</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 292B.</td>
<td>Earthquake Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 290.</td>
<td>Soil Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 291.</td>
<td>Earth Structures</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 293.</td>
<td>Experimental soil mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Geophys. 262.</td>
<td>Rock Mechanics</td>
<td>4</td>
</tr>
</tbody>
</table>

Total .......................................... 8–12

In addition to course work, M.S. candidates are required to do an M.S. research project, normally engineering geologic mapping, and prepare a thesis.

Environmental Earth Sciences

All students in the Environmental Earth Sciences Program are expected to have completed a prior degree in one of the science or engineering disciplines, including courses in elementary biology, chemistry, and physics, analytical geometry and calculus, computer science, and geology.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 130, 131, 132.</td>
<td>Environmental Earth Sciences</td>
<td>14</td>
</tr>
</tbody>
</table>

A.E.S. 133. Remote Sensing of the Environment 3
C.E. 270. Water Quality in Water Resources Development 3
Geol. 222. Geomorphology 4

Subtotal .......................................... 24

Electives may be used to design coherent programs to meet individual interests and career objectives.

Environmental Geochemistry

All students in the Environmental Geochemistry Program are expected to have completed a prior degree in one of the science or engineering disciplines, including courses in elementary chemistry and physics, analytical geometry and calculus, computer science, mineralogy, petrology, field geology, and physical chemistry.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 225.</td>
<td>Surfaces and Interfaces</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 227A.</td>
<td>Problems in Applied Aqueous Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 228.</td>
<td>Environmental Planning</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 270.</td>
<td>Water Quality in Water Resources Development</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 273.</td>
<td>Water Chemistry Laboratory or equivalent</td>
<td>1</td>
</tr>
<tr>
<td>C.E. 274.</td>
<td>Water Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 173.</td>
<td>Kinetics of Geochemical Processes</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 271.</td>
<td>Low Temperature Aqueous Geochemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

Subtotal .......................................... 22

Extractive Metallurgy and Materials Processing

This is a joint program of the Department of Applied Earth Sciences and the Department of Materials Science and Engineering. Students whose career objectives lie primarily in mineral processing, metal production, refining and alloying should enter the program through the Department of Applied Earth Sciences. Those whose interests are closer to solid fabrication, e.g., electronic materials, are advised to enter through the Materials Science Department. Options available are general course option, research option, and management option. Generous substitutions are allowed to suit the interest of the student.

Mineral Processing and Hydrometallurgy

Students with prior degrees in these areas who wish to broaden their backgrounds in Extractive Metallurgy, environmental control, geochemistry, or economic geology are encouraged to enroll in the Extractive Met-
allurgy and Materials Processing Program. Specialized programs are encouraged.

Pyrometallurgy

High temperature extractive metallurgy covers all aspects of reduction, refining, alloying, and ingot making.

Metallurgical Engineering Management

This option includes mineral and metallurgical economics and management courses in this department in conjunction with a group of courses from the Business School and other departments.

Core Courses for all Metallurgy and Materials Processing Options:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 105</td>
<td>Extractive Process Metallurgy</td>
<td>2-3</td>
</tr>
<tr>
<td>A.E.S. 203</td>
<td>Mineral Processing</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 207</td>
<td>Metal Refining and the Nature of Liquid Metals</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 214</td>
<td>Metallurgical Reaction Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Mat. Sci. 181</td>
<td>Thermodynamics and Phase Equilibria</td>
<td>4</td>
</tr>
<tr>
<td>Mat. Sci. 182</td>
<td>Rate Processes in Materials</td>
<td>3</td>
</tr>
<tr>
<td>Mat. Sci. 185</td>
<td>Mechanical Behavior of Solids</td>
<td>3</td>
</tr>
</tbody>
</table>

Subtotal ........................................ 21-22

Recommended technical electives:

A.E.S. 120, 173, 201, 206, 215, 222, 225, 226, 227A, 227B, 228, 229, 232, 393, also various other Mat. Sci., Math., Science, and Engineering courses. 8-9

Total ........................................... 30

The remaining 15 required units are taken under either the Research-Technical Option or the Management Option described under Group B.

Hydrogeology

All students in the Hydrogeology Program are expected to have completed a prior degree in one of the science or engineering disciplines, including courses in elementary chemistry, physics and fluid mechanics, analytical geometry and calculus, computer science and geology.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 222 (or equivalent)</td>
<td>Water Resources Planning</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 266</td>
<td>Engineering Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 267</td>
<td>Advanced Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 270 (or equivalent)</td>
<td>Water Quality in Water Resources Development</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 230</td>
<td>Hydrogeology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 232</td>
<td>Numerical Methods in Hydrogeology</td>
<td></td>
</tr>
</tbody>
</table>

or A.E.S. 194. Geomathematics III—Numerical Methods for Geologists 2-3

Subtotal .............................................. 19-20

Mineral Economics

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 215</td>
<td>Mineral Economics</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 230</td>
<td>Case Histories</td>
<td>2</td>
</tr>
<tr>
<td>A.E.S. 231</td>
<td>Valuation of Mineral Properties</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 300</td>
<td>Advanced Work</td>
<td>6</td>
</tr>
<tr>
<td>A.E.S. 387</td>
<td>Resource Management</td>
<td>2</td>
</tr>
</tbody>
</table>

Electives from following list 13

Total .............................................. 30

Mining Engineering Management

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 215</td>
<td>Mineral Economics</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 230</td>
<td>Case Histories</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 231</td>
<td>Valuation of Mineral Properties</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 300</td>
<td>Advanced Work</td>
<td>6</td>
</tr>
</tbody>
</table>

Electives 13

Total .............................................. 30

Mineral Exploration

Previous training should include courses that are judged approximately equal to those of the Undergraduate core requirements in Ore Deposits, leading to the B.S. degree in A.E.S. at Stanford. This program is flexible, and students who wish to make substitution for core requirements may petition the faculty with a statement of the justifications.

It is anticipated that a new A.E.S. program in Ore Deposits, leading to the M.S. degree, will be formulated shortly. This will be of four-quarters duration with a highly specified core curriculum. This core will prepare professionals directly for industry. Students accepted to enter this program will not be proceeding on to either a research M.S. or Ph.D., both of which emphasize preparation for research. For details apply directly to the Chairman, School Committee on Economic Geology.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ore Deposits and Geochemistry:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.E.S. 220 A,B. Advanced Ore Deposits</td>
<td>(W3, S3)</td>
<td>6</td>
</tr>
<tr>
<td>Geol. 172</td>
<td>Geological Thermodynamics (Win)</td>
<td></td>
</tr>
</tbody>
</table>
or Mat. Sci. and Eng. 181. Thermodynamics and Phase Equilibria (Aut) 3–4
A.E.S. 240. Ore Finding (Spr) 3
A.E.S. 320. Research Seminar in Ore Genesis (Aut) 2
Geol. 371. Seminar in Geochemistry (Spr) 1

Mapping:
A.E.S. 277. Field Mapping of Mineral Deposits (Spr vac.) 3
or A.E.S. 285. Engineering Geologic Mapping (Spr) 3

Structural:
Geol. 210. Tectonics or Geol. 311B Seminar in Structural Geology or A.E.S. 294. Plate Tectonics and Ore Deposits (given 76/77, Win) or A.E.S. 295. Structural Setting of Major Mineral (Metal and Oil) Districts 1–3

Computing and Statistics:
A.E.S. 292. Geomathematics IV: Advanced Computer Applications in Geology and Applied Earth Sci. (Spr) 4
or Geol. 293. Geomath V: Applications of Probability and Statistics in Geology (given 76/77, Spr) 3

Exploration:
Geophys. 191. Geophysical Field Techniques (Spr) 4
A.E.S. 296. Airborne Exploration: Advanced Photogeology and Radar Techniques (given 76/77, Win) 3
or A.E.S. 297. Airborne Exploration: Infrared and Other Geophysical Techniques (given 75/76, Win) 3

Valuation and Development:
A.E.S. 388. Offshore Exploration Seminar (given 75/76, Win) 4
or A.E.S. 390. Geology of Energy Sources (Win) 4
or A.E.S. 211. Fuel Resources Development (Spr) 4
or A.E.S. 230. Case Histories (given 76/77, Aut) 2
or A.E.S. 231. Valuation of Mineral Properties (Win) 4
or A.E.S. 287. Minerals, Politics, and Economics 3

Total ........................................... 35

Special Applied Earth Sciences Program

A program with 30 units of courses approved by the Department and the School curriculum committee.

GROUP B

Research Option

Select 15 or more units, which may include additional courses or original research (A.E.S. 300). These courses should amplify the academic base from which research is done and provide experience with the practice and techniques of research.

Total ........................................... 15

Management Option

Select a minimum of 15 units from the following courses:

Bus. 200-01. Economic Analysis and Policy 8
Bus. 220–21E. Business Finance 8
Bus. 261–62. Decision Analysis 8
Bus. 270. Organizational Behavior or Indus. Engr. 100. Theory and Management 4–6
C.E. 245. Advanced Construction Equipment and Methods 4
Indus. Engr. 229. Engineering Economy 3
Engr.–Econ. Sys. 231. Decision Analysis 3

Total ........................................... 15

Engineer’s Degree

A minimum of two years (six quarters) of graduate study is required. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. The candidate must complete 90 units of course work, no more than 10 of which may be applied to overcoming deficiencies in undergraduate training. At least 30 units must be taken in advanced work, that is, work beyond the undergraduate requirements, in engineering and closely allied fields. The student must prepare a thesis meeting the approval of the supervising instructor and
Doctor of Philosophy

Objectives—The degree of Doctor of Philosophy is conferred upon candidates who have demonstrated substantial scholarship, high attainment in a particular field of knowledge, and ability to do independent investigation.

Requirements—The University's requirements are described in the section “Advanced Degrees” in this Bulletin. A brief summary of additional Departmental requirements follows. A complete statement of requirements may be obtained from the office of Applied Earth Sciences.

Students are admitted to the Department for graduate study, not for a particular degree. The Department faculty may invite the student to pursue Ph.D. work at the end of the student's first year. This is the first step in the qualifying procedure. After completion of the qualifying procedures, the Department may recommend that the student apply to the University for Ph.D. candidacy. Passing of the University Oral Examination and acceptance of a dissertation by the Graduate Division of the University complete the academic requirements for the degree.

The Department qualifying procedures involve four steps: completion of core course sequence, faculty recommendation, departmental oral examination and proposal of research project. The first three steps must be completed within the first eighteen months after initial registration.

Courses—The student must pass the M.S. core courses required for his or her option with an average grade of “B” or higher, or demonstrate that he or she has done the equivalent elsewhere. In addition, the student must select a minor program of courses or must take a series of courses, approved by the Department Curriculum Committee, consisting of three or more units of graduate work under the direction of each of four Stanford faculty members.

Department Oral Examination—The student must pass the Department oral examination, which is a test of mastery of the major option and at least one related area. Mastery is expected at levels of breadth and sophistication sufficient to support Ph.D. work.

Research Proposal Seminar — Before the end of the second year of graduate work, the student must present a short, written, dissertation research proposal and present a seminar to members of his or her faculty Research Advisory Group. The seminar will be followed by a question period lasting about two hours.

University Oral Examination—After a student has been admitted to candidacy, shown special ability in his or her field of study and proven capacity for independent investigation to the satisfaction of his or her Research Advisory Group, the student may arrange through the Graduate Study Secretary for the University oral examination. The examination is a defense of the dissertation, based on a complete manuscript, and administered by a representative of the Graduate Division of the University and four or more faculty members representing the major and minor departments. The examination begins with a short talk in which the candidate presents the essential features of his or her dissertation.

Scheduling — Detailed scheduling of all events is left to the student. With diligence the degree may be earned in three years (9 quarters) of full-time enrollment. Normally, a maximum of 4 years of graduate study is allowed and a further year is allowed only if the Department Curriculum Committee is satisfied that the work can be completed in that time.

UNDERGRADUATE COURSES

100. Industrial Report—Student required to submit a report covering at least two consecutive months of industrial experience in economic geology, engineering geology, mining engineering, mineral processing, or metallurgical plant work.

1 unit, Aut, Win, Spr (Staff) by arrangement

101. Elements of Mining—Introduction to prospecting, development, mining methods, mine plant and equipment. Emphasis on the close interrelationship of geological conditions and mining problems. Prerequisite: consent of instructor.

3 units, Aut (Kruger) MWF 11

105. Extractive Process Metallurgy—Introduction to the thermodynamics and fundamentals of metal production processes. Unit
process types are dealt with under the following major headings: (a) concentration of minerals, (b) preparation for reduction, (c) reduction to the metal, (d) refining and alloying, and (e) casting. The course also surveys integrated processes, flowsheets, and the general industrial field as applied to important metals. Prerequisite: Chemistry 4.

2 to 3 units, Aut (Parke) MWF 2:15

105A. Introduction to Metallurgy—Designed for non-metallurgy majors. Lectures and reading assignments in all phases of metallurgy: Extractive, process, and physical metallurgy.

2 to 3 units, Aut (Parlee) MWF 2:15

120. Introduction to Ore Deposits—A survey course emphasizing description and classification of ore deposits. Topics include evolution through geologic time; tectonic-petrologic setting; morphology and structure; mineral associations. Laboratory study includes hand lens inspection of rock suites and discussions with some sessions on inter-relationship of plans and cross-sections in visualizing three dimensional aspects of ore bodies, alteration patterns and structure. Prerequisite: Geol. 161, which may be taken concurrently.

3 units, Aut (Einaudi) TTh 9; one lab by arrangement

130. Environmental Earth Sciences I—First of a three-course sequence investigating the relationship of the environmental earth sciences to city and regional planning. General earth science and planning background is presented throughout the sequence by earth scientists and a city planner, supplemented by laboratories and field trips. Background and techniques acquired in the first two quarters are applied to the preparation of a land-use plan for a selected location in the San Francisco Bay Area in the third quarter.

First-quarter topics include: environmental data, non-renewable resources, geologic constraints to development, weather and climate, emergence of the urban environment, factors affecting the use of land. Laboratories include: data projection, climatic water balance, use of maps and air photos in planning, land use, population, economics and mineral resources. Seminars and field trips relate to local problems.

4 units for graduates; 5 units for undergraduates, Aut (Mader, Remson) MWF 11; labs., seminars, and field trips by arrangement

131. Environmental Earth Sciences II—See course sequence description under 130. Topics include: geologic constraints to development, stream and air pollution, shoreline processes, reconnaissance studies for planning, selected urban analyses, urban responses to earth sciences. Laboratories on: computer storage system for environmental data, stream pollution, community site selection, environmental transport. Reconnaissance study of environmental and planning factors for an area selected for the course land-use planning project. Prerequisite: 130 or consent of instructor.

5 units, Win (Mader, Remson) MWF 11; labs., seminars, and field trips by arrangement

132. Environmental Earth Sciences III—See course sequence description under 130. Lectures on: land capability studies and evaluation systems, environmental impact studies, general plan preparation, location and space requirements for land uses, waste disposal and sanitary landfill, geologic hazards. Laboratory devoted to preparation of land use plans for selected project area. Prerequisite: 130 or consent of instructor.

5 units, Spr (Mader, Remson) MWF 11 labs., seminars, and field trips by arrangement

133. Remote Sensing of the Environment—Survey course covering the methods of rapid reconnaissance of the environment stressing those techniques suited to change-detection. Emphasis will be placed on detection of various types of pollution of water and air, potential landslide areas, and evaluating the condition of coastal wet land environments. Test sites on the Campus or Baylands can be studied for extra credit.

3 units, Spr (Lyon), by arrangement

143. Materials: Non-Renewable Earth Resources and Man—(Enroll in V.T.S. 143.) Abundance, location, and elementary geology of non-renewable energy and mineral resources in the earth's crust, including the probable extent of undiscovered deposits. Patterns of usage, population trends, industrial development, and future demand. Limitations that specific resource scarcities will eventually impose on living standards. Economic and environmental costs of extracting

3 units, Spr (Kruger) MWF 11

150. Introduction to Mineral Extraction Processes—Elements of mineral extraction processes for geology, mining, and other students not majoring in process metallurgy. The relationships between process technology, economics, ecology, and the mineralogical characteristics of ore deposits are considered. Production of refined minerals and metals, as well as industrial non-metallic mineral products, are all dealt with.

3 units, Aut (Parlee) MWF 2:15


3 units, Win (Anderson) MWF 3:15

180. Field or Laboratory Study and Report in Mining or Metallurgical Engineering.

1 to 2 units, Aut, Win, Spr (Staff) by arrangement

183. Geological Archeology—(Same as Anthropology 183.) This course treats the application of geology to archeology. Topics include the role of geochronology in providing a framework of relative as well as numerical dates, the use of sedimentology, paleontology and geomorphology in environmental reconstruction, and the methods of archeological exploration, including use of geophysical techniques. Stress is placed on the student's involvement in actual problems that are introduced in a succession of weekend field trips.

5 units, Spr (Harbaugh, Zubrow) TTh 3:15–5:05; labs. and field trips by arrangement

192. Geomathematics I: Computer Applications in Geology and Applied Earth Sciences—An introduction to digital computing and FORTRAN in a geological and applied earth sciences context. No previous knowledge of computing is assumed. Various topics are introduced, including elementary matrix algebra, least-squares surface fitting, machine contouring, information storage and retrieval, and numerical solution of differential equations in finite-difference form. Applications touched upon include ore deposits, petroleum geology, paleontology, structural geology, and flow of fluids. Work in the course consists mostly of developing and using computer programs. Toward the end of the course, each student develops a programming application in his own field of interest. Prerequisite: an introductory course in calculus. This course may be followed by Geomathematics II or Geomathematics IV, or both.

4 units, Aut (Harbaugh) TTh 10:00–12:00

194. Geomathematics III: Numerical Methods for Geologists—A course intended for students in all fields of the earth sciences. Topics covered include an introduction to numerical, finite element, linear programming and matrix methods in earth sciences. The emphasis is on application to mathematical models. Prerequisite: Introductory calculus.

3 units, Spr (Remson) MWF 9

199. Special Problems in Applied Earth Sciences for Undergraduates—Guided research or reading on special problems.

Any quarter (Staff) by arrangement

GRADUATE COURSES

201. Principles and Methods of Crystal Growth—(Enroll in Materials Science and Engineering 201.)

3 units, Spr (Tiller) TTh 2:15–3:30; optional 2 unit lab. to be arranged

203. Mineral Processing—Detailed study of mineral and solid-solid separation techniques and auxiliary operations with emphasis on practical use of principles in preliminary process feasibility appraisal. Topics include sizing, solid-liquid separations, and gravity, magnetic, electrical, and flotation methods of solid-solid separation. Prerequisite: 150 or equivalent and elementary physics; some experience with fluid mechanics recommended.

3 units, Aut (Parks) MWF 10

3 units, Aut (Anderson) MWF 3:15, alternate years, given 1976–77

207. **Metal Refining and the Nature of Liquid Metals** — Metal refining processes and the physical chemistry underlying them. A systematic treatment of unit processes based on types of impurity phases; deals effectively with the fundamentals of such widely different methods as the zone refining of semiconductors, the industrial refining of copper, steelmaking, and the vacuum refining of high temperature alloys. Structures and properties of liquid metals.

3 units, Win (Parlee) MWF 2:15

211. **Fuel Resources Development** — An overview of the principal factors that bear on the development of oil and coal resources, including their geology, exploration technology, and political and economic influences. Modern methods of exploration decision analysis are introduced, and opportunities for entrepreneurship are discussed. The course includes interpretation of subsurface geology from borehole data, the use of computerized mapping methods, the solution of problem sets in decision analysis, and field trips.

4 units, Win (Harbaugh) TTh 10:00–12:00

214. **Metallurgical Reaction Engineering** — Mass transport in fluids and applications of kinetic and transport data in the design of metallurgical unit operations: rotary kilns, shaft furnaces, fluidized bed reactors, leaching, slag/metal refining, converter processes, flotation. Recommended prerequisite 173 or equivalent.

3 units, Spr (Anderson) MWF 3:15

215. **Mineral Economics** — Lectures, discussions on mineral importance, national minerals policy, marketing, prices, geography, accounting, taxation, conservation, stabilization, government activities, international affairs, future supplies, environmental problems, foreign investment, and labor relations pertaining to minerals, including petroleum, natural gas, and coal; surveys of individual minerals as commodities.

3 units, Spr (Kruger) MWF 10

220 A, B. **Advanced Ore Deposits** — A sequence course extending through Winter and Spring quarters designed to integrate field, theoretical, and laboratory data on the geology of the major types of ore deposits and application to exploration concepts. Emphasis is placed on magmatic, hydrothermal, and sedimentary processes and on empirical and theoretical development of genetic models. First part of Winter quarter laboratory consists of an introduction to the reflected light microscope and measurement of reflectivity and hardness as tools for the identification of opaque minerals, followed by advanced study of rock suites from district collections by hand lens, polished thin section microscopy, X-ray diffraction, electron microprobe and other techniques; emphasis on characterization of whole-rock mineral assemblages and paragenesis, and on genetic interpretation; individual projects and reports. Field trips in lieu of some laboratory sessions. Participation in A.E.S. 277 strongly advised. Prerequisites: Geol. 163, 171, A.E.S. 120.

3 units each quarter, Win-Spr (Einaudi) TTh 9, one lab by arrangement, alternate years, given 1975–76

222. **Statistical Thermodynamics** — (Enroll in Materials Science and Engineering 222.)

3 units, Spr (Pound) MWF 10

225. **Surfaces and Interfaces** — Detailed study of the influence of surfaces and interfaces on chemical equilibria in water systems, emphasizing particle size effects on solubility, adsorption on solids, and stability of suspensions. Useful in geochemistry, water chemistry, hydrology, chemical oceanography, water pollution abatement, etc. Purpose is to provide background necessary for interpretation of observed phenomena and, where possible, for quantitative prediction of effects.

3 units, Spr (Parks) 3 lecs. by arrangement

226. **Corrosion and Electrometallurgy** — (Enroll in Materials Science and Engineering 226.)

3 units, Win (Stevenson) TTh 8:30–9:50 alternate years, given 1976–77

227A. **Problems in Applied Aqueous Thermodynamics** — A systematic in-depth lecture
and self-study review of the ideas and principles needed for solving quantitative problems in applied aqueous geochemistry or hydrometallurgy and a series of applied problems which test your understanding of principle and your ability to use it. There will be two weekly class meetings. Intended for those who have had some exposure to aqueous thermodynamics. Prerequisite: Geology 271 or equivalent; Geol. 272 or Mat. Sci. 181 recommended (may be taken concurrently).

3 units, Win (Parks) by arrangement

227B. Workshop in Aqueous Thermodynamics—Intensive study and experience in about eight topics including: analysis of problems; temperature, pressure, and ionic strength effects on equilibria; estimation and critical appraisal of thermodynamic data; computer models; and topics selected by the class. There are two 1.5 hour sessions per week, one lecture and one workshop. You will be expected to submit at least two written papers based on analysis of a problem of your choice in terms of the topics covered in the course. Prerequisites: Geol. 171 and Civ. Eng. 273A, Geol. 173 or Mat. Sci. 181, and A.E.S. 227A. A.E.S. 225 is recommended.

2 units, Win (Parks) by arrangement

228. Extractive Metallurgy Seminar—Lectures, student seminars, and report preparation on selected topics in extractive process metallurgy designed to (a) satisfy the special interests of the student, (b) fill out areas not covered by formal courses, and (c) survey the field of extractive and process metallurgy from several broad points of view.

2 to 3 units, Spr (Parlee) by arrangement

229. Principles of Steelmaking—Systematic development of the physical chemistry underlying ironmaking and steelmaking process. Treatment generalized to promote understanding of the physical chemistry of other metals as well. Seminar treatment of important processes and new developments.

2 to 3 units, Spr (Parlee) by arrangement, alternate years, given 1976-77

230. Case Histories in Exploration, Mining, and Metallurgy — A seminar to which industry leaders are invited to lay out a problem that faced their company, outline what was needed to solve it, give the prognosis for the future, and engage in lively discussion.

2 units, Aut (Kruger, Guest Lecturers)

231. Valuation of Mineral Properties—Acquisition, valuation, financing, mineral law, ethics, organization, decision making, and management. Lectures, problems, discussion and class projects.

4 units, Win (Kruger) TTh 10-12

232. Mineral Project Financial Analysis and Optimization — Introducary course on mineral project feasibility, planning and optimization of the project design. Calculating profitability; cost estimation; determining project size; failure tolerance, equipment redundancy, ore blending and stockpiling; structure of systems-design alternatives; search for optimum conditions; brief survey of linear programming and suboptimization.

3 units, Aut (Staff) MWF 3:15, given 1976-77

240. Ore Finding—Lectures, seminars and laboratory periods in problem solving, directed to the integrated use of all forms of exploration technology to the central problem of finding ore and other mineral resources. Includes geochemical and geophysical prospecting, aerial surveying (remote sensing), etc., incorporating the results into a meaningful exploration program based upon solid geological reasoning. Prerequisites: A.E.S. 120, Geophysics 190, plus Geophysics 191, and A.E.S. 220 A,B, both of which may be taken concurrently.

3 units, Spr (Lyon, Einaudi) 2 lectures and 2 labs. to be arranged.

241. Correlated Field Trip—A ten-day field trip to various mining and metallurgical operations, including Ruth and McGill in Nevada; Bingham, Garfield, Tintic and Price in Utah, or in alternate years, San Manuel, Ray, Magma, Mission, Pima, Twin Buttes, Silver Bell, Sierra, and Old Dick in Arizona, and Eagle Mountain, Boron, Vanderbilt and Mountain Pass in California. Each student is required to prepare one chapter for the trip guidebook. During winter quarter this report will be presented orally to group meetings. Transportation is provided but living expenses are the student's responsibility. May be repeated for credit.

2 units, Win plus Spr vacation (Lyon) by arrangement

277. Field Mapping of Mineral Deposits—A seven-day field trip to a specific mineral

T evening, alternate years, given 1976-77
district in California or Nevada, emphasizeing largescale, surface mapping of mineralized ground, adits and (where possible) underground workings. Students (in Spring quarter) will prepare the maps and produce a report suitable for presentation to management or for publication.

3 units, Spr vacation (Lyon)

284. Engineering Geology—Application of geologic and hydrologic factors in location, design, and construction of engineering works. Emphasis on solution of real problems through effective interaction among geoscientists and engineers. Lectures, seminars, and field trips.

4 units, Aut (Johns) TTh 10; field trips and seminars by arrangement

285. Engineering Geologic Mapping — Detailed field work and preparation of an engineering-geologic map and a stability-analysis map of one of the many fascinating areas of ground instability near Stanford. Mostly independent work, requiring about 8 hours of field time per week. Some prior field experience is desirable but soils engineers without field experience are welcome.

3 units, Spr (Johnson) by arrangement

286. The Practice of Engineering Geology—Survey of current case histories in professional practice of engineering geology, environmental geology and soil engineering. Includes discussions of planning and management of projects, of data presentation and analysis, and of basic operations and skills such as field exploration and soil classification. Also includes several hours of individual internship on project work in the field and in a consulting office. Course is taught by geologists and engineer from a consulting firm, Earth Sciences Associates.

3 units, Aut (Meehan) by arrangement

287. Minerals, Politics, and Economics—Role of minerals and energy in the world of the future. Where energy and minerals come from, how they are transported and used, and how they are affected by political and economic factors.

3 units, Win (Park) by arrangement

292. Geomathematics IV: Advanced Computer Applications in Geology and Applied Earth Sciences—A continuation of Geomathematics I. Topics include surface and space fitting, harmonic analysis, numerical classification, contour mapping, and statistical map analysis. Additional emphasis is placed on development of dynamic simulation models of geologic processes, including representation of space and materials, random variables, Markov chains, fluid flow, diffusion, and mass balance. Work in the course consists largely of developing and using computer programs associated with problem sets, plus assigned reading. Students are encouraged to develop computing applications in their research fields, as for example, in conjunction with thesis work. Fluency in FORTRAN programming is assumed at the outset of the course. Persons who are familiar with computer languages other than FORTRAN are urged to take a FORTRAN short course during a preceding quarter. Persons with little or no computing experience should enroll previously either in Geomathematics I, or in Computer Science 105 or 106 plus a FORTRAN short course.

4 units, Win (Harbaugh) TTh 9

294. Plate Tectonics and Ore Deposits—Seminar consideration of possible relationships between plate tectonics and the distribution of different kinds of metallic ore deposits in space and time.

3 units, Win (Dickinson and Lyon), seminar by arrangement, alternate years, given 1976-77

295. Structural Setting of Major Mineral (Metal and Oil) Districts—Seminar presentation and discussion of the structural environments of mines and mineral deposits. Integration of regional tectonics, major and minor lineaments, jointing and other rock fabric elements to assess the structural setting and to define search models in exploration. Each student will prepare and present a detailed report for class distribution on the structural style of a district, using all the available literature, maps, and aerial photography. Prerequisite: Geology 221 or consent of instructor.

3 units, Spr (Lyon) seminar TTh 1:15–3:05, alternate years, given 1976-77

296. Airborne Exploration: Advanced Photogeologic and Radar Techniques—Advanced photographic and radar interpretation of larger-scale structures, for rapid reconnaissance, as in the initial search for mineral districts. Particular emphasis is placed upon understanding ultraviolet, visible (and photographic infrared), and radar
electromagnetic spectral signatures of rocks, soils, vegetation, and oceans. The effect on geological (and geobotanical) interpretation, with varying sun angles and radar look-directions, of flight altitudes, scales, and seasons and of film-filter combinations and radar wavelengths will be evaluated. Includes laboratory and field study. Term paper for fourth unit. Prerequisite: Geology 221 or consent of instructor.

3 to 4 units, Win (Lyon) lab. TTh 2:15–4:05, alternate years, given 1976–77

297. Airborne Exploration: Thermal Infrared and Other Geophysical Techniques—In a more detailed study of smaller areas (1–10 sq. mi.), as around individual mineral deposits, one must use a sophisticated approach in the evaluation of the complex geological structures. This course relates the thermal behavior of the surface materials to the underlying geology, for detection of faults, folds, and anomalous heat flows, using infrared and microwave measurements. The effect of moisture distribution on the thermal behavior is stressed, and the relationship is used to map the buried faults, and to indicate proximity to ground water, etc. Thermal infrared and microwave response from open water bodies (thermal pollution, ocean current patterns, etc.); seasonal effects of vegetation; cultural patterns (roads, irrigation); and atmospheric effects will be evaluated and their influence on the interpretation demonstrated. Airborne geomagnetics, gamma-ray, and other geophysical measurements in exploration are covered in addition. Includes laboratory and field work with infrared instrumentation, and field evaluation of infrared imagery taken over varying geological materials and structures. Term paper for fourth unit. Prerequisite: Geology 235 or consent of instructor.

3 to 4 units, Win (Lyon) TTh 1:15; lab. TTh 2:15–4:05, alternate years, given 1976–77

299. Special Problems in Applied Earth Sciences—Individual research or guided reading on special problems.

Any quarter (Staff) by arrangement

300. Advanced Work in Applied Earth Sciences—Individual work on a dissertation or Master's report in economic geology, engineering geology, mining, mineral processing, or metallurgy.

Any quarter (Staff) by arrangement

320. Research Seminar in Ore Genesis—Discussion of classic ideas and current research on the genesis of ore deposits. Students will prepare papers and make oral presentations. Topics will be selected mainly on the basis of participant interest and timeliness. Prerequisite: A.E.S. 220 (may be taken concurrently) or consent of instructor.

2 units, Aut (Einaudi) by arrangement, given 1976–77

327. Topics in Environmental Geochemistry—Independent study of any topic in the general field of environmental geochemistry, including further study of topics listed under 227A,B. Students must submit a proposal and secure approval prior to registration. Prerequisite 227B.

1 to 3 units, Aut, Win, Spr (Parks) by arrangement

383. Studies of Metallic Ores—Advanced study of mineral suites from the district collections, with emphasis on genesis and localization control. The studies will be designed for individual needs and for independent work. Students will be encouraged to use modern methods of microscopy, X-ray diffractometry and spectrophotography, optical spectrography, and electron microprobe analysis. Prerequisite: 282 or consent of instructor.

6 units, Spr (Staff) seminar and labs. by arrangement

386A,B. Seminar on Literature of Engineering Geology.

1 unit, Win (Johnson) Spr (Jahns) by arrangement

387. Resource Management: A Seminar in Ore Deposits—Class is organized as a board of directors to which exploration, mining, or investment proposals are made by each student as “Chief Geologist” for the company, for critical discussion and decision. Exploration case histories are discussed.

2 units, Spr (Kruger) by arrangement

388. Offshore Exploration Seminar—Lectures, discussions, student papers covering geological, geophysical, and production problems of exploration for oil, gas, and solid minerals in the marine environment.

2 units, Win (Crandall) T 3–5, alternate years, given 1975–76
390. Geology of Energy Sources — Course will touch on supply, demand, and other oil, gas, oil shale, tar sands, nuclear fuels, geothermal energy, and water power, but will also touch on supply, demand, and other economic considerations as well as environmental and social factors.

3 units, Win (Crandall, Visiting Lecturers) TTh II; W 1

392. Survey of Selected Industrial Minerals — Lectures by specialists on the geology, specifications, and economics of selected industrial minerals.

2 units, Spr (Kruger and guests) by arrangement, alternate years, given 1975–76

393. Nuclear Metallurgy—An introductory course covering the materials and metallurgical aspects of nuclear reactors. Course topics will include reactor fuel materials, effects of burn-up, fuel reprocessing, radiation effects on materials, and liquid metal technology.

3 units, Win (Anderson) alternate years, given 1976–77

GEOLoGY

Emeriti: Arthur D. Howard, A. Myra Keen, Charles F. Park, Jr. (Professors)

Chairman: Konrad B. Krauskopf

Associate Chairman: William R. Evitt


Assistant Professors: Gordon E. Brown, Marco T. Einaudi*, Bernard Hallet*, John G. Liou

Visiting Assistant Professor: Raymond Fletcher

* Joint appointment with Applied Earth Sciences.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The program leading to the degree of Bachelor of Science in Geology provides a high degree of flexibility for each individual student. Of the total of 180 units required for the bachelor's degree, not more than 120 are in the form of formal requirements, permitting the student to take elective courses totaling at least 60 units, or one-third of his undergraduate program. The required courses for a student majoring in geology can be grouped into three categories: (1) required courses offered within the Department of Geology, (2) courses in chemistry, physics, and mathematics that are essential to the geology curriculum but are taught in departments other than the Department of Geology, and (3) the University's requirements pertaining to courses in subjects other than science.

Core Course Sequence in Geology

The geology courses that are required form an integrated core course sequence totaling a maximum of 57 units. All undergraduate geology majors are expected to complete the core course sequence, regardless of their intended subsequent specialization in geology. The core course sequence is as follows:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interpreting the Earth</td>
<td>Aut,Win,Spr</td>
<td>5</td>
</tr>
<tr>
<td>2. Earth History</td>
<td>Spr</td>
<td>4</td>
</tr>
<tr>
<td>101. Framework of Geology</td>
<td>Spr</td>
<td>4</td>
</tr>
<tr>
<td>102. Introduction to Field Geology</td>
<td>Sum</td>
<td>3</td>
</tr>
<tr>
<td>103A,B. Advanced Field Geology</td>
<td>Sum</td>
<td>12</td>
</tr>
<tr>
<td>110. Structural Geology</td>
<td>Spr</td>
<td>5</td>
</tr>
<tr>
<td>151. Sedimentary Geology and Paleoecology</td>
<td>Win</td>
<td>4</td>
</tr>
<tr>
<td>152. Stratigraphic Geology andPaleoecology</td>
<td>Spr</td>
<td>4</td>
</tr>
<tr>
<td>161. Crystal Chemistry and Mineralogy</td>
<td>Aut</td>
<td>5</td>
</tr>
<tr>
<td>180. Petrology I</td>
<td>Win</td>
<td>3</td>
</tr>
<tr>
<td>181. Petrology II</td>
<td>Spr</td>
<td>3</td>
</tr>
</tbody>
</table>

In addition to the courses noted above the student is required to take one of the following courses of his choosing:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>143. Principles of Paleontology</td>
<td>Win</td>
<td>5</td>
</tr>
<tr>
<td>163. Optical Microscopy</td>
<td>Aut</td>
<td>4</td>
</tr>
<tr>
<td>171. Introduction to Geochemistry</td>
<td>Aut</td>
<td>3</td>
</tr>
<tr>
<td>214. Physical Processes of Geology</td>
<td>Aut</td>
<td>5</td>
</tr>
<tr>
<td>Geophys. 190. General Geophysics</td>
<td>Aut</td>
<td>3</td>
</tr>
</tbody>
</table>

Total core course units Max. 57
in geology Min. 55
The core course sequence places emphasis on problem solving, and it provides an early introduction to field geology in Geology 102 which is conducted during a period of about two weeks immediately preceding autumn quarter and would normally be taken just before Geology 161. A student can enter the core course sequence as early as the freshman year, but entry in the sophomore or junior year is also feasible. If the student enters as late as the beginning of the junior year, it is imperative that he or she have completed most of the requirements in mathematics, chemistry, and physics, as well as having taken courses equivalent to Geology 1 and 2, to avoid possible delay in obtaining the bachelor's degree.

The minimum number of required courses in mathematics, physics, and chemistry for the Bachelor of Science in Geology varies with a student's high school preparation in the three subjects, general quantitative ability, and the speed at which he or she desires proficiency. Students with interests in analytical aspects of geology should plan on completing mathematics courses through differential equations as well as taking courses in statistics (such as Geology 190). The following course sequences describe the minimum requirements:

### Mathematics

1. For students entering Stanford with only high school algebra and trigonometry: Mathematics 10, 11, 21, 22, and 23 or Mathematics 41, 42, 43 (Analytical Geometry and Calculus)  

2. For students entering Stanford with credit in analytical geometry: Mathematics 41A, 42A, and 43A (Calculus)

### Physics

1. For students with average interest and ability in physics and with mathematical preparation through Mathematics 11 or 41 and concurrent registration in Mathematics 21 or 42: Physics 51 (Mechanics), 53 (Electricity), and 55 (Light and Heat)

2. For students with exceptional ability and interest in physics, advanced placement in mathematics, and concurrent registration in Mathematics 44: Physics 59 and 60 (Advanced Freshman Physics)

### Chemistry

1. For the majority of students majoring in geology, Chemistry 31 (Chemical Principles) and Chemistry 135 (Physical Chemical Principles)  

2. In some instances the following sequence may be substituted for Chemistry 31 and 35 with consent of the adviser: Chemistry 31 (Chemical Principles) and Chemistry 33 (Structure and Reactivity; organic chemistry)

### Electives

A student entering Stanford with credit in high school algebra, trigonometry, and natural science normally will have a minimum of 60 units of free electives in addition to the core curriculum in geology and requirements of the University. These elective units afford an opportunity to acquire substantial strength in one or more of the many subdisciplines in geology and allied earth sciences at the undergraduate level. Alternatively, elective units can be utilized to complete requirements for a Standard Teaching Credential or to acquire depth in a discipline outside the earth sciences such as civil engineering or marine biology. Appropriate electives that are in accord with the interests of a student can be selected in conference with the adviser. There are no constraints on elective courses, and they may be taken in the Department of Geology or any other department of the University.

All courses numbered in the 100's and 200's are open to qualified undergraduate students. The number of courses offered within a given subdiscipline of Geology commonly exceeds the number of elective units available to a student.

### COTERMINAL B.S. AND M.S. PROGRAM

A Stanford undergraduate majoring in Geology may be admitted to the University Division for the purpose of working simultaneously toward bachelor's and master's degrees, provided:

1. The student applies after the beginning of the 8th quarter of undergraduate work and before the end of the 11th quarter;

2. Admission is recommended by the school
or department in which the student seeks a master's degree, that department applying the same standards for admission that it would to an applicant for the Graduate Division.

Both degrees may be granted simultaneously, provided:

1. The student completes 15 full-time quarters or the equivalent (or 3 full quarters after completing 180 units). (Partial tuition registration is possible after the completion of 12 quarters),
2. The student applies for each degree at the appropriate time and to the appropriate agency,
3. The student completes all the requirements for the baccalaureate degree and is recommended for the degree by the Subcommittee on Graduation; and
4. The student completes all the requirements for the master's degree and is recommended for that degree by the University Committee on Graduate Studies.

GRADUATE PROGRAMS

Opportunities for advanced studies and original research leading to the M.S. and Ph.D. degrees are available in the Geology Department. Graduate studies involve academic courses and independent research. Current course requirements for the M.S. and Ph.D. programs are available in the Department Office for the following graduate Core programs:

- General Geology
- Structural Geology
-Geomorphology
-Hydrogeology and Environmental Geology
-Sedimentary Geology and Paleontology
-Mineralogy
-Geochemistry
-Petrology
-Mathematical Geology

Each Core Program is directed by a Core Group consisting of four or more faculty members, some of whom are in other departments of the School of Earth Sciences. Course work contained in the various programs involves offerings in other departments of the School of Earth Sciences as well as other parts of the University.

Programs in Engineering Geology and Environmental Earth Sciences may be pursued by students enrolled in the Department of Geology. Core courses for these programs are listed under the Department of Applied Earth Sciences in this bulletin.

Students interested in Economic Geology, Petroleum Exploration, Ore Deposits, Ore Genesis, and Mineral Exploration should direct their attention to the description of the School of Earth Sciences Programs in Economic Geology and Petroleum Exploration.

For admission to graduate work in the department, the applicant must have taken the Aptitude Test (Verbal and Quantitative) of the Graduate Record Examination.

Graduate programs will vary from student to student. For the typical well-qualified student with a background equivalent to that of a Stanford geology undergraduate, completion of the requirements for the M.S. normally takes from four to six full-time quarters and for the Ph.D. no longer than twelve full-time quarters including both academic course work and research.

MASTER OF SCIENCE

Objectives—The primary purpose of the Masters program in geology is to train professional geologists for work of high quality in industry, private practice, and government. The Masters program also may serve to continue a student’s training in general geology or to help in formulating a Ph.D. program.

Procedures — A written Counseling Examination will be given during the week prior to initial registration, in order to test the student’s background in geology and the supporting basic sciences and mathematics at the undergraduate level. The purpose of this examination is to define weaknesses and strengths in past training so that the former may be rectified and the latter enhanced through a wisely planned academic program. This program will be developed by the student and his or her Academic Advisor with appropriate consideration of the student’s background, interests, and professional goals.

As early as possible, preferably during the first quarter at Stanford, the student is encouraged to select a Core Program. The appropriate faculty Core Group then supervises completion of the departmental requirements for the M.S. program, as outlined below.
Requirements—The University’s requirements for the Masters degree are stated in the section “Advanced Degrees” of this bulletin. The student also should be guided by the following Department requirements:

1. The student is to make up deficiencies in previous training, as indicated by the Counseling Examination. Previous training should include courses that are approximately equivalent to those of the Undergraduate Core Curriculum leading to the B.S. degree in geology at Stanford.

2. The student is to complete a minimum of 45 units of course work.
   a. Not more than 15 of the 45 units may comprise research (Geol. 4X9 series) and special problems (Geol. 3X9 series).
   b. The courses are to be junior, senior, or graduate level (courses numbered 100 or higher).
   c. The courses either are to include one of the sequences of M.S. courses established by faculty Core Groups, or they are to include those designated by an ad hoc Core Group, comprising three or more faculty members selected by the student in consultation with his or her M.S. academic adviser. Each ad hoc Core Group and course sequence must be approved by the Graduate Committee of the Department.

3. The student must complete a manuscript describing his or her research before the end of the sixth quarter of graduate work at Stanford. The manuscript normally is expected to be based on 10 to 15 units of research. The research and manuscript should demonstrate that the student has developed proficiency in at least one area of geology and hence is prepared to begin a professional career in at least that area.

4. The student is to make a public presentation of his or her results. The presentation should be approximately 30 minutes long.

5. Members of the faculty Core Group will determine whether the manuscript is acceptable for the M.S. degree in the Department of Geology and will determine whether the manuscript is ready to be submitted either as an M.S. thesis by the Graduate Division of the university or accepted for publication in an appropriate journal.

Schedule—The recommended schedule of events in the Masters program is:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counseling Examination and selection of Academic Advisor</td>
<td>Upon arrival</td>
</tr>
<tr>
<td>Selection of Core Program and Research Advisor. File list of Core Courses in Geology Office.</td>
<td>1-2</td>
</tr>
<tr>
<td>Certification by Core Group and petition to Graduate Studies Office for M.S. program.</td>
<td>3-5</td>
</tr>
<tr>
<td>Presentation of complete draft of manuscript to each member of Core Group at least one month prior to last day for filing M.S. thesis with Graduate Studies Office.</td>
<td>5-6</td>
</tr>
<tr>
<td>Completion of M.S. Thesis (or publishable manuscript) and public presentation of results of research.</td>
<td>5-6</td>
</tr>
</tbody>
</table>

Doctor of Philosophy

Objectives—To develop the skills needed to conduct original geologic investigations, to interpret the results, and to present the data and conclusions in a clear and concise manner.

Opportunities for Original Investigation—Stanford University is situated in a region that invites geologic field research at all seasons of the year. The California Coast Ranges, Sierra Nevada, Cascade Mountains, Colorado Plateau, Columbia Plateau, and the Basin Ranges are all within easy reach, and their complex geology offers many unsolved problems in all branches of the science. Laboratories are available for research in the various branches of geology, including paleontology and micropaleontology, sedimentology, mineralogy, petrology, geomorphology, photogeology, ore and mineral genesis, ground water, geochemistry, structural geology, rock mechanics, and geophysics.

Procedures and Requirements—The Uni-
SCHOOL OF EARTH SCIENCES

versity's requirements are described in the section "Advanced Degrees" in this bulletin.
A brief summary of additional Department procedures and requirements follows. A complete statement may be obtained in the Geology office.

Two groups of faculty are primarily responsible for guiding Ph.D. students, the Core Groups and the Research Advisory Committees. The faculty Core Groups are responsible for establishing a student's Core Course program and reviewing the student's progress to the time of advancement to Ph.D. candidacy. Subsequently, a Research Advisory Committee is to be selected by a student in consultation with his or her research adviser. The committee is to be made up of three to five members, at least two of whom must be geology faculty. The primary responsibility of the Research Advisory Committee is to aid in establishing and accomplishing the research program of the student.

Upon entering Stanford, a Ph.D. student is to take the Counseling Examination and to select an Academic Advisor, who helps the student design a course schedule. Before the end of the second quarter the student selects a Core Program and before the end of the third quarter selects a Research Advisor.

The Department qualifying procedures for Ph.D. candidacy involve five steps: completing the Core Course sequence, preparing the Ph.D. research proposal, establishing the Research Advisory Committee, passing the Core Program examination, and passing the Research Examination. These five steps, by University regulation, must be completed before the end of the student's sixth quarter at Stanford. If the student is unable to meet this deadline, an explanatory petition requesting an extension must be filed with the Dean of the Graduate Division.

Schedule—The recommended schedule of events in the Ph.D. program is:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counseling Examination and selection of Academic Advisor</td>
<td>Upon arrival</td>
</tr>
<tr>
<td>Selection of a Core Program</td>
<td>1-3</td>
</tr>
<tr>
<td>Selection of Research Advisory Committee including the Research Advisor</td>
<td>1-3</td>
</tr>
<tr>
<td>Preparation and petition for the Ph.D. program</td>
<td>2-5</td>
</tr>
<tr>
<td>Departmental Examinations</td>
<td>2-6</td>
</tr>
<tr>
<td>Admission to Candidacy for Ph.D.</td>
<td>before 7</td>
</tr>
</tbody>
</table>

Courses—The student is to satisfy the Core Course requirements in his or her program. The courses include a minimum of four courses of at least three units each from four different faculty members at Stanford.

Research Proposal—Each student is to prepare a research proposal describing the scientific goals of the intended Ph.D. research, the relevant literature, other resources, and the time required to complete the program. The proposal normally is to be completed before the end of the student's fifth quarter at Stanford. In general, the student will select a Research Advisory Committee at the time he or she prepares a research proposal.

Core program Examination—The Core Group will review a Ph.D. student's course program and research proposal and certify that the student is prepared to take the Departmental Examination. The first examination is the Core Program Examination which is either written or oral, according to the procedure of the student's Core Group, and which is designed to assess breadth and depth of background in the general core area.

Research Examination—The second Departmental Examination is the Research Examination, conducted by the Research Advisory Committee. This examination is an oral examination based on the Ph.D. research proposal prepared by the student.

Demonstration of foreign language proficiency may be required of the candidate at the discretion of the Research Advisory Committee.

Upon satisfactory completion of the Core Program Examination and the Research Examination, the Department will certify to the University Committee on Graduate Studies that the student has successfully completed the preliminary procedures required for admission to candidacy for the Ph.D. degree. Responsibility for the remainder of the student's Ph.D. program passes from the Academic Advisor and the Core Group to the Research Advisor and other members of the Research Advisory Committee.

Under the supervision of the Research Ad-
visory Committee, the candidates must prepare a doctoral dissertation which is a contribution to knowledge and is the result of independent research. The dissertation will be reasonably concise and prepared in a format suitable for publication in part or as a whole.

The candidate is to pass the University Oral Examination which involves an oral defense of the dissertation. The University Oral Examination Committee will normally include the members of the Research Advisory Committee and a Chairman who is not a member of the Geology Department, and is appointed by the Graduate Studies Office.

The Ph.D. dissertation is to be submitted in its final form within five calendar years from the date of admission to candidacy by the University Committee on Graduate Studies. In case of unusual circumstances a candidate for the degree who fails to meet this deadline may receive an extension of one year provided that the Research Advisory Committee is satisfied that the dissertation can be completed in that time.

**Courses**

*Note* — Courses in the 300 and 400 series ordinarily are not open to undergraduates. Courses in the summer quarter are offered for a ten-week period unless otherwise noted.

The student is urged to examine the course offerings listed by other departments. Of particular importance are those in: Applied Earth Sciences, Geophysics, Petroleum Engineering, Chemistry, Physics, Materials Science, Mathematics, and Statistics.

1. **Interpreting the Earth**—Presentation and discussion of some Earth studies, especially those relating the Earth’s present-day processes to its materials and internal constitution. The basis of observations and measurements will be introduced by field trips and labs, and the logic of actual investigations will be examined. Implications for human activities will be evident. Lectures, one three-hour laboratory period per week, and one or two field trips required. A transportation fee will be charged for field trips. High school chemistry and physics or Physical Science 1 and 2 strongly recommended.

   5 units, Aut (Compton) MWF 8; lab. and field trips by arrangement

2. **Earth History** — Evolution of the major features of the Earth’s surface. Topics will include the history of ocean basins, continents, and mountain belts related to current theories of sea-floor spreading and continental drift; the development of life on Earth as a cause and effect of physical geologic phenomena; and indications from Earth history of Man’s dependency on the Earth and its finite resources. Lectures and one three-hour laboratory discussion session per week. Field trips are scheduled in lieu of some laboratory discussion sessions. Prerequisite: 1.

   4 units, Spr (Evitt) MWF 11; lab. discussion sessions and field trips by arrangement

3. **Man’s Natural Environment**—A brief survey intended to instill an appreciation of man’s natural environment and an understanding of natural processes and the ways in which they affect or may be affected by man’s activities. Topics include the Earth in time and space; the Earth as a dynamic system; the materials of the Earth; earthquakes; vulcanism; landscape; the oceans; the atmosphere; organization and evolution of life; energy and mineral resources.

   4 units, Sum (Staff) MTWTh 9

10. **Field Seminar**—The principal component of this course is a week-long trip through the Grand Canyon, Death Valley, or other region in which rocks and earth structures are exceptionally well exposed and where there is an interesting history of man’s activities. The trip, scheduled for the spring recess, is followed by one or more discussion sessions during the early part of the spring quarter. Students who wish to extend their trip experience into a modest library or laboratory research project may register for 3 units rather than 2. Transportation by automobile caravan; meals prepared in the field from group-purchased food. Prerequisites: 1 and 2 (recommended but not required) and consent of instructor.

   2 units, Spr (Staff) by arrangement

101. **Framework of Geology**—Introduction to the dimensional, physical, and chemical features and materials of the earth’s crust, with analysis of some space and time rela-
tionships among geologic units and features. Emphasis is placed on developing an understanding of the kinds of problems handled by an earth scientist and the methods he uses to define, attack, and solve these problems. Laboratory and field trips are designed to provide the student with a basic appreciation of field observations, and their translation into maps, cross-sections, diagrams, and interpretations. Prerequisites: 1 and 2 recommended.

4 units, Spr (Dickinson and Johns)
MWF 10; lab. and field trips by arrangement

102. Introduction to Field Geology — Instruction and practice in the basic methods of geologic investigation and recording in the field. Primary emphasis is placed upon techniques of systematic observation on the outcrop and the construction of a geologic map from the data obtained. The field area studied may vary from year to year, but each site used will be selected to display a variety of rock types and landforms related to clearly defined structures. The course is conducted from a tent camp during the two-week interval preceding the beginning of the Autumn Quarter. Details of the schedule each year are given in the Summer Sessions Bulletin. Prerequisite: 101 or consent of instructor.

3 units, Sum (Dickinson) Sept. 6-20

103A, B. Advanced Field Geology — This course provides an opportunity for junior- and senior-level students to become involved in a substantial field investigation of professional scope and assumes familiarity with elementary techniques of field mapping and a proficiency in basic geologic concepts. The aim of the course is to provide an in-depth exposure to independent analysis of relatively complex geologic problems in the field and the presentation of research results in the form of a professional geologic report. The course is conducted from a tent camp at one or more localities in the western states and involves a coordinated field study involving mapping, description, and interpretation of a relatively unknown field area. Emphasis in the field is placed on observation of lithologic and structural features, measurement of stratigraphic and structural sections, application of various survey methods, and plotting of geologic data on topographic maps and aerial photographs. Graduate students must obtain the permission of the instructor(s) to enroll. Prerequisites: 1, 2, 101, 102, 110, 151 and 181; or enrollment by consent of instructor(s).

103A. Introduction to advanced field techniques; detailed stratigraphic and structural mapping; description and interpretation of lithologic features; conducted from a field camp in California or Nevada.

8 units (Staff) June 18—July 26

103B. Preparation of comprehensive geologic report on field area studied during 103A; work done on campus.

4 units (Staff) July 29—Aug. 12

105. Geologic Problems — Supervised reading, field and/or laboratory work, written reports thereon.

1 to 10 units, any quarter (Staff) by arrangement

110. Structural Geology — Introduction to geometric analysis of structures. Emphasis is on use of stereographic projections, descriptive geometry and plane-table surveying in order to develop three-dimensional views of structures. One hour per week devoted to case studies of structures. Two problem sessions per week deal with geometric methods. Several homework problems assigned each session. One day per week spent in field, mapping structures at Moss Beach. Prerequisite: 1 or 101. Recommended: 102.

5 units, Spr (Fletcher, Johnson) MWF 9 plus field lab. 8:00 A.M. to 5:15 P.M. Tues or Sat

141. Geologic Record of Life — A survey of life on earth during 3 billion years, designed for the non-geology major. Illustrated lectures will cover: where fossils are found, how collected and how studied; the record of earliest life and the evolution of the earth's atmosphere; important fossils preserved in unusual ways; microscopic fossils; conspicuous evolutionary successes; coral and other reefs during the last 600 million years; products of ancient life in the service of man. Term report. No prerequisites.

3 units, Win (Evitt) MWF 11; alternate years, given 1976-77

142. Vertebrates of the Past — A survey for nonspecialists, exploring through readings and illustrated lectures the distinctive characters, specializations for particular modes of life, evolutionary history and distribution
in space and time of major vertebrate groups. Term report. No prerequisites.

4 units, Aut (Evitt) MTWTh 11; alternate years, given 1975-76

143. Principles of Paleontology — Fossils and how they are studied; emphasis on principles. Reading and lectures on the nature of the fossil record, the use of fossils for geologic dating and correlation, the record of evolution, and the interpretation of ancient environments. Laboratory introduction to several major groups of fossil organisms. Term project or report. Prerequisite: 2 or consent of instructor.

5 units, Win (Evitt) MWF 11; lab. TTh 1:15-4:05

150. The Oceans: An Introduction to the Marine Environment—This course provides an insight into the science of oceanography including the nature of sea water, the interplay between circulation of the oceans and atmosphere, the tides, waves, sea floor topography, and history of the major ocean basins. Particular attention is paid to the interface between continents and ocean basins; beaches, estuaries, and the continental shelves. Lectures and discussions include a broad view of the biology of the oceans emphasizing the sympathetic interaction between the distribution of inorganic constituents, oceanic circulation, and biologic productivity. The course closes by examining real and potential marine resources together with attendant legal conflicts. Lectures, occasional laboratory demonstrations, one afternoon coastside field trip, and one shipboard field trip required. A term paper on a marine topic is also required; students are encouraged to undertake and complete an independent investigation of a marine problem in the field rather than a library research problem. No prerequisites.

4 units, Spr (Ingle) MWF 10; one three-day field trip is required; additional field trips and research conferences by arrangement

151. Sedimentary Geology — Inquiry into sedimentary and geomorphic processes; study of the petrology of sedimentary rocks and the morphology of landforms. Topics explored include source provenance and weathering, development of erosional and depositional surfaces, mechanics of sediment transport and deposition, lithification and diagenesis of sediments, textures and structures of sedimentary rocks, classification and nomenclature of rocks and landforms. Prerequisite: 102 or consent of instructor.

4 units, Win (Dickinson) TTh 9; plus lab M or W 1:15-4:05 includes field exercises by arrangement

152. Stratigraphic Geology and Paleoecology—Rudiments of interpreting sedimentary rocks with emphasis placed on the utility of integrating paleontologic, sedimentologic, and geochemical evidence to reconstruct paleoenvironments. Characteristic variations of modern and ancient biofacies and lithofacies are traced in time and space. Concepts of biostratigraphy are interwoven with discussions of the dynamics of the marine ecosystem and evolution at the species level, the population level, and the community level. An independent and original investigation of a modern or fossil sedimentary environment serves as a basis for a required term paper. Lectures and discussions are supplemented by extensive reading from classic and current scientific literature. Prerequisites: 1, 2, 101 and 102.

4 units, Spr (Ingle) MWF 10; one three-day field trip is required; additional field trips and research conferences by arrangement

161. Crystal Chemistry and Mineralogy — Introduction to the crystallographic groups and the theory of x-ray diffraction. Principles of crystal chemistry. Factors affecting the stability of minerals and the solid contaminants of our environment. Systematic examination of the structures, chemistry, physical properties and paragenesis of the major rock-forming minerals with emphasis on silicates. Introduction to the principles of optical mineralogy. Laboratories will be concerned with determinative mineralogy including hand specimen, optical and x-ray methods. One field trip. Prerequisites: 1, 101, 102 and Chemistry 31 or 4 (may be taken concurrently).

5 units, Aut (Brown) MWF 10; lab. MW 1:15-4:05

163. Optical Microscopy — A course provided for students who are interested in using the polarizing microscope as an instrument of research. It covers the fundamental concept of optical properties of crystals and systematic study of the rock-forming min-
171. Introduction to Geochemistry—Application of elementary chemistry to geologic problems, such as weathering, sedimentation, formation of sedimentary ores and evaporites, origin of petroleum, and magmatic differentiation. Introduction to thermodynamic functions and the phase rule. Lecture, discussion, problems sets. Prerequisites: 1, 161, Chemistry 135. 161 may be taken concurrently.

3 units, Aut (Krauskopf) MWF 9

172. Geological Thermodynamics and Phase Equilibria—Development of elements of thermodynamics and phase equilibria important to the understanding of chemical processes in nature. Principles governing the distribution of chemical elements among crystalline, liquid, and gaseous phases. Selected topics from the geological and geochemical literature that illustrate applications of thermodynamics to geologic problems. Prerequisite: 171.

4 units, Win (Luth) TTh 10; lab. TTh 1:15-4:05

180. Petrology I—Introduction to the occurrence, classification, and genesis of the igneous rocks. Topics covered include: crystallization of igneous minerals; chemistry of the igneous rocks and minerals; igneous rock suites in space and time; origin and development of magmatic systems. Laboratory exercises include both hand lens and petrographic study of common igneous rocks and minerals. Prerequisites: 102, 161.

3 units, Win (Luth) MWF 9

181. Petrology II—Introduction to the occurrence, classification, and genesis of the metamorphic rocks. Topics covered will be textures and structures of metamorphic rocks; physical chemistry and crystallization of metamorphic minerals; concept of metamorphic facies; magmatic and metamorphic belts and crustal evolution. Laboratory exercises include both hand lens and petrographic study of common metamorphic rocks. Two one-day field trips to local areas that display rocks of special interest. Prerequisite: consent of instructor. Generally some experience in field geology will be required.

3 units, Spr (Liou) TTh 11; lab. W 1:15-4:05

182. Igneous and Metamorphic Rocks—Interpreting origins of rocks by studying the relationships among their mineral grains and by comparing them to chemical data and to field occurrences. Petrographic study of thin sections is the principal laboratory method. Field relations and chemical analyses are gained from papers in journals and from lectures. Prerequisites: 181, 163.

4 units, Win (Compton) TTh 10; lab. TTh 1:15-4:05

193. Geomathematics II: Introduction to Probability and Statistics in Geology—Discrete and continuous probability theory; applications of probability to model-building; the role of probability in sampling and experimentation; statistical techniques in the analysis of sample data; statistical verification of models and statistical estimation of model parameters. This course may be followed by Geomathematics III or Geomathematics V or the Geomathematics Seminar. Prerequisite: Introductory calculus.

3 units, Win (Switzer) TTh 11:00-12:15
(Note—replaces 190)

201. Fall Field Geology—A course for students wishing to study geological problems by field and laboratory methods. During weekends students will prepare a geologic map in a selected area of diverse rock types and structures. During the field work each student will choose a problem illustrated in the area for more advanced study by laboratory or other techniques. The results are to be presented in a report that frames the special problem in the context of the geology. Suitable for undergraduates desiring an extension of field geology beyond 103B, and graduates in Earth Sciences desiring enhanced training in field geology. Prerequisite: consent of instructor. Generally some experience in field geology will be required.

3 units, Aut (Liou) Th 8; one day per week in field

210. Tectonics—Modern ideas of crustal deformation. Examination of structural record on land in relation to ocean floor spreading and plate tectonics. New views of mountain building. Two lectures and one seminar per week, plus reading and term paper. Prerequisite: 110 or equivalent.

3 units, Aut (Page) TTh 9; Seminar Th 4:00-5:30

212. Natural Strain in Rocks—Measurement of rock deformation, especially that
produced by solid-state flow. Rock fabrics will be plotted by using a universal stage and analyzed in light of mapped folds and faults. Stress fields that affected marbles and associated quartzites will be deduced from petrofabric data, giving a basis for interpreting causes of deformation. Prerequisites: 182 and 110 or equivalent.

3 units, Spr (Compton) W 11; lab. MW 1:15-4:05

214. Physical Processes of Geology—Studies of physical geologic processes such as igneous intrusion, folding, faulting and jointing and flow of ice, lava and debris. Emphasizes the application of elementary engineering mechanics to the solution of problems in structural geology and geomorphology. Prerequisite: Calculus.

5 units, Aut (Johnson) MWF 10, TTh 8; field trip by arrangement

215. Mechanics of Igneous Intrusion—Application of selected theoretical concepts and solutions from the field of rheology, elasticity and plasticity theories, fracture mechanics, fluid mechanics, and heat transport to the study of igneous intrusion. Topics will include physical properties of magma and host rock; regional and local stress states; host rock deformation; contact instabilities; flow of magma; phenocryst orientation and concentration; heat convection and conduction. The correlation between theoretical concepts and field observations will be emphasized with particular reference to sheet intrusions. Prerequisites: 110, 214.

3 units, Spr (Pollard) F 1:15-2:05, 3:15-5:05; alternate years, given 1975-76

221. Photogeology—Introduction to principles and practices of obtaining geologic data from air photographs. Particular emphasis is placed on the geologic interpretation of air photos for use in surficial, stratigraphic, and structural geology and in environmental analysis. Characteristics of the various commonly used films and filters and the geometry of the resultant imagery are examined. Simple photogrammetric equipment is employed to obtain quantitative data from photos as an aid to geologic interpretation. Prerequisite: 110; 222 recommended but not required.

3 units, Aut (Rich) TTh 1:15-4:05; alternate years, given 1975-76

222. Geomorphology — A general inquiry into the origin and evolution of landforms. Stress is placed on the evolutionary development of some of the chief landform patterns in various climatic regions and on semi-quantitative study of the physical processes that modify the land surface. Particular emphasis is placed on landform analysis as related to bedrock geology and the environmental changes resulting from the various natural processes. Prerequisites: 110 or consent of instructor; general course in sedimentary geology is recommended.

4 units, Aut (Rich) TTh 10; lab. W 1:15-4:05; field trips by arrangement, alternate years, given 1976-77

230. Hydrogeology — Theory of underground water, analysis of field data and pumping tests, geologic groundwater environments, solution of problems. Prerequisites: elementary calculus and physics.

5 units, Win (Remson) MWF 8; seminar M 2:15-4:05; lab. by arrangement

231. Groundwater Resources — Continuation of 230 with emphasis on practical applications, field techniques used in groundwater surveys and exploration, well development, groundwater law, chemistry of underground waters. Prerequisite: 230.

3 units, Spr (Remson) TTh 9; lab. by arrangement; alternate years, given 1976-77

232. Numerical Methods in Hydrology—Supervised self study of numerical methods with illustrative examples chosen from hydrology. Prerequisite: consent of instructor.

2 units, any quarter (Remson) by arrangement

241. Introduction to Micropaleontology—Study of microscopic marine fossils including diatoms, ostracods, and radiolarians with emphasis on foraminifera. Detailed study of principles of classification, evolutionary trends, common genera, and ecology of foraminifera. Application of planktonic and benthonic foraminifera to problems of paleoecology, paleoceanography, and correlation of marine sediments. An original quantitative investigation of a fossil or a modern foraminiferal fauna serves as a basis for required term paper. Instruction in laboratory and field techniques. Prerequisite: 152, with 143 highly recommended.
242. Introduction to Palynology—Study of microfossils smaller than 200 micra, especially spores, pollen, dinoflagellates, and acritarchs. Techniques of recovery and microscopy, morphology and classification, geologic distribution, application to stratigraphic problems. Prerequisite: 143 or consent of instructor.

243. Stratigraphic Palynology — Detailed laboratory study of assemblages of microfossils smaller than 200 micra, from Cambrian and younger strata, supplemented with lectures and discussions. Prerequisite: 242.

250. Introduction to Marine Geology—General survey of the topography, structure, sediments, and geologic history of the ocean basins and submerged continental margins. Review of selected topics in physical oceanography including deepwater and shallow water waves and major current systems. Discussion of marine sedimentary processes, characteristic patterns of sediment distribution, and the interaction between sediments, water, and organisms. Paleooceanographic and paleoclimatologic analysis of deep-sea cores and deep-sea biostratigraphy. Extensive reading from the current scientific literature. An independent and original investigation of a marine problem serves as a basis for a required term paper. Prerequisites: 151, 152 or consent of instructor.

253. Sedimentary Petrology—Examination and interpretation of clastic sediments and sedimentary rocks. Lectures emphasize processes that control the compositions, textures, and structures of sediments and sedimentary rocks; aspects of provenance, transport, deposition, and diagenesis or incipient metamorphism are treated. Laboratory work emphasizes examination with the petrographic microscope but includes staining techniques, separation of heavy minerals, examination with the binocular microscope, and modal point counting. Emphasis is placed on sandstones of all kinds including calcarenites, but study of conglomerates, lutites and cherts, and volcanioclastic rocks is included; systematic carbonate petrology is not covered. Prerequisite: 163.

255. Sedimentary Basins—Analysis of the depositional framework, tectonic evolution, and economic potential of sedimentary basins, both marine and continental. Topics covered include the plate tectonic settings of different kinds of sedimentary sequences, tectonic and environmental controls on facies relations, analysis of paleocurrent and paleo-slope patterns, and synthesis of basin development through time in terms of depositional systems and tectonic setting. A term paper is required.

261. Advanced Mineralogy—Crystal chemical principles and current theories of chemical bonding as applied to minerals. Spectroscopic properties of minerals. Systematic examination of the structures, chemistry, physical properties and paragenesis of the major rock-forming silicates and related mineral groups. Silicate glass and melt structures. Introduction to the mineralogical literature. Prerequisite: consent of instructor.

262. Structural Mineralogy — Matrix-algebraic development of the crystallographic groups. Theory of x-ray diffraction from crystals and amorphous solids; powder and single-crystal diffraction techniques; elements of crystal structure analysis and refinement. Statistics in crystallography. High-temperature x-ray techniques. Neutron diffraction and inelastic scattering. Geologic applications. Laboratories will consist of single-crystal and powder x-ray investigations of metamorphic and igneous minerals. Prerequisite: consent of instructor.
istry—A systematic study of ideas and principles needed for solving quantitative problems in aqueous geochemistry at temperatures near 25°C and atmospheric pressure. The use of thermodynamics in predicting the feasibility and extent of chemical processes such as dissolution and precipitation, hydrolysis and complexation, oxidation and reduction. Emphasis on resolution of general questions into tractable problems and on problem solving and graphical representation of results. Course is based on lectures, problem sets, and discussion of problem solutions. Prerequisites: 171, 172 or equivalent experience with chemical thermodynamics.

3 units, Aut (Leckie) TTh 9, F 2:15

272. Advanced General Geochemistry—Application of physical chemistry to problems of igneous and metamorphic rocks and ore deposits. Distribution of the rarer elements in geologic environments. Prerequisites: 171, 181, or 1 and Chem. 171.

3 units, Win (Krauskopf) TTh 9; lab. TorW 1:15–4:05

275. Geochemical Transport and Metasomatism—Elementary treatment of single- and multi-component mass transport in a pore fluid by diffusion and convection, combined with description of fluid-solid equilibria to provide a quantitative model for processes of geochemical transport and metasomatism. Solution of boundary and initial value problems, emphasizing numerical methods, provides a basis for discussion and interpretation of rocks of metasomatic origin described in the literature. Prerequisites: Calculus 171 or 172 or equivalent background.

3 units, Aut (Fletcher) MWF 10

278. Organic Geochemistry and the Geological Environment of Life — Course unites aspects of geology and chemistry in study of origin and occurrence and fate of organic materials in geological environments. Principles of organic geochemistry are applied to sedimentology, paleontology, petroleum geology, chemical evolution of life, and environmental science. One field trip and one term paper are required. There are no formal prerequisites although introductory courses in geochemistry and organic chemistry are helpful.

2 units, Win (Kvenvolden) TTh 11; alternate years, given 1976–77

279. Microprobe and X-ray Fluorescence and Analysis—Principles of x-ray emission spectrography, with emphasis on the electron microprobe. Classroom discussions of instrument design and operation, basic theory and analytical correction procedures. Laboratory use of the microprobe to develop sufficient skills for independent operation.

4 units, Spr (Staff) two lecs. and lab. by arrangement

281. Igneous Petrology—Analysis of the crystallization and recrystallization history of the igneous rocks using field, petrographic, mineralogic, and chemical data. Estimation of intensive parameters, such as pressure and temperature, at the time of origin, emplacement, and crystallization on the basis of these data. Interpretation of chemical variation in suites of related rocks in terms of fractional and equilibrium melting and crystallization processes. Laboratory studies on mineral separation and x-ray powder diffraction techniques in conjunction with petrographic studies. Prerequisites: 171, 172, 182.

4 units, Win (Luth) TTh 11; lab. M 1:15–4:05; alternate years, given 1976–77

282. Metamorphic Petrology—Physical and chemical aspects of metamorphic processes. Emphasis on (1) thermodynamic and graphic approaches to construct phase diagrams; (2) methods to determine the externally imposed conditions for metamorphic recrystallization; and (3) role of C, O, H, F, in metamorphic processes (theoretical and experimental approaches). Laboratory work will emphasize examination of suites of rocks from metamorphic terrains such as Franciscan, Abukuma, and Barrovian types. Introduction to the use of conventional hydrothermal apparatus and of the electron microprobe. Prerequisite: 172 or 182 or consent of instructor.

4 units, Spr (Liou) 2 lecs., 1 lab. by arrangement; alternate years, given 1975–76

293. Geomathematics V: Applications of Probability and Statistics in Geology—A variety of techniques will be presented along with their applications to geological problems. Students will then be expected to offer critical reviews of selected published research papers with respect to the appropriateness and correctness of statistical us-
299. Geomathematics Seminar — Geostatistics, probability models and simulation, sampling theory, and other topics chosen according to the interests of the participants. Prerequisite: consent of instructor.
3 units, Spr (Switzer) TTh 11:00-12:15; alternate years, given 1975-76

311A,B,C. Seminar in Structural Geology—Group discussions of most important research papers in structural geology. Purpose is to become familiar with classic ideas in structural geology. Prerequisites: 210, 212, 214.
1 unit, Aut (Page) T 4:15; 2 units, Win (Johnson, Thompson); 1 unit, Spr (Compton) by arrangement

312. Theories of Folding—In-depth studies of mechanical theories of folding. Begins with classic, single-layer theories of Smoluchowski, Ramberg, and Biot. Continues with improvements by Chapple and Fletcher. Ends with modern theories of folding of multilayers, including theories of sinusoidal, concentric, kink and chevron folding and monoclinar flexuring of elastic multilayers. Course uses seminar approach of reading and discussing details of derivations and conclusions. Prerequisite: 214 or equivalent background.
3 units, Spr (Johnson, Fletcher) MWF 10; alternate years, given 1975-76

313. Theory and Applications of Finite Strain—Derivation and analysis of fundamental equations of two- and three-dimensional finite strain. Thorough conceptual understanding will be emphasized through comparison to infinitesimal strain theory; study of special cases such as simple shear; manipulation of graphical representations including the Mohr diagram; measurement of strain in rock using pebbles, fossils, and other markers; analysis of laboratory models. Concepts will be applied to possible rock deformation associated with structures such as cleavage, shear zones, and folds. Prerequisite: 110.
3 units, Spr (Pollard) F 1:15-2:05, 3:15-5:05; alternate years, given 1976-77

314. Seminar on Transformations in Non-hydrostatically Stressed Rock — Treatment of thermodynamic equilibrium at solid-solid and solid-fluid interfaces in non-hydrostatically stressed rock. Discussion of topics such as development of preferred lattice orientation by recrystallization, isochemical phase transformation, mechanisms contributing to the alteration of seismic waves, and coupling of mass transfer and bulk deformation. Prerequisite: 172 or equivalent.
2 units, Win (Fletcher) TTh 9

320. Seminar in Glaciology—Dynamics of temperate and polar glaciers, with emphasis on recent research on surging and glacial hydrology.
2 units, Spr (Hallet) by arrangement

322. Advanced Geomorphology — A systematic quantitative evaluation of some physical processes and geomorphic agents (water, ice, and air) that modify the land surface. Principles of fluid flow and theories of sediment transport are used in an effort to understand the origin and modification of a wide variety of destructive and constructive landforms. Topics will include, but are not limited to, river mechanics, dynamic equilibrium theories, movement and deposition of sediment by water, wind, and ice. Classroom discussions will be augmented by a review of actual field observations. Prerequisites: 222, and C.E. 107 or 207 or consent of instructor.
3 units, Win (Rich, Johnson) MWF 10; field trips by arrangement, alternate years, given in 1976-77

325. Seminar in Geomorphology—An analysis of current problems in geomorphology, with emphasis on new data and concepts based on review of classic and modern literature pertaining to the various topics discussed.
2 units, Win (Rich) by arrangement

361. Seminar in Mineralogy.
1 unit, Win (Staff) by arrangement

371. Seminar in Geochemistry.
1 unit, Aut (Staff) by arrangement

381. Seminar in Igneous Petrology—Analysis of current problems, concepts, and research in igneous petrology and closely allied fields, with emphasis on newly available data. Topics for discussion are selected
mainly on the basis of interests expressed by the course participants.

2 units, Win (Jahns) by arrangement

382. Advanced Petrology — Fundamental topics in petrology, the selection of which will be announced at least one quarter in advance. Students will read papers, prepare written abstracts, and make oral presentations before the class. Emphasis will be on logical analysis, internal consistency, and contribution to geological thought. The range of subject matter is to be kept sufficiently compact to permit in-depth investigation. Prerequisite: 172 or equivalent, or consent of instructor.

3 units, Spr (Dickson) T 2:15-4:05; alternate years, given 1976–77

383. Seminar in Metamorphic Petrology — Discussion of selected topics in the area of physical chemistry of metamorphic processes, research problems and methods of study of metamorphic rocks on their origin and relationships in time and space. Prerequisite: 281 or 282 or consent of instructor.

1 unit, Spr (Liou) by arrangement, alternate years, given 1974–75

Problems in Various Fields of Geology — Units, quarter, and time by arrangement (Staff)

309. Problems in General Geology.
319. Problems in Structural Geology and Physical Processes.
329. Problems in Geomorphology and Photogeology.
339. Problems in Environmental Earth Sciences and Hydrogeology.
349. Problems in Paleontology, Palynology, and Paleoecology.
359. Problems in Sedimentary Geology.
369. Problems in Mineralogy.
379. Problems in Geochemistry.
389. Problems in Petrology.
399. Problems in Geomathematics.

Research in Various Fields of Geology — Units, quarter and time by arrangement (Staff)

409. Research in General Geology.
419. Research in Structural Geology and Physical Processes.
429. Research in Geomorphology and Photogeology.
439. Research in Environmental Earth Sciences and Hydrogeology.
449. Research in Paleontology, Palynology, and Paleoecology.
469. Research in Mineralogy.
479. Research in Geochemistry.
489. Research in Petrology.
499. Research in Geomathematics.

GEOPHYSICS

Chairman: George A. Thompson
Associate Professors: Jon F. Claerbout, Amos M. Nur
Assistant Professor: David M. Boore
Research Associate: Björn Engquist

OFFERINGS AND FACILITIES

Geophysics is the branch of earth science concerned with exploration of the earth and its history by physical measurements. The undergraduate and graduate programs are designed to provide (1) the background of fundamentals necessary to the study of geophysics and (2) course work in geophysics to coordinate and organize the required background with the principles of geophysics. The four-year undergraduate program leads to the degree of Bachelor of Science. The objectives of the graduate program are to prepare students for positions in the exploration industry, geophysical research programs, governmental work, and education. The Department of Geophysics is housed in the Ruth Wattis Mitchell Earth Sciences Building and the Henry Salvatori Laboratory of Geophysics. The Department has a number of research facilities among which are a seismic observatory, a rock-magnetism laboratory, time-sharing computer facilities, a high pressure and temperature rock deformation laboratory, and various instruments for field measurements. Current research activities in the Department include earthquake prediction studies, studies of geothermal areas, near field seismology, geophysical monitoring of the San Andreas fault, paleomagnetic investigations and a major research program in data analysis techniques as applied to geophysical exploration. Graduate
programs lead to the degree of Master of Science and Doctor of Philosophy.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The following course requirements for the degree of Bachelor of Science in Geophysics are in addition to the University requirements in general studies. An undergraduate thesis is also required. Normally this will be undertaken as part of the student's participation in three quarters of Research Seminar (Geophysics 185, Sections A, B, C, D, E, or F) during the senior year. Seniors in Geophysics who expect to do graduate work are urged to take the Graduate Record Examination as early as convenient in their terminal undergraduate year.

Curriculum

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 31</td>
<td>Chemical Principles</td>
<td>Aut</td>
<td>4</td>
</tr>
<tr>
<td>Chemistry 135</td>
<td>Physical Chemical Principles</td>
<td>Win</td>
<td>3</td>
</tr>
<tr>
<td>Electrical Engineering 141</td>
<td>Electromagnetic Fundamentals or Physics 120</td>
<td>Aut, Win</td>
<td>3</td>
</tr>
<tr>
<td>Geology 101</td>
<td>Framework of Geology</td>
<td>Spr</td>
<td>4</td>
</tr>
<tr>
<td>Geology 102</td>
<td>Introduction to Field Geology</td>
<td>Sum</td>
<td>3</td>
</tr>
<tr>
<td>Geology 110</td>
<td>Structural Geology</td>
<td>Spr</td>
<td>5</td>
</tr>
<tr>
<td>Geology 161</td>
<td>Mineralogy</td>
<td>Aut</td>
<td>4</td>
</tr>
<tr>
<td>Geophysics 185 (A, B, C, D, E, or F)</td>
<td>Research Seminar</td>
<td>Aut, Win, Spr</td>
<td>6</td>
</tr>
<tr>
<td>Geophysics 190</td>
<td>Elementary Geophysics</td>
<td>Aut</td>
<td>4</td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23 and 44 or 41, 42, 43 and 44</td>
<td>Analytical Geometry and Calculus</td>
<td>Any</td>
<td>18</td>
</tr>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>Aut or Win</td>
<td>3</td>
</tr>
<tr>
<td>Physics 51, 53, 54, 55 and 56</td>
<td>Elementary Physics</td>
<td>Win, Spr, Aut</td>
<td>14</td>
</tr>
<tr>
<td>Physics 110, 111. Mechanics</td>
<td>Win, Spr</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

As electives in the Geophysics Curriculum the following courses are recommended: Geophysics 102, 150, 191, 192, Geology 103A and B or 201, Geology 181, Physics 57, 58, 100, 101, 121 or Electrical Engineering 142, Mathematics 131, 132, and Engineering 44.

MASTER OF SCIENCE

General Program

Objectives—To round out the student's training for professional work in geophysics through the completion of fundamental courses, both in the major field and in related sciences, and by obtaining a start on independent work and specialization.

Requirements for the Degree—The candidate must fulfill the following requirements:

1. Be registered in the graduate school for at least three quarters.
2. Complete 45 units with at least a B average. At least 6 of these units must be independent work on a research problem. Normally this research will be undertaken as part of the candidate's participation in three quarters of Research Seminar (Geophysics 385, Sections A, B, C, D, E, or F).
3. Make up deficiencies in previous training. Not more than 10 units of such work may be counted as part of the minimum total of 45 units. Background in field geology should be at the level of Geology 201 or 103A and 103B.

Students who do not meet the standard course requirements (see undergraduate curriculum) but who have unusual competence in other areas, such as environmental geophysics or space physics, may petition the Geophysics faculty to arrange individual programs.

Exploration Program

Objectives—To provide the theoretical background needed for a career in geophysical exploration, with emphasis on techniques used in the search for new petroleum energy resources. The program is designed for graduates with B.S. in physics, engineering, mathematics, geophysics, or geology. The program is not intended as an intermediate step to the Ph.D. degree, although admission to the Ph.D. program will be considered after the student has gained at least one year's on-the-job experience subsequent to obtaining the M.S. degree.

The program will normally take four quarters, beginning and ending in the Autumn quarter. In addition, short courses offered for two weeks immediately prior to both Autumn quarters are required of students with no prior training in geology. A summer internship in industry or government research is an integral part of the program. Although a formal M.S. thesis is not required, the student will present an oral and written interpretation of geophysical data as part of the Geophysics 380 seminar in the final Autumn quarter.

Requirements for the Degree—A total of 45 units is required for the degree and the normal course load is 12 to 15 units per quar-
The required courses for the degree are listed in the following model schedule.

**First Year**

<table>
<thead>
<tr>
<th>Autumn Quarter</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geophysics 190</td>
<td>General Geophysics 4</td>
</tr>
<tr>
<td>Geophysics 397</td>
<td>Contemporary Geophysics Seminar 1</td>
</tr>
<tr>
<td>Geology 255</td>
<td>Sedimentary Basins 5</td>
</tr>
<tr>
<td>Electrical Engr. 261</td>
<td>Fourier Transform and its Application 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter Quarter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geophysics 192</td>
<td>Geologic Interpretation of Reflection Seismograms 3</td>
</tr>
<tr>
<td>Geophysics 274</td>
<td>Seismology 3</td>
</tr>
<tr>
<td>Geophysics 275</td>
<td>Seismology Laboratory 2</td>
</tr>
<tr>
<td>Geophysics 262</td>
<td>Rock Physics 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring Quarter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geophysics 150</td>
<td>Plate Tectonics 3</td>
</tr>
<tr>
<td>Geophysics 191A</td>
<td>Geophysical Field Techniques 6</td>
</tr>
<tr>
<td>Geophysics 280</td>
<td>Data Analysis 3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer Session (Final two weeks only)</td>
<td>Geology 102</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Autumn Quarter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Geophysics 284</td>
<td>Reflection Seismology 3</td>
</tr>
<tr>
<td>Geophysics 380</td>
<td>Seminar: Professional Presentation of Geophysical Data and Conclusions 2</td>
</tr>
<tr>
<td>Geophysics 397</td>
<td>Contemporary Geophysics Seminar 1</td>
</tr>
<tr>
<td>Petroleum Engr. 150A</td>
<td>Formation Evaluation 3</td>
</tr>
</tbody>
</table>

Normal course loads of 12–15 units will include additional elective courses in related fields, such as Petroleum Engineering, Geology, Applied Earth Sciences, Mathematics, Physics, Economics, Computer Science, and Operations Research.

**Doctor of Philosophy**

**Objectives**—The degree of Doctor of Philosophy is conferred upon evidence of high attainment in geophysics, and ability to conduct an independent investigation and to present the results of such research.

**Requirements for the Degree**—A minimum of three years (nine quarters) of university graduate study must be satisfactorily completed. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. During his first year the candidate will take three quarters of Research Seminar (Geophysics 385, Sections A, B, C, D, E, or F). Ph.D. candidates in Geophysics are required to complete Physics 121 or Electrical Engineering 142, and Electrical Engineering 261 and two of the following: Mechanical Engineering 201, Physics 210, 211, Applied Physics 213, 215, Mathematics 220A, 220B. Additional advanced courses are to be selected from the following topics: Applied Physics, Astrophysics, Atomic and Nuclear Physics, Communications Theory, Electromagnetic Theory, Civil Engineering, Engineering Mechanics, Geology, Geophysics (200 level or higher), Materials Science, Physics of Solids, Thermodynamics. Students who wish to waive any of the required courses can petition the department in writing. Petitions must state a well-reasoned plan for the substitute requirements. Students without practical electronics experience are strongly encouraged to take a laboratory course such as Engineering 41A, 42A, or 44. The candidate's record must indicate outstanding scholarship, and deficiencies in previous training must be removed. The student must pass the Departmental qualifying examination; fulfill the requirements of the minor department, if a minor is elected; pass the University oral examination, which is essentially a defense of the dissertation problem, and prepare under faculty supervision a dissertation which is a contribution to knowledge and the result of independent work expressed in satisfactory form.

The Ph.D. dissertation must be submitted in its final form within five calendar years from the date of admission to candidacy by the University Committee on Graduate Studies. Candidates for the degree who fail to meet this deadline will be required to reapply for admission to candidacy and retake the Departmental and the University oral examinations. They will be given an additional one year in which to submit their dissertations.

**Courses**

13. **Earthquakes and Man**—Earthquakes occur daily in California with the prospect that a large earthquake in the San Francisco Bay area is a distinct possibility during our lifetime. This course provides an insight into the science of seismology, the study of earthquakes. Topics to be discussed include why and where earthquakes occur, the nature of earthquake motions, earthquake effects on buildings and other construction and earthquake risk and protective measures.

The course closes by examining the effect of man's activities on determining the environment in which earthquakes occur, raising the tantalizing possibility that earth-
quakes can be controlled. Lectures and one Saturday field trip.

3 units, Aut (Kovach, Boore) TTh 10, field trip by arrangement

35. Great Earthquakes of the West — This seminar will focus on a detailed study of an earthquake of particular historical, scientific, and social significance. Prerequisite: permission of the instructor. Class enrollment will be limited to 10. No auditors.

2 units, Spr (Boore) by arrangement, alternate years, given 1976–77

51. Physics of the Earth — This course is directed toward science, engineering, and mathematics majors interested in obtaining a general understanding of the origin of the earth, geomagnetism, earthquakes, and related geophysical phenomena. Recent developments in the theory of sea floor spreading will provide the framework for considering the following subjects: north-south reversals in the direction of the geomagnetic field; the use of magnetic reversals to determine the rate of sea floor spreading; continental drift; polar wandering; the world wide distribution of earthquakes and volcanoes; how to determine the magnitude, energy, location, and depth of earthquakes; earthquake prediction. Prerequisites: Mathematics 41 or 11, and enrollment in Mathematics 42 or 21.

4 units, Win (Cox, Thompson) MWF 9; discussions by arrangement


3 units, Aut (Cox) MWF 8; alternate years, given 1976–77


3 units, Spr (Cox, Dickinson) by arrangement

185A,B,C,D,E,F. Research Seminars — The research seminar provides the undergraduate an opportunity to participate directly in one of the ongoing research projects in the Geophysics Department. Participation will consist of helping with experimental and computational work; joining in reading and study groups; giving seminar papers; and doing original research for the undergraduate thesis. Enrollment limited to Geophysics undergraduates and coterminal master candidates. Prerequisite: consent of instructor.

185A. Research Seminar: Geophysical Computations — Discussion of current departmental research and current journal articles on geophysical computational techniques, especially seismology and exploration. Prerequisite: Geophysics 280 or concurrent registration in 280.

2 units, Aut, Win, Spr (Clarebort) by arrangement

185B. Research Seminar: Geomagnetism — Current research in paleomagnetism, geomagnetism, and plate tectonics.

2 units, Aut, Win, Spr (Cox) by arrangement

185C. Research Seminar: Seismology — Current research in seismology, seismicity, and earthquake source mechanisms.

2 units, Aut, Win, Spr (Kovach) by arrangement

185D. Research Seminar: Tectonophysics — Research in areas of current interest in rock mechanics, tectonophysics, and related problems. Content varies from quarter to quarter.

2 units, Aut, Win, Spr (Nur) by arrangement

185E. Research Seminar: Tectonics — Research topics on the origin, major structures, and tectonic processes of the earth's crust.

2 units, Aut, Win, Spr (Thompson) by arrangement

185F. Research Seminar: Strong Motion Seismology — Current research concerning near field wave propagation, studies of
source models, interpretation of strong motion data.

2 units, Aut, Win, Spr (Boore)
by arrangement


4 units, Aut (Thompson, Cox) MWF 11; lab. by arrangement

191. Geophysical Field Techniques—Geophysical field investigations in a region of geologic interest using seismic refraction, gravity, magnetic and electrical field techniques. Students engage in all phases of program, interpret the data, and prepare a final report. Prerequisite: consent of the instructor.

4 units, Spr (Kovach, Thompson, Boore) by arrangement

191A. Geophysical Field Techniques — Field investigations as in Geophysics 191 supplemented with lectures and classroom exercises on the quantitative interpretation and inversion of electrical and electromagnetic prospecting data. Prerequisite: Physics 120 or Electrical Engineering 141.

6 units, Spr (Kovach) by arrangement

192. Geologic Interpretation of Reflection Seismograms—Elementary principles of reflection seismology, seismic data processing, and field operations, including field trip to an operating crew. Geology of petroleum: source rocks, migration and accumulation, structural and stratigraphic traps. Workshops in stratigraphic and structural interpretation of seismic sections and well logs, utilizing data from various oceans and continents.

3 units, Win (Claerbout, Crandall, Thompson) TTh 10 and Lab W 1:15-4:00

250. Geomagnetism — Magnetic anomaly fields; secular variation; spherical harmonic analysis of geomagnetic field; elements of rock magnetism; history of geomagnetic field. Prerequisite: Physics 53.

3 units, Win (Cox) MWF 1:15; alternate years, given 1975–76

260. Tectonophysics—Topics selected from theories of elasticity, viscoelasticity, friction and fracture as related to geotectonic processes. Transport theories and related phenomena in geophysical processes. Fluid, electrical, and thermal flow in rocks, with particular emphasis on the mechanics of fluid flow in porous, deformable solids. Discussion of effective stress laws, dilatancy, and role of fluids in earthquakes, after-shocks, creep, and time dependent strain in the crust. Application of dislocation theory to crustal and mantle deformation, faulting and creep. Application to earthquake prediction and fault studies. Content varies from year to year.

3 units, Win (Nur) MWF 11

262. Rock Physics—Properties of and processes in rocks as related to geophysical exploration, crustal studies and tectonic processes. Emphasis on (1) wave velocities and attenuation in rocks as a function of stress, pore pressure, time and temperature; (2) hydraulic permeability; and (3) electrical resistivity. Application to in situ velocity, attenuation, resistivity and fluid flow problems, using laboratory data, theoretical results and symmetry considerations.

4 units, Spr (Nur) MWF 10


3 units, Win (Boore) MWF 9, alternate years, given 1976–77

274. Seismology — Study of earthquakes. Topics to be discussed include: principles of seismographs, seismicity, earthquake magnitude and energy, construction of travel-time tables, general theory of elastic waves, interpretation of seismograms, source mechanisms, earthquake prediction. Prerequisites: some knowledge of waves and Fourier transforms (check with instructor if in doubt).

3 units, Win (Boore, Thatcher) TF 2:45–4:00

275. Seismology Laboratory — Practical ex-
exercises in seismology using records from local and teleseismic events. Required for those taking Geophysics 274.

2 units, Win (Boore, Thatcher) M 2:15–5:00

276A. Seismic Waves: Sources and Propagation I—Basic wave propagation, including finite difference, finite element, and Cagniard–De Hoop methods. Application to source mechanism studies, strong motion data and its interpretation. Prerequisites: Applied Mechanics 253 and Physics 211 or equivalent.

3 units, Win (Boore) MWF 9, alternate years, given 1975–76


3 units, Spr (Boore) MWF 9, alternate years, given 1975–76


3 units, Spr (Claerbout) MWF 9


3 units, Aut (Claerbout) MWF 10

295. Physics of Planetary Interiors — A study of the available data of seismology, volcanology, geodesy, heat flow, high pressure laboratory work and solid state physics for developing an up-to-date understanding of the properties and processes of the interiors of the earth and other terrestrial planets. Emphasis is placed on current unresolved problems in geophysics. Prerequisite: consent of instructors.

3 units, Aut (Kovach, Nur) MWF 10, alternate years, given 1976–77

301. Problems in Geophysics.
Any quarter (Staff) by arrangement

311. Seminar in Structural Geology—enroll in Geology 311B.

2 units, Win (Johnson, Thompson) by arrangement

380. Seminar: Professional Presentation of Geophysical Data and Conclusions—This seminar gives the master's candidate an opportunity to frame and pursue his thesis research within the context of one of the ongoing research projects in the department. It gives the advanced student a regular opportunity to present progress reports before a critical audience.

2 units, Aut (Cox) by arrangement, given 1976–77

385A,B,C,D,E,F. Research Seminars—The research seminar serves several purposes for the graduate student. It gives the master's candidate an opportunity to frame and pursue his thesis research within the context of one of the ongoing research projects in the department. It gives the first-year Ph.D. candidate a chance to participate directly in advanced research prior to making his final commitment concerning a thesis subject, which he normally does during his second year. It gives the advanced graduate student a regular opportunity to present progress reports on his thesis research before a critical audience. Prerequisite: consent of the instructor.

385A. Research Seminar: Geophysical Computations—Discussion of current departmental research and current journal articles on geophysical computational techniques, especially seismology and exploration. Prerequisite: Geophysics 280 or concurrent registration in 280.

2 units, Aut, Win, Spr (Claerbout) by arrangement

385B. Research Seminar: Geomagnetism—Current research in paleomagnetism, geomagnetism, and plate tectonics.

2 units, Aut, Win, Spr (Cox) by arrangement

385C. Research Seminar: Seismology—Current research in seismology, seismicity, and earthquake source mechanisms.

2 units, Aut, Win, Spr (Kovach) by arrangement
385D. Research Seminar: Tectonophysics—Research in areas of current interest in rock mechanics, tectonophysics, and related problems. Content varies from quarter to quarter.

2 units, Aut, Win, Spr (Nur) by arrangement

385E. Research Seminar: Tectonics—Research topics on the origin, major structures, and tectonic processes of the earth’s crust.

2 units, Aut, Win, Spr (Thompson) by arrangement

385F. Research Seminar: Strong Motion Seismology—Current research concerning near field wave propagation, studies of source models, interpretation of strong motion data.

2 units, Aut, Win, Spr (Boore) by arrangement

397. Introduction to Contemporary Geophysics — Seminar on current topics of interest in geophysics with particular emphasis on active research programs within the department. Required for all incoming graduate students.

1 unit, Aut (Staff, Kovach in charge) by arrangement

398. Seminar: Special Topics in Geophysics.

Any quarter (Staff) by arrangement

400. Research in Geophysics.

Any quarter (Staff) by arrangement

PETROLEUM ENGINEERING

Emeritus: Frederick G. Tickell (Professor)  
Chairman: Frank G. Miller  
Professors: Sullivan S. Marsden, Jr., Frank G. Miller, Henry J. Ramey, Jr.  
Associate Professor: William E. Brigham  

OFFERINGS

The study programs of the Department of Petroleum Engineering are designed to train graduates competent in the engineering technology of mineral fluids and energy production from the earth. The broad scientific base involved in this field qualifies graduates for wide-ranging professional assignments in areas such as:

- Improved Oil Production  
- Natural Gas Engineering  
- Geothermal Energy Production  
- Mineral Fluid Economics  
- Water Production and Reclamation  
- Pipeline Transportation  
- Environmental Engineering  
- Mineral Fluid Production Research

Scientific disciplines involved include geology, geophysics, chemistry, mathematics, physics, and computer science. Depth in engineering disciplines is also encouraged. The rapidly evolving energy and material fluid production industries require professionals of unusual versatility interested in wide-ranging technological, sociological, and geographical interests. Qualified students are encouraged to take graduate study because typical assignments often lead to responsible assignments in industrial management and research. Graduate research is conducted in specialties such as geothermal engineering, improved oil recovery, water production and reclamation, natural gas engineering & mineral resource management and development, and mathematical simulation of these systems. Undergraduate participation in both research and industrial practice is encouraged and aided. The main objective of this program is to produce mature engineers of unusually broad scientific base qualified to grow in the evolving fields of energy resource production and environmental and social responsibility of technology. Because of the international nature of this field, special opportunities exist for those persons interested in language, culture, and travel. Participation in the Stanford Overseas Centers is encouraged, and summertime employment in the energy industries is required for at least one summer prior to the Baccalaureate. Graduate programs lead to the degrees of Master of Science, Engineer, Engineer (Management Option), and Doctor of Philosophy.

LABORATORY FACILITIES

The Department occupies portions of the Mitchell Earth Sciences Building, and the Lloyd Noble Petroleum Engineering Build-
ing, which is devoted exclusively to the Department. The Lloyd Noble Building contains five laboratories for instruction and research and high temperature fluid flow and geothermal energy research, a classroom, a seminar and library room, a drafting room, a computing room, and office study space for graduate students. Faculty and departmental offices are in the Mitchell Earth Sciences Building. Laboratories and additional student study rooms and research laboratories are also located in the Mitchell Building. Research in natural gas engineering, improved oil recovery, and water reclamation are conducted in both buildings.

**Programs of Study**

**Undergraduate**

The four-year program leading to the B.S. degree provides a foundation for a career in many facets of the energy industry. The Petroleum Engineering curriculum is fully accredited by the Engineers Council for Professional Development (ECPD). The Department undergoes accreditation inspections with the School of Engineering, and further information may be found in the School of Engineering portion of this bulletin. Basic sciences and engineering are stressed to provide depth sufficient for the wide spectrum of careers possible in energy and environmental engineering. Breadth is provided through courses in social sciences and humanities. Typical plans of study emphasizing specific career objectives such as pre-law, industrial assignments, or pre-graduate school are available in the Petroleum Engineering departmental office.

### Course Program for Undergraduates

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>6</td>
</tr>
<tr>
<td>Social science</td>
<td>9</td>
</tr>
<tr>
<td>Humanities</td>
<td>9</td>
</tr>
<tr>
<td>Mathematics</td>
<td>21</td>
</tr>
<tr>
<td>Science</td>
<td>36</td>
</tr>
<tr>
<td>Engineering breadth</td>
<td>26</td>
</tr>
<tr>
<td>Engineering major</td>
<td>33</td>
</tr>
<tr>
<td>Technical electives</td>
<td>6</td>
</tr>
<tr>
<td>Free electives</td>
<td>34</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>180</td>
</tr>
</tbody>
</table>

**Graduate Degrees**

The energy industries are increasingly interested in engaging petroleum engineers having advanced training. A balanced Master's degree curriculum covering both professional engineering and research requires a minimum of one academic year beyond the baccalaureate. The demand for people with this background far exceeds the supply. As a result, there are many attractive employment opportunities.

The degree of Engineer requires a comprehensive two-year program of graduate study. This degree emphasizes professional practice rather than research.

The degree of Engineer (Management Option) requires two years of graduate study, combining engineering and business administration. This program is conducted in cooperation with the Graduate School of Business.

The degree of Doctor of Philosophy is awarded primarily on the basis of accomplishments in research. A minimum of three years of graduate work beyond the Master's degree is required for the degree.

**Master of Science**

The objective is to prepare the student for professional work in petroleum engineering through the completion of fundamental courses, both in the major field and in related sciences, and by obtaining a start on independent work and specialization.

The candidate must fulfill the following requirements:

1. Be registered in the graduate school for at least three quarters.
2. Complete 45 units with at least a B average. At least 6 and no more than 9 of these units must be independent work on a research problem.
3. Make up deficiencies in previous training. Not more than 10 units of such work may be counted as part of the minimum total of 45 units.
4. Demonstrate his or her knowledge of basic principles and research methods in his general field of study by preparing a report, ordinarily a term paper written for 6 units of research, to be submitted to at least two faculty members.

Usual research subjects include reservoir engineering, transient well-test analysis, flow of non-Newtonian fluids, geothermal energy, natural gas engineering and energy industry management, pipeline transportation, and certain groundwater hydrology and environmental problems.
Courses Required for the Master's Degree

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 200A</td>
<td>Mathematical Methods in Mechanical Engineering*</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 200B</td>
<td>Mathematical Methods in Mechanical Engineering*</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 200C</td>
<td>Mathematical Methods in Mechanical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270A</td>
<td>Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270B</td>
<td>Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270C</td>
<td>Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 272</td>
<td>Advanced Natural Gas Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 274</td>
<td>Introduction to Research Methods</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 275</td>
<td>Fundamentals of Well-Test Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Electives†</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

* The series of courses consisting of Mathematics 131, Partial Differential Equations, Mathematics 132, Partial Differential Equations, and Statistics 110, Statistical Methods in Engineering may be used to substitute for the series M.E. 200A,B,C.

† Electives are to be selected with the approval of the student's advisers.

The above course listing is typical, but other specific course listings are available in the department for students interested in concentrating on geothermal energy and environmental engineering, hydrology, oil transportation or improved oil recovery.

ENGINEER

The objective is to round out the student’s training through additional work in engineering and related sciences and by additional specialization.

A minimum of two years (six quarters) of graduate study is required. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. The candidate must complete 90 units of course work, including credit for research (Pet.E. 360), and including all the course requirements of the Department's Master's degree except the research. If the candidate has received unit credit for such research, this credit ordinarily would be transferable to the Engineer degree. No more than 10 of the required 90 units may be applied to overcoming deficiencies in undergraduate training. The candidate is required to take a minimum of 36 units in Industrial Engineering and the Graduate School of Business.

These may be selected from the following:

- Bus. 210-211. Accounting I and II 4 ea.
- Bus. 220. Business Finance 4
- Bus. 240. Marketing Management 4
- Bus. 303. Economic Forecasting 4
- Bus. 321. Investment Management 4
- Bus. 366. Information Systems Survey 4
- Ind. Eng. 229. Engineering Economy 3
- Ind. Eng. 230. Capital Budgeting 3

Additional units needed to make up the required 90 may be electives selected with the consent of the student's adviser. The student must maintain a C average in Graduate School of Business courses. In all other courses the student must maintain a B average. The student must prepare a thesis on a combined engineering and economic study representing 15 units of research. It is to have the approval of the supervising instructor and the University Committee on Graduate Studies.

Note: Engineers' theses require only one faculty signature; in practice they are generally read by two faculty members.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred upon evidence of high attainment...
involving the ability to conduct an independent investigation and to present the results of such research.

A minimum of three years (nine quarters) of graduate study must be satisfactorily completed. At least two of these years, ordinarily the last, should be spent as a registered student at Stanford. The student is expected ordinarily to take at least 90 units of course work including credit for research (Pet.E. 360) beyond the 45 units required for the Master's degree. Approximately 65 units are generally required, exclusive of research units. The 65 units in question should represent graduate courses in petroleum engineering offered at Stanford, plus courses picked from the following list, and other courses approved by the Department.

Math and Applied Math
Math. 115. Fundamental Concepts of Analysis 3
Math. 131. Partial Differential Equations 3
Math. 132. Partial Differential Equations 3
Math. 106. Introduction to Theory of Functions of a Complex Variable 3
Math. 113. Linear Algebra and Matrix Theory 3
Math. 114. Linear Algebra and Matrix Theory 3
Stat. 110. Statistical Methods in Engineering and Physical Sciences 4
Comp. Sci. 106. Introduction to Computing 3
Comp. Sci. 135. Numerical Methods 3
Comp. Sci. 137A and B. Numerical Analysis 3
Comp. Sci. 234. Numerical Methods of Optimization 3
Aero. & Astro. 192. Vector Analysis and Cartesian Tensors 3
Aero. & Astro. 291A and B. Linear Transforms and Their Applications to Engineering Problems I and II 3 ea.

Science
Appl. Earth Sci. 225. Surfaces and Interfaces 3
Appl. Earth Sci. 388. Offshore Exploration Seminar 2
Geol. 230. Hydrogeology 5
Geol. 231. Groundwater Resources 3
Geol. 278. Organic Geochemistry and the Geochemical Environment of Life 2
Geophys. 190. General Geophysics 4

Engineering
Chem. E. 140. Fluid Dynamics 3
Chem. E. 150. Heat and Mass Transfer 3
Civil Engr. 201. Environmental Field Mechanics I, II 4 ea.
Engr. 290A and B. Engineering Teaching 1 ea.
Engr. 298. Fluid Mechanics 1
Ind. Engr. 229. Engineering Economy 3
Mech. E. 250A. Heat Transfer 3

General
Appl. Earth Sci. 278. Minerals, Politics, and Economics 3

The Ph.D. program is normally a 4-year program. Except in unusual circumstances, the first year is consumed in fulfilling the requirements for the M.S. degree. During the second and third years, the student acquires the foregoing minimum of 65 units of credit in courses approved by the Departmental faculty. During the second and third years, the student also acquires 25 units of research. The student begins the research work by making a literature survey and by formalizing research objectives. The fourth year the student is enrolled as a Terminal Graduate Registrant (TGR) and spends full time completing research and writing the dissertation, getting it into final form before the end of the academic year.

The Departmental qualifying examinations usually are taken at the beginning of the second year of graduate study, or at any time mutually agreed upon by the student and the faculty. The qualifying examinations extend over a period of about ten days and consist of a written part and an oral part. The written part consists of three or four two-hour examinations on different subjects. The oral part is a two-hour examination in which the student is questioned by members of the Departmental faculty.

The student's record must indicate outstanding scholarship. The student must pass the Departmental qualifying examination, fulfill the requirements of the minor department, if a minor is elected, and pass the University oral examination, which is essentially a defense of the dissertation problem. The student must prepare under faculty supervision a dissertation which is a contribution to knowledge and the result of independent work expressed in satisfactory form.

The Ph.D. dissertation must be submitted
in its final form within five calendar years from the date of admission to candidacy by the University Committee on Graduate Studies. Candidates for the degree who fail to meet this deadline will be required to re-apply for admission to candidacy and retake the Departmental qualifying and University oral examinations. They will be given one additional year in which to submit their dissertations.

COURSES

103. Survey of the Energy Industries—Arranged to give the students a comprehensive view of organization and operation of energy industries. Exploration; drilling and offshore drilling; development and production methods; transportation and storage; refining and petrochemicals; marketing; geothermal energy.

3 units, Aut, Spr (Abbott) MWF 11


3 units, Aut (Brigham) MWF 11

150B. Formation Evaluation — Continuation of 150A: Lectures, problems. Radioactivity, sonic and nuclear magnetism logging; formation evaluation programs.

3 units, Win (Marsden) T 9–11 and Th 10

151A. Underground Earth Fluids — Lectures, problems. Chemical, physical, and thermodynamic properties of underground earth fluids. Gas laws, behavior of liquids, phase equilibria, viscosities of hydrocarbons; properties of subsurface waters and steam. Prerequisite: 103.

3 units, Aut (Miller) T 9, Th 9 and 10


3 units, Win (Miller) MWF 10

151C. Drilling Fluids—Lecture, laboratory. Colloidal behavior and rheology of drilling fluids.

3 units, Spr (Marsden) MW 1:15; lab. MW 2:15–5:05

151D. Reservoir Fluids Laboratory—Physical properties of petroleum and its products, including distillation with fractionation, gravity, viscosity, surface tension. Prerequisites: 103, and 151A (may be taken concurrently).

3 units, Aut (Marsden) M 2:15; lab. WF 2:15–5:05

151E. Core Analysis Laboratory—Porosity, permeability, capillary pressure, relative permeability, formation resistivity factor, analog models. Prerequisite: 151B (may be taken concurrently).

3 units, Win (Marsden) T 1:15; lab. TTh 2:15–5:05

152A. Drilling Technology—A course designed to provide a comprehensive picture of modern drilling operations, practices, and equipment both onshore and offshore. Lectures, visual aids, field trips, problems.

3 units, Aut (Abbott) MWF 10

152B. Development and Production Technology — Lectures, demonstrations, field trips. Field equipment for drilling, production.

2 units, Spr (Miller) T 9–11, alternate years, given 1974–75 and 1976–77


1 unit, any quarter (Staff) by arrangement

170. Elements of Reservoir Engineering—Lectures, problems. Description and classification of natural underground oil and gas reservoirs. Engineering calculations of fluid contents of reservoirs and predicted recoveries of geothermal, oil, water, and natural gas reservoirs. Prerequisite: 151B.

3 units, Spr (Miller) MWF 9


3 units, Aut (Ramey) MWF 10


Any quarter (Staff) by arrangement

267. Engineering Valuation and Appraisal of Oil and Gas Properties—Seminar, prob-
lems. Methods in appraising oil lands; estimation of productive capacity, reserves; operating costs, depreciation of materials, salvage, value of future profits, tax returns, purchase strategy. Prerequisite: consent of instructor.

3 units, Win (Miller) S 9–12, alternate years, given 1975–76


1 unit, any quarter (Staff) by arrangement

269. Geothermal Engineering—Steam well deliverability measurement, forecasting, and steam reserves determination and forecasting. Vapor and liquid-dominated systems. Field problems and examples.

3 units, Win (Ramey) MWF 10


3 units, Aut (Miller) MWF 9


3 units, Win (Miller) MWF 9

270C. Advanced Reservoir Engineering—Continuation of 270B. Lectures and problems.

3 units, Spr (Miller) T 9; Th 9–11

270D. Applications of Computers in Fluid Reservoir Engineering—Lectures, seminar. Advanced group study of reservoir engineering. Applications of electronic computing machinery to reservoir problems. Prerequisite: 270B.

3 units, Spr (Staff) by arrangement

272. Advanced Gas Engineering—Lectures, problems. Transient flow of gas in reservoirs, testing of gas wells, advanced water well testing. Gas reservoir material balances, water-drive (recharge) gas reservoirs, production matching and forecasting, reserve estimation, gas storage reservoirs. Prerequisite: 172, 275, or consent of instructor.

3 units, Spr (Ramey) MWF 10


Any quarter (Staff) by arrangement


3 units, Aut (Marsden) MWF 10


3 units, Win (Dykstra) W 3:15–6:05

280A. Modern Fluid Injection—Lectures, problems. Chromatographic transport of mass and heat through porous media. Specific applications to immiscible and miscible displacement of oil. Includes water flooding, gas injection, miscible displacement, thermal oil recovery methods, and other modern fluid injection methods. Prerequisite: 270A (may be taken concurrently).

3 units, Aut (Brigham) MWF 8

280B. Modern Fluid Injection—Continuation of 280A.

3 units, Win (Brigham) MWF 11

281. Applied Mathematics in Reservoir Engineering—Lectures, problems. Philosophy of solution of engineering problems, solution of partial differential equations, operational calculus, numerical integration, application of statistics to petroleum engineering. Prerequisites: Mechanical Engineering 200A or Mathematics 131, and consent of instructor.

3 units, Spr (Brigham) MWF 8


3 units, Spr (Marsden) MWF 11

284. Non-Newtonian Fluids in Production
Engineering—Properties and applications of non-Newtonian fluids in drilling, completions, cementing, fracturing, production improvement of wells, transportation, and secondary recovery of energy fluids.

3 units, Spr (Marsden) MWF 9


Any quarter (Brigham, Marsden, Miller, Ramey) by arrangement
The School of Education is responsible for the preparation of scholars investigating educational processes, and of teachers, supervisors, guidance workers, administrators, and other educational specialists. Three degrees with specialization in education are granted by the University: Master of Arts, Doctor of Education, and Doctor of Philosophy. The Master of Arts in Teaching degree is offered jointly with several academic departments. Various teaching and educational service credentials are issued by state departments of education upon certification of the School that properly accredited work has been completed by the student. The University recommends to the California Commission For Teacher Preparation and Licensing that credentials be granted.

Acceptance of Work Done Elsewhere — Students transferring with advanced or graduate standing from other universities may have some equivalent training accepted in lieu of the courses required at this University for degree programs.

The University offers no correspondence or extension courses.

Summer Session

The full Summer Session in the School of Education is for eight weeks. In addition, several one-, two-, three-, and four-week workshops and institutes are offered which make it possible for students to earn credit in shorter periods of time. However, those who pursue a full program of study (15 units) for eight weeks may earn a quarter of residence toward degree and credential programs. The number of units for which a student may register in the Summer Session may not exceed 16, unless part of the registration is for thesis or dissertation.

The Summer Session Bulletin, issued each year in February, will contain more definite information about summer offerings.

Programs of Study

Information about programs of study is reported below in relation to degrees and credentials. Many students entering the School of Education are candidates for both degrees and credentials. In that case, both applicable sections should be consulted. Below are listed degrees offered by the School
of Education with which credentials may be associated. (There is no necessary association between degrees and credentials. Requirements for degrees and credentials differ even when the candidate is preparing for both at the same time.)

GRADUATE DEGREES

Students who wish to be candidates for advanced degrees are urged to write to the Admissions Office, School of Education, for full information and application forms. The sections below summarize the requirements for the degrees but do not describe the programs in detail. The details are supplied upon request by the School of Education.

Basis of Acceptance as Candidates for Advanced Degrees in Education — Students who have been admitted to graduate standing at Stanford University should inquire, during their first quarter in residence, about advanced degree application procedures. Admission to graduate standing by the University does not in itself constitute admission to candidacy for advanced degrees in the School of Education.

The Graduate Record Examination (Aptitude Test) is required for all graduate admissions.

Students working toward graduate degrees should follow the suggestions outlined under each degree. Students applying for the Master's or Doctor's degree will present a preliminary program of study which represents the work to be completed in earning the degree. They will also consult their advisers with regard to organizing their graduate programs within the limits described in this bulletin.

Students who are candidates for a Master's or Doctor's degree should consult also the University's general requirements described in the section "Degrees" in this bulletin.

Program Areas for Advanced Degrees — Candidates for advanced degrees in education should plan to specialize in the field of their professional interest, preparing for some line of professional activity and at the same time securing mastery of an organized body of knowledge. The choice should be made in light of the professional objectives of the student. The course of study for the various program areas is somewhat flexible, allowing a student, in consultation with the adviser, to emphasize certain aspects of the work, depending on particular interests and professional objectives. Each candidate will have a faculty adviser from his or her program area to assist in planning a program of study and in projecting research plans for the dissertation. Other members of the faculty of the School of Education may also be consulted with regard to the particular area chosen by the student.

The program areas for the Doctor of Education and Doctor of Philosophy degrees are listed below.

Administration and Policy Analysis
Curriculum and Teacher Education, with concentrations in any of the following fields:
- Art
- Bilingual (Bidialectal)/Bicultural Education
- Design and Evaluation of Educational Programs (General Curriculum, Evaluation, Elementary Education, Teacher Education)
- Foreign Language Teaching and Second Language Learning
- Language Arts or English
- Mathematics
- Music
- Physical Education
- Social Studies
- International Development Education
- Mathematical Methods in Educational Research
- Political and Economic Studies
- Psychological Studies:
  - Child Development and Early Education
  - Counseling Psychology
  - Educational Psychology
- Socio-Humanistic Studies:
  - History of Education
  - Philosophy of Education
  - Sociological and Anthropological Studies

Other possible program areas may be arranged for applicants with the approval of the Committee for Academic Affairs.

Application for formal admission to candidacy for the Ph.D. degree should be made no later than the sixth quarter of graduate study at Stanford (see School of Education Manual on Advanced Graduate Degrees for procedures).
MASTER OF ARTS

The degree of Master of Arts in Education is offered in the following fields:

Administration and Policy Analysis
Cultural Pluralism in Education
Curriculum and Teacher Education (with specializations in the following areas:
Art, Language Arts or English, Mathematics, Foreign Languages [Second Language Learning and Bilingual Education], Physical Education, Social Studies, Elementary Education, General Curriculum
Early Childhood Education
Physical Education with Specialization in Dance
Secondary Teacher Education Program*
Social Foundations of Education

Other program areas may be arranged for individual advanced graduate applicants when approved by the Committee For Academic Affairs. Ordinarily candidates for the Master's Degree in the Curriculum and Teacher Education Area will have completed student teaching or other practicum, or have one year or more of teaching experience before entering the A.M. program.

More detailed information about the Master of Arts programs and requirements in specific areas may be obtained from the Master of Arts Secretary, School of Education.

A minimum of 36 quarter units of graduate work is required. At least 30 units must be completed at Stanford. A minimum of 12 of these must be taken for a letter grade. Eighteen units of the program must be in the School of Education. In no case will the degree be granted unless the student has been registered at Stanford for three quarters after the conferring of the Bachelor's degree. One full-time quarter (a minimum of 12 units during the academic year or 15 units for Summer Quarter) is required. The remainder of the work may be carried on a part-time basis. However, University residence requirements must be met. The minimum residence requirement for the Master's degree is "registration at Stanford as a graduate during at least three quarters and the payment of the equivalent of at least three full quarters' tuition at Stanford as a graduate."

The degree of Master of Arts (A.M.) is conferred by the University, on recommendation of the faculty of the School of Education and the University Committee on Graduate Studies. No thesis is required.

Information on program requirements and the order of procedure for applying for the Master's degree should be obtained from the Master of Arts Secretary, School of Education, during registration in the first quarter of residence.

MASTER OF ARTS IN TEACHING†

The degree of Master of Arts in Teaching is offered jointly by the following academic departments and the School of Education: Art, Biology, Chemistry, Classics, Drama, English, French and Italian, German, History, Humanities, Latin American Studies, Linguistics, Mathematics, Physical Sciences, Physics, Political Science, Slavic Languages and Literature, Sociology, Spanish and Portuguese. In addition to these fields, it is possible for candidates to work out special programs in areas such as the social sciences. General requirements for the degree include these:

1. The applicant must have completed a Bachelor's degree with an acceptable grade point average to qualify him or her for graduate study. The department of the major teaching field determines the adequacy of this preparation. The School of Education determines the adequacy of the candidate's background in professional education. The candidate must be admitted to the program both by the department of the teaching major and the School of Education.

2. The candidate must have a teaching credential and/or relevant teaching experience.

3. Three quarters of full-time residence (or

* A program for candidates who are seeking initial preparation for the Single Subject Teaching Credential (Secondary) as well as for the Master's degree. See "Teaching Credential" for pertinent information.

† The degree of Master of Arts in Teaching is ordinarily reserved for experienced teachers or for individuals who have previously completed a program of teacher preparation. Candidates seeking their initial preparation for teaching by way of a teaching internship may prepare for the degree of Master of Arts in Education as well as for a credential. See "Teaching Credential" for pertinent details.
equivalent) are a requirement for this degree. This may be satisfied in many cases by the candidate’s attending a series of summer quarters when appropriate courses are available.

4. A minimum of 45 quarter units of graduate study is required. At least 36 of these units must be completed at Stanford. University residence requirements must be met. The minimum residence requirement for the Master's degree is “registration at Stanford as a graduate during at least three quarters and the payment of the equivalent of at least three full quarters’ tuition at Stanford as a graduate.”

5. A minimum of 25 units of the courses taken for the MAT must be in the teaching field in which the degree is to be given.

6. At least 12 units of the MAT requirements shall consist of graduate courses in the School of Education at Stanford. Certain courses cross-listed in two departments may be used to satisfy requirements in either the academic department or the School of Education, but the same courses may not be used to meet requirements in both departments. Requirements for the School of Education consist of courses in the following areas to supplement the candidate’s preparation:
   a) Methods in the candidate’s teaching field.
   b) A course in curriculum.
   c) Recent work in Psychological or Social Foundations is required. If both have been completed elsewhere, other work in the foundation fields (History, Philosophy, Comparative Education, etc.) must be selected in consultation with the adviser in the School of Education.

7. Requirements in the major teaching field are determined by the major department, and the program of professional courses by the School of Education. Both the preliminary and the final application forms for the degree must be signed by a representative of the academic department and of the School of Education.

8. The candidate must achieve at least a B average in approved Stanford courses in the teaching subject and in professional education or grades in these courses equivalent to those required for the academic department’s Master of Arts degree.

9. Approved general background courses outside of the teaching field and professional education may be used to satisfy some of the unit requirements for the degree.

10. Specific course requirements in both the teaching field and professional education will be determined in part by the candidate’s previous program of studies.

**Doctor of Education**

The degree of Doctor of Education (Ed.D.) is a professional degree conferred by the University on recommendation of the faculty of the School of Education and the University Committee on Graduate Studies.

**Residence**—Nine full quarters of graduate study (a minimum of 108 units, including relevant and acceptable graduate work taken elsewhere up to a maximum of 36 quarter units) beyond the baccalaureate degree are required for the doctorate. Evaluation of residence is based on tuition payments. A minimum of 12 quarter units must be outside the field of education. Candidates for the degree normally will be required during the course of work to register at Stanford for a minimum of two academic years (six quarters). A minimum of two of these quarters must be in consecutive full-time residence. All requirements for the degree must be completed within five years of the establishment of Ed.D. candidacy. Graduate course work beyond the Master’s degree taken seven or more years ago will not ordinarily be included in the doctoral program.

**Organization of Program**—The candidate for the Ed.D. degree will organize a program in conference with advisers relevant to his field of concentration. The program adviser will make recommendations to the area committee in connection with application for candidacy, will aid in planning the program of the individual, and usually function as adviser on research for dissertation. The adviser will be aided by other members of the faculty in the direction of the research program.

Complete information concerning the organization of this program may be secured from the School of Education Doctoral Study Office, Room 24.
DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy (Ph.D.) is conferred by the University on recommendation of the faculty of the School of Education and the University Committee on Graduate Studies. Students working toward this degree in the School of Education are ordinarily preparing for the direction of research work in public school systems or in specialized institutions, or are preparing to conduct research as faculty members of colleges or universities.

Residence—Nine full quarters of graduate study (a minimum of 108 units, including relevant and acceptable graduate work taken elsewhere up to a maximum of 36 quarter units) beyond the baccalaureate degree are required for the doctorate, which must include a minor field of study if the candidate does not hold an acceptable Master's degree outside the field of education. Evaluation of residence is based on tuition payments. Candidates for the degree normally will be required during the course of work to register at Stanford for a minimum of two academic years (six quarters). A minimum of two of these quarters must be in consecutive full-time residence. All requirements for the degree must be completed within five years from the date the applicant is admitted to Ph.D. candidacy by the University Committee on Graduate Studies. Time tables showing how the student is expected to progress toward the Ph.D. degree are available for each program area. Graduate course work beyond the Master's degree taken seven or more years ago will not ordinarily be included in the doctoral program.

Organization of Program — Considerable flexibility is allowed in projecting a program for the Ph.D. degree. The candidate will be expected to organize a program of work for the degree in conference with advisers relevant to the field of concentration. All programs require the approval of the School of Education area committee, the Committee for Academic Affairs and the University Committee on Graduate Studies. Complete information may be secured from the School of Education Doctoral Study Office, Room 24.

Foreign Language Requirement—In some specializations in Education foreign language competence is required. Applicants should inquire about this from the specialization chairman.

Ph.D. Minor in Education — Candidates for the Ph.D. degree in other departments or schools of the University who elect a minor in Education will be expected to choose a field of concentration and to have fundamental grounding in certain foundation fields. They will be required to take a minimum of 30 units in graduate courses in education. In the organization of the program, the student who applies for a minor in the School of Education will consult with the Vice-Chairman for Doctoral Programs, Committee for Academic Affairs.

CREDENTIALS FOR PUBLIC SCHOOL SERVICE

The University is authorized to recommend the granting of certain credentials for service in the public schools of California. The course work and teaching experience required for California credentials will in many instances meet the credential requirements of other states.

Note: The State credential structure is being revised. Details about the revision will be available during the year from the Credential Secretary.

ADMINISTRATIVE SERVICES CREDENTIAL

The Stanford School of Education is authorized to recommend the Services Credential with Specialization in Administrative Services. In order to qualify for the Administrative Services credential, one must hold a fully satisfied basic credential (teaching or pupil personnel); have three years of successful, full-time experience (either teaching or in the field of pupil personnel services); pass the N.T.E. Commons Examination; and complete Stanford’s approved program in order to be recommended by the University for the credential. Information about current advisers, programs of study, and application procedures should be obtained from the Credential Secretary in the School of Education on or shortly after registration day in the first quarter of residence.

The Services Credential with specialization in Administrative Services authorizes the holder to serve as superintendent, associate superintendent, deputy superintendent, principal, assistant principal, supervisor, consultant, coordinator, or in an equiva-
lent or intermediate level administration position.

TEACHING CREDENTIALS*

The Stanford School of Education is authorized to recommend the California Single Subject Teaching Credential for those students who complete the Secondary Teacher Education Program.

The lists of requirements for teaching credentials are available from the School of Education Credential Secretary.

Programs of study and order of procedure should be obtained from the Credential Secretary in the School of Education on registration day in the first quarter of residence.

SECONDARY TEACHER EDUCATION PROGRAM (INTERNSHIP)

The Stanford Secondary Teacher Education Program is a twelve-month, fifth-year program which leads to a California Single Subject Teaching Credential and the Master of Arts degree in Education. It begins in June with a summer quarter of intensive preparation in the process of teaching and experiences in summer programs in nearby schools. During the academic year, students take courses in their academic fields and in professional education; they also teach part time in local schools.

1. Eligibility. Graduates in the humanities and sciences from colleges and universities of recognized standing are eligible to be considered as candidates for admission to the Secondary Teacher Education Program, if they have maintained at least a B− academic average in undergraduate and graduate courses. Applicants must have an acceptable teaching major and little or NO course work in professional education or experience in supervised teaching. Persons who have been out of college for some time but now seek to prepare to teach, as well as recent graduates, are encouraged to apply. The number of candidates who can be admitted to prepare in a particular subject area is limited by the facilities of the University and by the number of school assignments available in that subject field.

2. Closing date for filing applications. Completed applications (available from the Admissions Office, School of Education) should be filed no later than the first of March. However, candidates who wish to receive consideration for scholarship awards must have their applications filed by January 15.

3. The Graduate Record Examination ( Aptitude Test) is required for admission.

4. Notice of admission. Candidates will be notified of their acceptance into the program no later than April 1, 1975. Candidates must reply within two weeks, or no later than April 15.

5. Teaching internship. Each intern must successfully complete a year of teaching at a local cooperating secondary school under the supervision of a Stanford teacher-supervisor and a resident supervising teacher. The intern normally spends a half day in school, including teaching two classes. Some interns receive a small salary, but many candidates complete the requirement of the program through holding non-salaried student teaching positions.

Every effort is made to secure placement for an intern that reflects his preferences and that provides an income. However, no guarantee is made that a salaried internship position can be provided.

6. Requirements. To complete the program in secondary school teaching, the candidate must satisfy the following requirements.

a) A four-year college course and a baccalaureate degree or higher degree except in professional education.

b) A teaching major consisting of a minimum of 36 quarter units (24 semester units) of upper division or graduate courses. Requirements for specific majors may be obtained from the Credential Secretary of the School of Education. Stanford offers the credential in the following major fields only: Art, English, Life Science, Mathematics, a Modern Language, Music, Physical Education, Physical Science, Social Sciences.

c) A two-unit course or examination on the U.S. Constitution and the health education unit requirement.

d) Interns will be responsible for a pro-
program, over a four-quarter residence at Stanford, which includes approximately one third of the work in academic courses, one third of the work in professional courses in education, and one third in practical teaching experiences. A minimum of 45 quarter units of graduate study is required. At least 36 of these units must be completed at Stanford.

How the Program Is Organized

Summer Quarter—Full-time residence at Stanford University. Courses in the teaching major and in professional education; foundations of education, curriculum and instruction in the teaching major and secondary education.

Academic Year — Part-time teaching responsibilities. Additional course work in the academic major; course work in education to include additional work in the foundations of education, curriculum and instruction, reading and secondary education; teaching internship.

In light of continuing program development these requirements are subject to revision.

COURSES IN OTHER DIVISIONS OF THE UNIVERSITY

Teachers, administrators, and specialists in other areas of education are expected to have a substantial knowledge of a variety of academic fields outside the areas encompassed by professional education. Students are therefore urged to consider the courses offered in other divisions of the University in planning their programs.

COURSES IN EDUCATION

The School of Education is primarily a professional graduate school. However, upper division undergraduates may enroll in courses numbered 100–299 if given special permission by the instructor or if the course description specifically permits upper division undergraduate enrollment.

Course descriptions are arranged by professional program areas:

Administration and Policy Analysis
Curriculum and Teacher Education
International Development Education (SIDEIC)

Mathematical Methods in Educational Research
Political and Economic Studies in Education
Psychological Studies in Education
Socio-Humanistic Studies in Education
  Anthropology
  Cultural Pluralism
  History
  Philosophy
  Sociology
Special Courses, Independent Study, Directed Reading, Practica, Research, Dissertation

ADMINISTRATION AND POLICY ANALYSIS

Basic and advanced courses will be offered in 1975–76 in Administration and Organization of Elementary and Secondary Schools. These courses will meet the requirements for administrative credentials in California. New credential policies are now being formulated by the California Commission for Teacher Preparation and Licensing.

110. Introduction to Models in Social Science. (See Socio-Humanistic Studies in Education.)

120. Organizational Decision Making. (See Socio-Humanistic Studies in Education.)


218. Computer Models of Social Behavior. (See Socio-Humanistic Studies in Education.)

220A,B,C. The Social Sciences and Educational Analysis—Addresses itself to the relationships among economics, political science, and sociology and their applications to education in the United States. While the sequence is required of students in the program in Administration and Policy Analysis, the courses are open to all students. Although each quarter focuses on the contribution of a particular social science, an attempt is made to integrate the subjects by stressing their interrelationships. The courses are taught by appropriate specialists from each area with some team teaching. The syllabus relies heavily upon reading assignments in conjunction with case studies. For schedul-
220A. The Social Sciences and Educational Analysis: Introduction to the Economics of Education—An overview of the relationship between education and economic analysis. Specific attention is devoted to investment and consumption theories of education as well as the financing of education. Particular topics include the effects of education on economic growth and the distribution of income as well as taxation for educational purposes. Students who lack training in elementary economics will be required to enroll in a parallel course in economic analysis for one additional unit of credit.

4–5 units, Aut (Levin) MW 11:00–12:30 and by arrangement

220B. The Social Sciences and Educational Analysis: Introduction to the Politics of Education—An overview of the relationship between political analysis and policy formulation in education. Specific focus is given to alternative models of the political process, the nature of interest groups, political strategies, community power and the external environment of organizations, and the implementation of policy. Particular applications to educational settings and problems are emphasized.

4 units, Win (Weiner) TTh 1:15–3:05

220C. The Social Sciences and Educational Analysis: Introduction to the Sociology of Education—(Same as Sociology 340.) An analysis of the links between education and the stratification system in the United States. Topics include: structure of class systems, theories of the origin of class systems, social mobility and education, barriers to educational social opportunity with a special focus on race and sex, and the recent debates over the meaning and existence of equality of educational opportunity.

4 units, Spr (Staff) by arrangement

221A,B,C. Administration and Organization of Educational Institutions in Context—An examination of the context within which educational institutions function, the issues they face and how they are organized, governed and administered. One of the three required three-term sequences for all programs in Administration and Policy Analysis open to other students in Stanford University. For scheduling information see specific course descriptions for 221A, 221B, and 221C.

221A. Administration and Organization of Educational Institutions in Context: American Educational Institutions—An examination of the context in which educational institutions function, the salient and emerging issues which educational institutions face and the likely direction of resolution of those issues. A lecture-discussion course, introducing students to different faculty members and requiring students to write intelligently and thoughtfully about each major topic considered.

4 units, Aut (Hatton) MW 3:15–5:05

221B. Administration and Organization of Educational Institutions in Context: Administration and Organization of Post-Secondary Institutions—An analysis of the nature of post-secondary educational institutions, how they are administered and governed and tactics and strategies available in the performance of administrative roles.

4 units, Win (Mayhew) MW 1:15–3:05

221C. Administration and Organization of Educational Institutions in Context: Administration and Organization of Public and Private Schools—An analysis of the nature of local educational agencies, schools and districts, how they are administered and controlled, how leadership is exerted and the tactics and strategies available to administrators.

4 units, Spr (Bridges) MW 10–12

222A,B,C. Decision Analysis in Education—A three-quarter sequence in the application of quantitative reasoning and decision making in education. For scheduling information see specific course descriptions for 222A, 222B, and 222C.

222A. Decision Analysis in Education: Decision Analysis I—(Same as Statistics 150.) An introduction to decision-making in the face of uncertainty using statistical decision theory. This course is especially designed as an introduction to probability, utilities and risks, descriptive and inferential statistics for non-statistics majors. Emphasis will be placed on the evaluation of alternative courses of action facing the industrialist, administrator, scientist, and layman.

5 units, Aut (Hatton, Sitgreaves) MTWThF 9
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222B. Decision Analysis in Education: Decision Analysis II—Considers the problems of optimization and the design and evaluation of decision experience. Marginal analysis, cost-benefit accounting, constrained maximization, mathematical modeling, program evaluation. An introduction to linear models for large-scale data analysis is provided. Particular attention is paid to the sensitivity of implications to model assumptions.

4 units, Win (Levin) MW 8:30-10:00 and by arrangement

222C. Decision Analysis in Education: Decision Analysis III—Deals with the problems of measurement, system modeling, and simulation from the point of view of the educational administrator or policy analyst. The focus is on the formation of administrative inference from numbers and the assessment of expert testimony in quantitative form. The course includes an introduction to computers as aids to educational decision making and to the formation and use of first approximations.

4 units, Spr (March, Weiner) TTh 8:30-10:00 and by arrangement

225X. Urban Administrative Issues in Elementary and Secondary Schools—This seminar is intended for students interested in urban educational leadership in elementary and secondary schools. It seeks to supplement courses currently offered at the University by considering in depth some of the macro issues facing urban school administrators on the firing line. It will stress some of the challenges made upon urban education in the past twenty-five years and assess the school system’s response to these new needs. The seminar will take into consideration issues of special interest to its participants and also review some of the common educational problems confronting schools in major American cities.

4 units, Aut, Spr (Drachler, Staff) T 3:15-5:05 and by arrangement

226. Educational Administration: Decision-Making and Cultural Pluralism—A seminar for those preparing for professional roles in communities of color; a primary focus is to address those concerns of particular relevance to the promotion of change within educational institutions to accommodate the diversity presented by persons of color.

4 units, Win (Hatton) Th 1:15-3:05 and by arrangement

227. Schools and Community—An examination of emerging issues in local school reform surrounding the effect of neighborhood on the style and quality of public education. Particular attention will be given to issues of community control and citizen participation in educational decision-making. Alternative proposals for community schools, community school districts, and participation approaches will be presented for discussion and analysis.

4 units, Spr (Hatton) MW 7:00-8:30 p.m. and by arrangement

249. College Curriculum and Instruction in Higher Education. (See Curriculum and Teacher Education.)

256X. Management Science Applied to Higher Education—(Same as Business 398.) Principles of management science applied to current issues in college and university administration. Course will focus on specific problems which lend themselves to quantitative analysis and economic modeling, and will deal with both the structure of models and the implementation of results. Since mathematics is to be used as a language of expression, students should have some facility with elementary probability, statistics, and calculus. Students will be expected to contribute to the course through class participation and the preparation of a term paper.

4 units, Win (Massy and Hopkins) TTh 10-12

300. Education and Law. (See Political and Economic Studies in Education.)

313A,B. Economics of Education. (See Political and Economic Studies in Education.)

322. Establishing Higher Educational Policy—An analysis of recent efforts to establish educational policy such as the Carnegie Commission on Higher Education, with special emphasis on implications for institutions and systems of institutions.

3 units, Aut (Mayhew) T 1:15-4:05

323A. Education and Public Policy: Federal Education Policy and Administration—The formulation and administration of federal education policy. Includes federal/state delivery systems and policy evaluation as well as the key actors and coalitions.

4 units, Aut (Kirst) Given 1976-77

323C. Education and Public Policy: The
Goverance of Elementary/Secondary Schools — Political behavior of key actors at the state and local levels, including the overall political setting. Stresses impact of teacher organizations and research approaches.

3 units, Spr (Kirst) MWF 9 and by arrangement

325A. Planning in Educational Administration — A review of current planning practices at the elementary and secondary school level; an analysis of principles, logistics, and problems related to the development and coordination of educational programs; emphasis upon the conceptualization of an educational resources management system.

4 units, Spr (Hatton) MW 4:15-6:05

326A. Topics in Financing Education — Addresses particular applications of economics and political science to issues in financing education. While the topics will differ somewhat from year to year, analyses will be focused on taxation for education, intergovernmental aid, educational vouchers, equity in educational expenditures, and the legal challenges to existing methods of financing education.

4 units, Aut (Levin) M 3:15-6:05 and by arrangement

326B. Seminar in Financing Education — Applications of the economic and political concepts for state and federal school finance reform. Students will work on specific problems in various states and the federal government.

3 units, Win (Levin) M 3:15-6:05

327. Survey Design and Analysis. (See Socio-Humanistic Studies in Education.)

330. Policy Research in the Social Sciences or Policy Analysis in Education. (See Socio-Humanistic Studies in Education.)

331. Financing Higher Education — The evolving nature of higher educational support and financial decision making in the colleges and universities. Specific attention is devoted to the changing role of the state and federal governments in financing higher education and to recent proposals to channel government support of colleges and universities through the use of scholarships, loans and vouchers rather than through the more traditional forms of direct aid to the institutions. The financial status of the independent institutions of higher education is also assessed. The course is organized as a seminar with a limit of 15 students. Participants are expected to have completed either Education 326A or 326B, and permission of the instructor will be required.

4 units, Spr (Levin) W 3:15-6:05 and by arrangement

333. Leadership in Organizations — (Same as Sociology 262 and Political Science 102.) The problems of leadership in complex organizations, such as universities, schools, hospitals, business firms, armies, and public bureaucracies. Special attention to the role of major executives.

4 units, Spr (March) MW 1:15-3:05

Alternate years, given 1975-76

363. Evaluation and the Educational Policy Making Process — Examines the role of educational evaluation in the policy making process. For students specializing in administration, policy making analysis, and evaluation. Emphasis on the problem of commissioning evaluations and using their results as distinguished from the problems of conducting evaluations. The nature of information actually used in policy making explored and the political context for evaluation stressed. The roles of various types of information in policy making linked to an identification of appropriate evaluative processes and instruments.

4 units, Aut (Weiner) TTh 3:15-5:05

364. Collective Bargaining — Considers collective bargaining both as a national and state level policy issue in education as well as an administrative problem in local organizations, and intended for both Ed.D. and Ph.D. students. Topics include the development and current status of employee bargaining groups in education; the regional and urban-rural patterns of influence of such groups; their impact upon the cost of education; trends in the supply of and demand for various types of educational personnel and the resulting implications for the bargaining process; the varying state legal contexts for bargaining; the nature of the issues subject to bargaining with specific attention to the impact of bargaining on local budgetary processes, affirmative action and community participation.

4 units, Win (Weiner) ThF 10-12
366. Systems Applications in Education—An overview of systems analysis procedures and their applicability to education. This course is intended for students who are interested in extending their knowledge of quantitative analysis for administrative problems. Students will be introduced to categories of problems faced by educational administrators and the relevant tools from the decision sciences for the resolution of these problems. Emphasis will be on how use of such analytical tools can enhance organizational effectiveness through additional input to the decisions processes of educational organizations.

4 units, Win (Hatton) Given 1976–77

368. Case and Field Studies in Educational Administration—A seminar for administrative interns which will not only consider their own internship experiences but other case material as well—all in a context of relevant administrative and organizational theory and research.

4 units. To be arranged

369. Educational Personnel Policies and Practice Analysis—This will cover a range of personnel matters including supervision, management, and negotiations. Especial stress will be placed on interpersonal relations.

4 units. To be arranged

418A,B,C. Advanced Research in Organizations I, II, III. (See Socio-Humanistic Studies in Education.)

422A,B. Internship Seminar in Higher Education—A seminar especially designed for all students in the higher education program holding field internships. The seminar will have three different types of activities: sharing experience and reflecting on field activities by interns; reading and theoretical discussions on university administration; visiting discussions and/or lectures by practicing university administrators or researchers on higher education.

4 units, Aut (Staff) by arrangement

424A. Structure and Functioning of Institutions of Higher Education—A detailed examination and critique of existing and emerging forms of administration, organization and governance of institutions of higher education. An advanced seminar for second and third year students which will analyze administrative structures of liberal arts colleges, junior colleges, state colleges, universities and multi-institutional organizations. Considerable use will be made of case materials. Although designed for administrative majors, this course should be appropriate for other students interested in understanding how collegiate institutions operate.

3 units, Win (Mayhew) T 1:15–4:05

424B. Technical Problems and Processes in Administration in Higher Education—Detailed examination of such technical concerns as budget preparation and control, management information systems, uses of institutional research and strategies for short and long range planning.

3 units, Spr (Mayhew) T 1:15–4:05

427A. Organization and Administration of Elementary and Secondary Schools—This seminar is concerned with the problems of creating school settings that are responsive to clients and staff. In seeking to increase their understanding of this problem, students will analyze a number of previous attempts to increase the responsiveness of schools and will examine the processes and difficulties of creating new settings and modifying existing ones.

3 units, Aut (Bridges) T 7–10

427B. Administration and Organization of Complex Systems of Elementary and Secondary Schools—This seminar will focus on the major problems faced by chief executives of elementary and secondary school systems. Samples of the kinds of problems to be addressed are the management of time, the development and maintenance of a comprehensive understanding of what is taking place in the organization and its environments, and the motivation of the staff.

3 units, Win (Bridges) Th 3:15–6:05

CURRICULUM AND TEACHER EDUCATION

109A. Cultural Pluralism: Classroom-Curricular Strategies—The primary objective of the course is to examine present educational policy and classroom practices in light of the cultural and social needs of diverse racial and ethnic groups in America. Theoretical concepts from anthropology, sociology, psychology and educational research will form the cognitive content of the course. The students will be encouraged to extract
important and meaningful principles and techniques which are useful in the understanding and resolving of everyday classroom problems which revolve around cultural pluralism. A thorough critique of promising classroom strategies will be central to the course. The course will have maximum benefit for students with little or no teaching experience or contact with minority youngsters in schools. Prerequisite: consent of instructor.

3 to 4 units, Aut (Deslonde) MW 3:15–5:05

109B. Cultural Pluralism: Classroom and Curricular Strategies — This course is designed primarily for those who have had teaching experiences in schools which serve communities of color. The course content will focus on present school and classroom practices addressed to the cultural and social needs of diverse racial and ethnic groups in America. Bilingual education, values education, ethnic studies and teaching strategies for the affective domain will be central to the course content. Theoretical and research constructs from anthropology, sociology, psychology and educational research will be drawn upon for discussion and application to problems of cultural pluralism. Prerequisite: consent of instructor.

3 to 4 units, Sum (Deslonde) MW 10–12

140. Evaluation in Education—A survey of evaluation procedures in various components of educational programs and processes. Much of the course will be devoted to case studies. The course is intended for consumers, rather than creators, of evaluation studies. No prerequisites: Enrollment limited.

3 units, Sum (Staff) by arrangement

141. Images of the Teacher and Teaching — This course explores conceptions, both contemporary and historical, of the role and functions of teachers and of the teaching process. A variety of contemporary and historical resources will be explored to enable students to conceptualize alternative forms of teaching.

3 to 4 units, to be arranged

142X. Practical Inquiry in Education—An introduction to the spirit and basic techniques of systematic inquiry that is directed toward the resolution of practical educational problems, as contrasted with research on basic processes or foundations. Attention will be given to empirical/experimental approaches as well as to conceptual/discursive/interpretive ones. It is intended for first-year doctoral students in Curriculum and Teacher Education and other areas who have little or no background in research and to those whose background is narrowly specialized to one sort of research. A major aim of the course is to enable students to choose more wisely in subsequent quarters among the many courses in methods of inquiry available in the university.

3 units, Aut (Walker) MWF 11

146. Practice Teaching in Music in the Elementary School.

1 to 2 units, Aut, Win, Spr (Kuhn) by arrangement

156. Foundations of Physical Education—Psychological, biological, and sociological bases of physical education, emphasizing basic research from the above disciplines, the body of knowledge of physical education and the development of sound principles from the above sources.

3 units, Aut (Nixon) MWF 10

159. Evaluation in Physical Education — Theory and principles of evaluation in physical education. Emphasis on test construction, the role of evaluation in physical education curriculum and instruction, and research.

3 units, Win (Nixon) MWF 10

165. Curriculum and Instruction in Elementary School Music — (Same as Music 282.) Methods, techniques of teaching music in elementary school. Examination and evaluation of new curricular trends such as the Kodaly Singing School, the Orff Music for Children, and Suzuki Talent Education.

3 units, Spr (Kuhn) by arrangement

177. Physiology of Exercise—Physiological adaptations of the human organism to exercise stress. Limited to those persons who have had or are taking Anatomy.

3 units, Win (Ruff) TTh 8:30–10:00

211B. Classroom Observation—The objective of this course is to provide students with opportunities to observe and discuss classrooms containing substantial numbers of minority students. Attention will be focused on: (1) A variety of commercial and locally (school district) produced curricular
materials, e.g., ethnic studies materials, interethnic reading materials, mathematics materials, English-language arts materials, commercial kits, games and simulation, etc.; (2) Special teaching strategies appropriate for certain cultural and ethnic groups in public schools; (3) Classroom teachers from nearby districts who have exemplary classroom programs focusing on interethnic problems in the classroom; (4) The classroom dynamics of ethnicity and culture.

1 unit, Sum (Deslonde) by arrangement

211C. Foundations of Education: Social—Application of sociological and social-psychological theories and research to teaching, learning, classroom interaction and the organization of the school.

3 units, Win (Cohen, Deslonde) M 4:15–6:05, W 4:15–5:05 and by arrangement

213. Foundations of Aesthetic Education—Analysis of historical and philosophical aspects of art education. Designed to introduce students to the changing functions of art in American education and to the examination of various conceptions of art as they relate to education.

4 units, Aut (Eisner) MW 4:15–6:05

215. Psychological Foundations of Education—(Same as Psychology 145.) Introductory course in application of psychological principles to educational practices. The spring Quarter offering is planned especially for teachers in training. Prerequisite: Psychology 1 or equivalent.

4 units, Aut (Cronbach) TTh 3:15–4:30, W 3:15–4:05
Spr (Gage) TTh 4:15–6:05,
Sum (Staff) MTWTh 10 and by arrangement

219. Artistic Development of the Child — Designed to introduce students to research in the behavioral sciences having relevance for understanding of the child's artistic development.

4 units, Win (Eisner) MW 4:15–6:05

239A,B. Observation and Directed Teaching of Study Skills and Developmental Reading in College. (See Psychological Studies in Education.)


1 unit, Sum (Staff), by arrangement

241. Current Issues in Curriculum—Reading and discussion of recent works proposing changes in the aims and programs of elementary and secondary schools. Discussion will focus on methods and grounds for judging the worth of such proposals. Intended for secondary interns and master's and doctoral students with little or no experience in schools.

3 to 4 units, Win (Walker) TW 4:15–6:05

242. Bicultural Processes in Education—Review and analysis of new research in cognition and motivation with special emphasis on the understanding of the psychological meaning of biculturalism.

3 units, Win (Castañeda) WTh 11:00–12:30

246A. Instruction Laboratory — Training and practice in specific skills of teaching.

3 to 4 units, Sum (———) by arrangement

246B.C,D. Internship in Teaching — Field experience in local secondary schools. Taken during each quarter of internship. Includes a 1-hour weekly meeting with Stanford tutor supervisors. Prerequisite: 246A.

246B. 2 to 6 units, Aut (Staff) by arrangement
246C. 2 to 6 units, Win (Staff) by arrangement
246D. 2 to 6 units, Spr (Staff) by arrangement

247. Affective Education: Research and Practice—This seminar will focus on current related research in the area of affective education. Humanistic education, valuing processes, sociodrama, group dynamics, and interpersonal processes will be investigated and discussed. The classroom implications of research on status, race, self concept of ability, peer culture, locus of control, cooperation, and motivation will be discussed. Doctoral students will be encouraged to focus on the evaluation and in-service components of affective education programs. Whereas elementary grades (K-8) will be stressed, the course will satisfy those whose interests are with higher grades.

4 units, Win (Deslonde), given 1976–77

249. Curriculum and Instruction in Higher Education — Examines the developmental needs of college students and appropriate curricular and instructional means to meet
those needs. Considerable stress placed on social-psychological research relevant to curricular concerns.

3 units, Spr (Mayhew) M 1:15-4:05

257X. Introduction to Curriculum Problems—This course presents an overview of the phenomena and problems associated with the curriculum in programs of mass general education, and introduces some of the major ideas and techniques that have been developed to address these problems and to manage and interpret these phenomena. The evening sessions will consist of real or simulated encounters with curricular problems and situations. The course is intended for masters and doctoral students from all areas of concentration.

4 units, Spr (Walker) TTh 4:15-5:05, W 7-9 and by arrangement

261A,B. Curriculum and Instruction in Art—Lectures and discussions on foundations of art education and curriculum development.

261A. 3 units, Sum (Staff) by arrangement
261B. 2 units, Aut (Eisner) TTh 4:15-6:05

262A,B. Curriculum and Instruction in English—Evaluation of conflicting views of programs of language arts; study of research and recommendations for teaching of composition, critical thinking, semantics, grammar, usage, punctuation, spelling; study of recommendations for teaching of reading and of the various types of literature.

262A. 3 units, Sum (Staff) MTWTh 3:15
262B. 2 units, Aut (Staff) TTh 4:15-6:05

263A,B. Curriculum and Instruction in Mathematics—Purposes and programs of mathematics in the secondary curriculum; teaching materials, methods.

263A. 3 units, Sum (Staff) MTWTh 2:15-4:05
263B. 2 units, Aut (Staff) TTh 4:15-6:05

264A,B. Curriculum and Instruction in Modern Languages—Methods, techniques of foreign language teaching, testing. Materials of foreign language teaching.

264A. 3 units, Sum (Staff) by arrangement
264B. 2 units, Aut (Politzer) TTh 4:15-6:05


265A. 3 units, Sum (Staff) by arrangement

265B. 2 units, Aut (Kuhn) T 4:15-6:05
265C. 2 units, Win (Kuhn) T 4:15-6:05
265D.* 2 units, Spr (Kuhn) T 4:15-6:05

266A,B. Curriculum and Instruction in Physical Education—Major emphasis on knowledge of the activities basic to school physical education and athletic programs. Also involves teaching techniques, curricular materials, and evaluation. Theoretical and practical training.

266A. 3 units, Sum (Staff) by arrangement
266B. 2 units, Aut (Nixon) F 8-10

267A,B. Curriculum and Instruction in Science—Examination of possible objectives of secondary science teaching and related methods; selection and organization of content and instructional materials; laboratory and demonstration techniques; evaluation, tests; curricular changes; ties with other subject areas.

267A. 3 units, Sum (Staff) MTWTh 3:15
267B. 2 units, Aut (Staff) TTh 4:15-6:05

268A,B,C. Curriculum and Instruction in Social Studies—Emphasis on the methodology of social studies instruction; review of curriculum trends; survey of teaching materials; opportunities to develop teaching and resource units.

268A. 4 units, Sum (Gross) MTWTh 3:15-5:05
268B. 2 units, Aut (Gross) TTh 4:15-6:05
268C. 2 units, Spr (Gross) given 1976-77 (For Social Studies Minors)

270. The Preparation of Teachers—An examination of teacher preparation for elementary and secondary school problems with current practices, and possible new directions.

3 to 4 units, To Be Arranged

271. Topics in Applied Linguistics—(Same as Linguistics 271.) Topics for 1975-76 include: choice of medium of instruction in multilingual societies, bilingual education, problems of non-standard varieties, and language standardization. May be repeated for credit. Prerequisite: 10 or equivalent.

4 units, Win-Hernandez-Chavez TTh 11-12:50

277. Human Physical Performance Research—Emphasizes relevant literature and laboratory research experience. Prerequisite:

* This course requirement may be waived at the discretion of the instructor.
177 or equivalent. Limited to A.M. Candidates majoring in Physical Education.

3 units, Aut (Ruff) TTh 8:30–10

282. Linguistics and the Teaching of English as a Foreign/Second Language — (Same as Linguistics 270.) Linguistic aspects of the problems of teaching English to speakers of other languages, and standard English to speakers of other dialects. Prerequisite: introductory course in linguistics or consent of instructor.

3 units, Spr (F. Politzer) MWF 10

291. Methods of Teaching German — (Same as German Studies 302.)

2 units, Spr (Mahroh) TTh 11

292. Methods of Teaching Spanish — (Same as Spanish 301.)

2 units, Spr (Petersen) TTh 11

Sum (Petersen) MTWThF 11 (short term)

293. Methodology Course — (Same as French 289.) Analysis and discussion of classroom practices and related pedagogical material in the context of the rationalist direct method of teaching French language.

4 units, Aut (Hester) Th 10 and by arrangement

295. Language Laboratory Techniques — (Same as Language Laboratory 215.) All aspects of such labs are covered, from administration and equipment selection to operation of recording and playback equipment. Assumes no prior electronics or instrumentation experience.

2 units, Spr (Metcalfe) TTh 1:15

Sum (Metcalfe) MTWThF 11 (short term)

297X. Overview of Reading Instruction for the Public Schools — General survey of elementary school reading instruction, including phonics as an approach to word identification. Introduction to reading in secondary school subjects and to remedial reading. (Limited to Secondary Interns.)

5 units, Win (Staff) MW 7–9

298. Practice Teaching in a Second Language or Bilingual Education in the Elementary School.

1 to 2 units, Aut, Win, Spr (Politzer) by arrangement

299. Children's Literature — General survey of children's literature for both pre-school and elementary school years.

3 units, Spr (Iverson) MW 4:15–5:30

314. Seminar in Citizenship Education — A seminar for experienced teachers, administrators, curriculum workers, and other school personnel. Includes a topical consideration of projects and research related to the problems of educating responsible citizens for a free society.

4 units, Spr (Gross) given 1976–77

317. Introduction to Research on Teaching — Introduction to theory, methodology, and substantive findings of research on teaching and teacher education. Prerequisites: Education 215, Education 250 or equivalent.

2 to 4 units, Aut (Gage) MW 4:15–6:05

340. Curriculum Theories and Curriculum Change — An examination of alternative conceptions of curriculum theory with special attention to competing value positions and to the techniques employed in curriculum development. Students will formulate searchable problems in general curriculum.

4 units, Aut (Eisner) MW 9–11

342A, B. Curriculum Construction — A practicum in the design of curriculum materials. Each year an interdisciplinary area is chosen and materials developed for teaching it. The topic and age level change from year to year. All phases of curriculum planning and evaluation are covered. Prerequisite: 340.

3 to 4 units, Win, Spr (Walker) MW 1:15–3:05

346. Teacher Education: An Urban Cross-Cultural Emphasis — The course will be designed to offer maximum benefit to doctoral students in Curriculum and Instruction—Teacher Education as well as doctoral students from other areas whose eventual careers or research might be concerned with teacher education. The course content will draw upon the literature in urban education as a mode of analysis for examining past or current models of teacher education programs. Both preservice and inservice teacher education will be included in the course content. Special emphasis will be placed on the design, content, activities and evaluation of teacher education programs especially suitable for urban areas with a cross cultural emphasis. Students will be encouraged to pursue their special interests, i.e., design, content, activities or evaluation,
in the form of a field experience. The student will then use this experience to develop an in-depth analysis focusing on the strengths and weaknesses of what is observed in the field.

4 units, Sum (Deslonde) TTh 10–12

347. Problems of Teacher Education—The course is designed to enable students to formulate researchable problems and promising methods for the study of teaching. It will also examine some of the current issues affecting contemporary teachers, such as competency based teacher education, voucher systems, the influence of packaged curricula, and other such educational developments.

3 to 4 units, To Be Arranged

349. Professional Education of Teachers—For doctoral candidates interested in studying programs and procedures for teacher education.

4 units, Sum (Bush) given 1976–77

354. Planning Educational Evaluations—Intended for doctoral students near the end of course work who expect to play responsible roles in evaluation of instructional programs. Lectures on representative evaluations, criteria of effective evaluation, data collection, etc. Each student develops a detailed plan for an evaluation. Enrollment limited; application for admission required during October. In admitting students, priority will be given to those with training in research method through Education 250B and with an orientation to curriculum problems.

3 to 4 units, Win (Cronbach) MWF 10–11:30

356. Seminar in Physical Education Research—Critique of selected recent literature and research.

3 to 4 units, Aut (Nixon) M 8–10, W 8–9 and by arrangement

357. Seminar in Physical Education Curriculum—Research in physical education curriculum and instruction.

3 to 4 units, Win (Nixon) M 8–10; W 8–9 and by arrangement

358. Special Assignments, Physical Education—An opportunity for the graduate student to undertake the study of a significant problem in physical education or to engage in applied or basic research under the direction of the instructor.

3 to 5 units, Win (Nixon) by arrangement

359. Seminar in Physical Education (Motor Learning)—Review of research concerning movement behavior, motor skills, motor learning, motor educability, and perceptual-motor acts related to sport, dance, designed exercises, and movement exploration in the physical education curriculum.

3 to 4 units, Spr (Nixon) MWF 8 and by arrangement

377. Research Seminar on Human Physical Performance—Recent research in physical education, sports medicine, physiology and related fields concerning man's ability to adapt to various forms of environmental stress while engaging in sports, dance, and designed exercise. Prerequisites: 177 and 277, or equivalent. Consent of instructor required.

4 units, Spr (Ruff) by arrangement

380. Curriculum Development in the Visual Arts—This course will be devoted to the application of curriculum theory to the construction of visual and verbal materials designed to increase students' ability to perceive, respond to and create visually expressive form. Students will work individually and in teams to develop curriculum material focused on particular aspects of artistic learning.

4 units, Spr (Eisner) W 7–10 and by arrangement

382. Current Practices in Bilingual-Bicultural Education—An examination of current teaching methodologies for elementary and secondary bilingual-bicultural education. Special emphasis on testing, evaluation and curriculum. Projects involving practical issues will be described and discussed by professional educators of the Bay Area Bilingual Education League.

2 units, Win, Spr (Staff) Th 12–2

383. Recent Developments in Foreign Language Education—Second Language Teaching in the context of Bilingual Education and Cultural Pluralism. Concerns with student variables and problems of individualization of instruction. Description and evaluation of linguistic and cultural objectives.

3 units, Spr (Politzer) T 4:15–6:05 and by arrangement

4 units, Win (Politzer) MW 4:15-6:05

386. Linguistic Theories of Language Acquisition and Language Teaching—Discussion of structuralism, syntactically and semantically based generative grammars and pragmatics as the basis of theories of language acquisition. Theories of language acquisition, developmental psycholinguistics, contrastive analysis and error analysis and their relation to second language teaching. Prerequisite: at least one graduate course in linguistics theory and/or psycholinguistics.

3 units, Win (Politzer) Th 4:15-6:05 and by arrangement


4 units, Aut (Politzer) MW 4:15-6:05

390. Recent Developments in Elementary School Mathematics—Purposes and program of mathematics in elementary schools; teaching materials, methods. For experienced teachers, supervisors, administrators only.

2 to 3 units, Spr (Begle) given 1976-77

391. Recent Developments in Secondary School Mathematics—Purposes and program of mathematics in secondary curriculum; teaching materials, methods. For experienced teachers only.

2 to 3 units, Spr (Begle) given 1976-77

392. Tutorial on Problems in Mathematics Education—Discussion of special problems of current interest in mathematics education. Prerequisite: consent of instructor.

2 to 4 units, Aut (Begle) given 1976-77


3 to 4 units, Win (Gross) given 1976-77

419. Seminar in Research on Teaching—A critical examination of research on teacher behaviors and characteristics considered as either dependent or independent variables. Prerequisite: Education 317.

3 units, Win (Gage), MW 3:15–5:05 alternate years, given 1976-77

440. Seminar in Bicultural Education—A seminar examining selected issues, topics and sources in bicultural forms of education. Prerequisite: Education 382.

3 units, Win, Spr (Staff) Th 2:15–5:05

459. Seminar on Physical Education Issues—Selected issues and problems in physical education.

3 to 4 units, Spr (Nixon) MW 9 and by arrangement

461A. Seminar in Art Education for Doctoral Students—This seminar provides an opportunity for doctoral students in Art Education to examine and critique specific research studies, reports, and theoretical materials published in the field and to present for group critique ideas and proposals that are being considered for doctoral dissertations.

Students will assume a major responsibility in the selection of the content for the seminar and for the ways in which the content is examined. The seminar is open to doctoral students in the School of Education who have a serious interest in understanding the role of the arts in education. Consent of the instructor is required.

2 to 4 units, Win (Eisner) by arrangement

463A, B, C. Seminar for Doctoral Students in the Design and Evaluation of Educational Programs—These seminars are intended for doctoral students in the Design and Evaluation of Educational Programs. Each quarter will focus on the problem or theme of special interest to the staff responsible.

2 to 4 units, Aut (Walker and staff) by arrangement

Win (Staff) by arrangement

Spr (Eisner and staff) by arrangement

4 units, Spr (Politzer) MW 4:15-6:05

492. Seminar in Mathematics Education—Discussion of recent research in mathematics curriculum and instruction. For advanced students. Consent of instructor required.

2 to 3 units, Aut, Win, Spr (Begle) given 1976-77

496A.B. Seminar in Social Studies Education—A continuing seminar in social studies education for advanced degree candidates. A comprehensive analysis of social studies education for the purpose of identifying researchable problems.

496A. The historical development of social studies education; analysis of the social, curricular, and instructional theories of the various contemporary schools of thought in the social studies.

1 to 4 units, Win (Gross) given 1976-77

496B. The identification of researchable problems in the social studies and the development of an appropriate design for conducting the research.

2 to 4 units, Spr (Gross) given 1976-77

INTERNATIONAL DEVELOPMENT EDUCATION (SIDEC)

106. Education as Cultural Colonialism—The course reviews theories of imperialism and colonialism and relates them to the role of formal schooling in Third World countries and in the high income countries themselves. Special emphasis is placed on assessing the traditional view of schooling as contributing to social and personal development. A model of societal transformation based on imperial and colonial relationships is introduced. Case studies of British and French imperialism in Africa, Asia, and Latin America, as well as internal colonialism in the United States and in the classroom are discussed.

3 units, Spr (Carnoy) T 7:30-9:30 p.m. and by arrangement

161. Introduction to Teaching and Learning in Asia—Designed for students preparing for transcultural living and teaching experiences in Asia. Through a variety of academic and practical experiences the course seeks to develop (1) knowledge of Asian languages, history and culture; (2) understanding of the implications of working or studying in an Asian community; (3) skills which will facilitate effective teaching and/or learning in a transcultural context; and (4) awareness of how one's own attitudes, values and behavior are shaped during the process of growing up in a Western culture.

3 to 7 units, Spr (Herring) Th 7-10 p.m. and by arrangement

206A,B,C,D. Problems of Development Education in Southeast Asia—This course is designed as a workshop throughout the year for students in the International Development Education Fellowship Program and, with the consent of the instructor, other interested students.

5 units, Aut, Win, Spr (Bock) MTh 9-11 and by arrangement

5 units, Sum (Bock) TTh 9-11 and by arrangement

207A,B,C,D. Problems of Development Education in Latin America—This course is designed as a workshop throughout the year for students in the International Development Education Fellowship Program and, with the consent of the instructor, other interested students. In the autumn it will deal with the general problem of education in Latin America; in the winter, with educational planning and evaluation models; and in the spring and summer, with a topic of broad common interest to the Fellows in preparation of background material for the annual Fellowship Program Conference.

3 units, Aut, Win, Spr, Sum (Carnoy) M 12-2 and by arrangement

208. Personality and Social Structure—(Same as Sociology 211.) Lectures and discussion of leading ideas, theories, and research on the relations of personality and social systems, with special emphasis on the ways in which personality modes influence the functioning of institutions. Among the issues reviewed are suicide, juvenile delinquency, recruitment to and performance in school and job, socialization, and political participation. Undergraduates with some background in personality theory or socio-
logical analysis will be accepted. Enrollment limited to sixty-five.

3 to 5 units, Win (Inkeles) TTh 3:15-5:05

212. The Politics of Educational Innovation: Comparative Analysis—This course will focus on innovations designed to enhance "equality of educational opportunity," and will analyze the political processes involved in the initiation, implementation, or rejection of those innovations. The lectures will present a conceptual framework for the analysis of innovation politics, and a comparative analysis of politics of educational innovation in three countries: (a) Great Britain; (b) West Germany; and (c) the United States. Students are encouraged to pursue individual studies on comparable case material to broaden the empirical basis for the course's discussion periods.

3 to 5 units, Sum (Staff) given 1976-77

214. Evaluative Research Methods for Math Media Projects in Developing Countries. (Same as Communications 257.)

3 to 5 units, Spr (McAnany, Hornik) F 1:15-3:05 and by arrangement


3 units, Aut (Bock) W 12-2 and by arrangement

229B. Research Colloquium in International Development Education—A colloquium for the discussion of research proposals and findings of students and faculty in the area of International Development Education. Emphasis is placed on common research preparation experience, and upon basic and remedial methodological training.

3 units, Win (Textor) Th 12-2 and by arrangement

229C. Research Colloquium in International Development Education—Continuation of 229B. Ecological and demographic aspects of development will be stressed. Students will be encouraged to relate these aspects to other crucial aspects of the development process, and to sketch plans for the utilization of education in helping to resolve ecological and population problems in the total context of development-relevant needs, demands, and constraints. Selected research literature on population socialization and on population or environmental education will be critically reviewed.

3 units, Spr (Textor) Th 12-2 and by arrangement

254. Anthropological Research Methods with Implications for Education—(Same as Anthropology 192.) This course is intended for students whose research plans call for substantial employment of anthropological research methods, especially where the research will concern educational processes, practices, or problems. Some attention will be given to ethnomethodological and formal comparativist approaches, but primary attention will be devoted to ethnographic methods and techniques, such as the collection of genealogies and life histories, the interviewing of key informants in depth, and various forms of participant observation. The coordination of such ethnographic approaches with more structured approaches will also be stressed. Students will be expected to participate in role-playing or other simulated field situations designed to develop empathy and sensitivity to overt and covert feedback. Students will be encouraged to collect and analyze their own field data.

4 to 7 units, Win (Textor) Th 7-10 and by arrangement

274A,B,C. Cross-Discipline Seminar: Decision-making in International Development—(Same as Engineering 297A,B,C, Political Science 140A,B,C, and Social Thought and Institutions 197A,B,C.) How engineering, education and government interact with problems of population, food, natural resources, energy, technology, and human values. Decision-making and the concept of interdependence—between man and man, between man and environment, between nation and nation and between present and future generations. Autumn: Definition of the global and national problems related to human survival utilizing specialists from several academic disciplines. Winter: Focus upon the ethics of development and strategies for changes. Spring: Concentration on the role of the individual in his own society. (The course may be taken for 1 unit pass/fail or more graded units with an individual project.)

1 to 3 units, Aut, Win, Spr (McWhorter, Textor, North, Cooper, Falcon, Linvill, Lusignan, McAnany) M 7:30-9:30 p.m. and by arrangement
306A. Education and Economic Development—An introduction into the analysis of the role of education in economic growth and development. Case material will consider development problems both in the U.S. and abroad. Discussion sections will deal with special economic aspects of educational development.

4 to 7 units, Aut (Carnoy) TTh 2:15-4:05 and by arrangement

306B. Education and Political Development—(Same as Political Science 116.) An introduction to the comparative analysis of the relations between educational and political systems. The lectures and discussion sections will deal with (a) problems of political socialization and recruitment, and (b) the politics of educational development and innovation.

4 to 7 units, Win (Bock) TTh 1:15-3:05 and by arrangement

306C. Education and Sociocultural Change—(Same as Anthropology 238.) This course examines the role of education in modernization from a cultural and social-structural perspective, relying on theories of social and cultural change and on case material from modernizing areas both outside and inside the U.S. The concept of "development" is analyzed in both pan-cultural and culture-specific terms. Role-playing, and other experiential techniques will complement a lecture-and-discussion format.

4 to 7 units, Spr (Textor) TTh 2:15-4:05 and by arrangement

307. Non-Formal Education: An Examination of Alternatives to Schooling in Western and Non-Western Societies—This course will investigate the distinction between education and "schooling," and examine the capabilities of formal schooling to effectively meet the needs of non-Western societies while preserving the cultural integrity of both indigenous cultures and sub-cultural minorities. An attempt will be made to explore viable, innovative non-formal alternatives to schooling. The course will utilize instructional strategies incorporating and reflecting the basic content of the course.

3 to 5 units, Spr (Bock) W 9-11 and by arrangement

308. The Social Psychology of Organizational Settings—(Same as Sociology 316.) An exploration of the human response to social climates, this seminar will treat the differential response which individuals and groups make to variation and alteration in the form of social organization in which they are involved. The participants will review available evidence in search of the answer to questions of this type: Do open classrooms increase teacher motivation and foster student development? Does a less restrictive atmosphere in prisons insure fewer riots and lower rates of recidivism? Can cooperative farming give traditional villagers a greater sense of personal efficacy? Settings to be studied will include, among others: schools, colleges, hospitals, factories, co-operative farms, housing developments, and villages. Strong emphasis will be placed on the theory and method for studying organizational climates and for judging the personal response to those climates. Open to graduate students with some preparation in sociology and psychology.

3 to 5 units, Spr (Inkeles) T 4:15-6:05 and by arrangement

309. The Social Psychology of Modernization—(Same as Sociology 315.) Exploration of the impact of political, economic, and socio-cultural change on the individual in developing countries. Review of standard works in the scientific literature, with special emphasis on data from the Project in Social and Cultural Aspects of Economic Development in Six Developing Countries, and presentation of results from research of advanced students. Education, mass communication, community development, technical innovation and political participation are illustrative of the topics on which students work. Enrollment will be limited to fifteen, the selection, if necessary, to be made at the first meeting.

3 to 5 units, Spr (Inkeles) Th 4:15-6:05 and by arrangement

408. Research Seminar on the Comparative Study of Political Socialization—(Same as Political Science 323.) The seminar emphasizes the conceptual and methodological problems involved in studying the role of education as a source of political learning in different cultural and sub-cultural settings. It is based on empirical data from field studies in different cultures and includes some comparative secondary analysis of such data. Requires previous course work in the general
area of political socialization, and facility in
the handling of empirical data.
4 units, Spr (Staff) given 1976–77

MATHMAT hICAL METHODS IN
EDUCATIONAL RESEARCH

250. Introduction to Statistical Methods I—
(Enroll in Statistics 160.) Especially designed
as a nonmathematical study of statistical
methods used in the social sciences, behavioral
sciences, biological sciences, and other
disciplines. Organization of data and methods
of summarization, including averages
and measures of variability and association.
Statistical inference based on a brief intro-
duction to probability theory, including tests
of hypotheses, estimation and confidence in-
tervals.
5 units, Aut (Staff) MTWThF 2:15
Spr (Staff) MTWThF 1:15
5 units, Sum (——) by arrangement

250A,B. Statistical Analysis in Educational
Research I—Designed for graduate students
who expect to use statistical methods in their
research. Foundations of statistical infer-
ence. Review of special hypotheses and test
procedures for the normal distribution.
Nonparametric analysis. Analysis of variance
and design of experiments, simple regression
and correlation, other measures of association.
Prerequisite: This course builds upon the
material of Education 250, so that other
courses will generally not be acceptable as
substitute prerequisites, except by special
permission of the instructor.
4 units, Win, Spr (Olkin) MWF 11–12:30

250C,D. Statistical Analysis in Educational
Research II—Continuation of Education
250B: These two courses may be taken in-
dependently of each other. Prerequisites:
250B or equivalent and consent of instructor.
For scheduling information see specific
course descriptions for 250C and 250D.

250C. Statistical Analysis in Educational
Research II—This course emphasizes mul-
tivariate analysis and applications. Topics
include multivariate normal distribution,
multiple regression, partial and multiple
correlations; linear and non-linear models,
advanced analysis of variance, analysis of
covariance.
4 units, Win (Sitgreaves)
MWF 11:00–12:30

250D. Statistical Analysis in Educational
Research II—This course deals with the
analysis of variance and design of experi-
ments. Topics include factorial, blocked
and fractional designs, linear contrasts,
and repeated-measures designs; applica-
tions of BMD and SPSS computer pack-
gages will also be covered.
4 units, Aut (Calfee) MWF 12:30–2:05
and by arrangement

351A,B. Advanced Statistical Analysis in
Educational Research—Applied multivari-
ate analysis including multiple regression,
canonical analysis, discriminant analysis,
factor analysis, cluster analysis. Prerequisites:
Statistics 220 or equivalent and consent of
instructor.
351A. 4 units, Spr (Sitgreaves) MWF 11–
12:30
351B. Given 1976–77

493A. Seminar in Mathematical Methods in
Educational Research—A continuing sem-
in in special topics in the applications of
statistical methods.
493A. 1 to 3 units, Aut, Win, Spr
(Okin, Sitgreaves) given 1976–77

493B. Practicum in consulting on methodo-
logical problems in educational research.
1 to 3 units, Aut, Win, Spr (Okin,
Sitgreaves) M 3:15–5:05 and by
arrangement

POLITICAL AND ECONOMIC
STUDIES IN EDUCATION

106. Education as Cultural Colonialism. (See
International Development Education.)

110. Introduction to Models in Social Sci-
ence. (See Socio-Humanistic Studies in Ed-
ucation.)

120. Organizational Decision Making. (See
Socio-Humanistic Studies in Education.)

202. Contemporary Problems in Social Insti-
tutions. (See Socio-Humanistic Studies in
Education.)

212. The Politics of Educational Innovation:
Comparative Analysis. (See International
Development Education.)

(See Socio-Humanistic Studies in Educa-
tion.)

220A. The Social Sciences and Educational
Analysis: Introduction to the Economics of Education—An overview of the relationship between education and economic analysis. Specific attention is devoted to investment and consumption theories of education as well as the financing of education. Particular topics include the effects of education on economic growth and the distribution of income as well as taxation for educational purposes. Students who lack training in elementary economics will be required to enroll in a parallel course in economic analysis for one additional unit of credit.

4 to 5 units, Aut (Levin) MW 11–12:30
and by arrangement

220B. The Social Sciences and Educational Analysis: Introduction to the Politics of Education—An overview of the relationship between political analysis and policy formulation in education. Specific focus is given to alternative models of the political process, the nature of interest groups, political strategies, community power and the external environment of organizations, and the implementation of policy. Particular applications to educational settings and problems are emphasized.

4 units, Win (Weiner) TTh 1:15–3:05

222A,B,C. Decision Analysis in Education. (See Administration and Policy Analysis.)

227. Schools and Community. (See Administration and Policy Analysis.)

300. Education and Law—Addressed to major issues of educational policy in terms of their legal and social science aspects. Topics will include integration, decentralization and community control, the allocation of educational resources, federal involvement in education, control of expression and conduct in the schools, conflicts between parent and state over the child's ideological and educational exposure, and the roles of private schools. A recurrent concern will be identifying the meanings of, and evaluating the methods of, achieving educational opportunity. Limited enrollment. Prerequisite: consent of instructor.

3 units, Aut (Levin) T 7:00–9:30 p.m.
and by arrangement

306A. Education and Economic Development—An introduction into the analysis of the role of education in economic growth and development. Case material will consider development problems both in the U.S. and abroad. Discussion sections will deal with special economic aspects of educational development.

4 to 7 units, Aut (Carnoy) TTh 2:15–4:05
and by arrangement

306B. Education and Political Development—(Same as Political Science 116.) An introduction to the comparative analysis of the relations between educational and political systems. The lectures and discussion sections will deal with (a) problems of political socialization and recruitment, and (b) the politics of educational development and innovation.

4 to 7 units, Win (Bock) TTh 1:15–3:05
and by arrangement

313A,B. Economics of Education—Major attention devoted to the "production," distribution, and financing of education; contribution of education to economic growth and development; education and the distribution of income; the role of educational characteristics in labor markets; and the organization of the education industry. Prerequisites: economic theory and quantitative methods, and consent of instructor.

313A. 3 units, Win (Carnoy, Levin) M 7:30–9:30 p.m. and by arrangement

313B. 3 units, Spr (Carnoy, Levin) M 7:30–9:30 p.m. and by arrangement

323A. Education and Public Policy: Federal Education Policy and Administration. (See Administration and Policy Analysis.)

323C. Education and Public Policy: The Governance of Elementary/Secondary Schools. (See Administration and Policy Analysis.)

326A. Topics in Financing Education. (See Administration and Policy Analysis.)

326B. Seminar in Financing Education. (See Administration and Policy Analysis.)

330. Policy Research in the Social Sciences or Policy Analysis in Education. (See Administration and Policy Analysis.)

331. Financing Higher Education. (See Administration and Policy Analysis.)

333. Leadership in Organizations. (See Administration and Policy Analysis.)

363. Evaluation and the Educational Policy Making Process. (See Administration and Policy Analysis.)
408. Research Seminar on the Comparative Study of Political Socialization. (See International Development Education.)

PSYCHOLOGICAL STUDIES IN EDUCATION

136. Behavior Modification: Introduction—(Same as Psychology 139.) Rationale, concepts and issues in application in educational settings. Implementations of behavior change program.
   3 units, Spr (Staff) Th 3:15–5:05 and by arrangement

155. Development of Measuring Instruments—Intended for teachers wishing to improve classroom examinations and for persons planning to develop achievement tests, reasoning tests, or questionnaires for research and evaluation. Planning the test, writing items, item tryout and criticism, qualities desired in tests. Lectures and practical exercises.
   3 units, Sum (Cronbach) TTh 1:15–2:45

215. Psychological Foundations of Education—(Same as Psychology 145.) Introductory course in application of psychological principles to educational practices. The spring quarter offering is planned especially for teachers in training. Prerequisite: Psychology 1 or equivalent.
   4 units, Aut (Cronbach) TTh 3:15–4:30, W 3:15–4:05
   Spr (Gage) TTh 4:15–6:05
   Sum (Staff) MTWTh 10 and by arrangement

230. Foundations of Counseling — Why counseling? Introduction to counseling theories and counselor as applied behavioral scientist. Contemporary social problems, e.g., counter culture, drugs. Personal behavior of the counselor is emphasized. Prerequisite: consent of instructor.
   4 units, Aut (Staff) T 3:15–5:05 and by arrangement
   4 units, Sum (Staff) MW 8–10

231. Counseling in Groups—Basic skills in leading small groups in applied settings (e.g., schools) to effect specific changes in client behavior. Emphasis on group setting as learning environment, establishing individual behavioral objectives, tailoring group techniques and assessing individual client change. Participation as member of counseling group. Prerequisite: consent of the instructor.
   4 units, Win (Thoresen) M 3:15–5:05 and by arrangement

232. Research in Counseling — Evaluation of research studies on attempts to foster student development and to prevent problems. Supervised experience in research activity. Introduction to systems design, research, and evaluation in education. In-basket exercises in systems analysis.
   3 units, Aut (Thoresen) by arrangement

234. Decision Making Competencies—Students are expected to learn and present evidence of competency in helping clients learn how to make decisions wisely and in using test information to help generate alternatives and estimate chances of success.
   3 units, Win (Staff) by arrangement

238A,B,C. Counseling: Supervised Applications—Supervised counseling interventions at Stanford Institute for Behavioral Counseling and in selected field settings. Sequence must begin in Autumn Quarter. For doctoral students in Counseling.
   4 units, Aut, Win, Spr (Thoresen, Staff) W 10–2 and by arrangement

239,A,B. Observation and Directed Teaching of Study Skills and Developmental Reading in College—Two-quarter practicum offering opportunity to participate as observer, tutor-counselor or group instructor in reading and study skills. Weekly seminar and/or conferences with instructor. Prerequisite: consent of instructor.
   2 to 4 units, Aut, Win, Spr (Browning, Staff) by arrangement

244. Issues in Early Childhood Education—(Same as Psychology 243.) This course is designed for graduate students interested in the education and development of the child during the first eight years of life. Philosophies and practices of various current early childhood programs will be reviewed in social, psychological and historical perspective. Such topics as: environments for early learning; teacher-child relationships; the role of curriculum in early childhood development; the effects of federal, state and local legislation on early school programs. The involvement of parents in the education of their children will be explored as well as behavior change, school grouping, early
reading, staffing, budgets, in-service teacher education.

3 units, Win (Staff) By arrangement

251. Laboratory Methods in Educational Research—Introduction to psychological methods of experimentation as applied to problems in education. Research topics will include process areas (perception, memory, verbal and concept learning, cognition) with examples from selected content areas (e.g. reading, mathematics). For graduate students with little or no background in Psychological Studies. Enrollment limited to 20, with preference given to first- and second-year students.

3 units, Aut (Calfee) MWF 9-10

252. Introduction to Test Theory—(Same as Psychology 248.) Concepts of reliability and validity; mathematical models underlying commonly used procedures for test analysis. Test scales and norms. Prerequisite: Education 250 or Psychology 60 or equivalent.

3 to 4 units, Aut (Snow) MW 2:15-4:05

253. Early Education Programs — This course will give students an overview of the historical and psychological bases for early education programs. The following topics will be discussed: Montessori Schools, Head Start, British Infant Schools, Behavior Analysis, Piagetian Influences, Follow-Through, Infant Programs and Day Care. Lectures and discussions will be combined with observations of different early education settings in the field.

3 units, Aut (Ambron) Th 12:00-2:05

255. Human Abilities—(Same as Psychology 155.) The nature, development, and measurement of intellectual abilities. Prerequisites: Psychology 1 and Education 250 or Psychology 60, or equivalent.

3 units, Spr (Snow) MWF 10

311A,B. Socialization of The Young in Contemporary Society—(Same as Psychology 245.) Students in this course will examine the role of the family, public school, preschool, and day care in socializing young children. Particular attention will be given to the processes through which institutions and social structures of the society affect individual behavior. Topics will include: discontinuities and continuities in socialization, diffuse socialization through mass media, variations by social class and ethnic groups in the U.S., national differences (Britain, China, Russia, Israel, Cuba, etc.) which illustrate relationships between socialization and political ideology.

311A. 3 units, Win (Hess) TTh 9 and by arrangement

311B. 3 units, Spr (Hess) TTh 9 and by arrangement

316. Advanced Educational Psychology: Basic Processes—Review of research on perception, learning, and memory processes. Emphasis on research procedures and analysis of problems of school learning. For doctoral students in Psychological Studies. Open to others with consent of instructor.

4 units, Win (Calfee) MWF 9 and by arrangement

317. Introduction to Research on Teaching—Introduction to theory, methodology, and substantive findings of research on teaching and teacher education. Prerequisites: Education 215, Education 250 or equivalent.

2 to 4 units, Aut (Gage) MW 14:15-6:05

338A,B,C. Internship in Counseling—Intensive supervised field experience in local schools or social agencies will be designed to provide the intern with opportunities to design individualized learning environments for the purpose of improving children's decision-making abilities, overcoming maladaptive behavior patterns, and preventing problems. For doctoral students in Counseling.

1 to 6 units, Aut, Win, Spr (Thoresen) by arrangement

350. Critical Analysis of Research Literature in Educational Psychology—An examination of contemporary research in educational psychology and its relevance to educational practice. Emphasis is on broadening student perspectives and on the development of critical skills in reviewing substance and method of current research. For doctoral students in any area of education. Admission by consent of instructor.

3 units, Win (Gage) MW 3:15-5:05

alternate years, given 1975-76

352. Individual Psychological Testing—Instruction and practice in the administration and interpretation of individual tests of intelligence and their use in connection with other diagnostic instruments.

3 units, Spr (Staff) Th 3:15-5:05
353. Problems in Measurement—(Same as Psychology 249.) Survey of alternative mathematical models used in test construction and analysis covering such topics as generalizability theory, measurement of gains, theory of personnel decisions. Prerequisites: Education 250B and 252, or Psychology 152 and 248, or equivalent.

3 to 4 units, Sum (Cronbach) MW 2:15–4:05, alternate years, given 1975–76

354. Planning Educational Evaluations—Intended for doctoral students near the end of course work who expect to play responsible roles in evaluation of instructional programs. Lectures on representative evaluations, criteria of effective evaluation, data collection, etc. Each student develops a detailed plan for an evaluation. Enrollment limited; application for admission required during October. In admitting students, priority will be given to those with training in research method through Education 250B and an orientation to curriculum problems.

3 to 4 units, Win (Cronbach) MWF 10:00–11:30

389. Experimental Psychology of Reading (Same as Psychology 143.)—Review of research literature on the reading process, and acquisition of reading. Emphasis on critical evaluation of process research, and on interaction of psychological, linguistic, and educational aspects of reading. Prerequisite: consent of instructor.

3 to 4 units, Spr (Calfee, Smith) MWF 9 and by arrangement

411. Seminar in Child Development and Early Education—This seminar will provide opportunities for graduate students to discuss professional issues, and to develop and present research ideas and proposals. Current child development and early educational literature will also be reviewed. Prerequisite: consent of instructor.

1 to 3 units, Aut, Win, Spr (Ambron, Hess) Th 2:15–4:05 and by arrangement

415. Seminar in Educational Psychology—Topical seminar for advanced students. Admission by consent of instructor.

1 to 3 units, any quarter (Staff) by arrangement

416. Seminar for Psychological Studies Students—Professional roles and problems of the psychologist working in education. May be repeated for credit. Limited to students in the Psychological Studies doctoral program.

1 unit, Aut (Snow) Th 4:15–6:05 and by arrangement

419. Seminar in Research on Teaching—A critical examination of research on teacher behaviors and characteristics considered as either dependent or independent variables. Prerequisite: Education 317.

3 units, Win (Gage) MW 3:15–5:05 alternate years, given 1976–77

431. Doctoral Seminar in Counseling—Designed for all doctoral candidates in counseling psychology and related areas. Analysis of professional problems. May be repeated for credit. Prerequisite: consent of instructor.

1 unit, Aut, Win, Spr (Thoresen, Zifferblatt) T 7:30–9:30 p.m., biweekly

SOCIO-HUMANISTIC STUDIES IN EDUCATION

105. American Education and Public Policy—This course seeks to introduce undergraduates to social science perspectives in public schools. Who influences education and how? How have American schools responded to human diversity? What consequences does schooling have (e.g., in promoting equality)? What are the prospects for reform in public education? Issues such as these will be analyzed in lectures and in small group discussions. Students may elect to do related fieldwork (for additional credit if desired).

3 units, Aut (Kirst, March, Tyack) Given 1976–77

109A. Cultural Pluralism: Classroom-Curricular Strategies. (See Curriculum and Teacher Education.)

109B. Cultural Pluralism: Classroom-Curricular Strategies. (See Curriculum and Teacher Education.)

110. Introduction to Models in Social Science—(Same as Sociology 271 and Political Science 185.) An introduction to models in social science. Models of choice, exchange, adaptation, diffusion, and structure are used to make predictions in a variety of situations involving human behavior. Emphasis is placed on the invention and application of models more than on the testing of them.

4 units, Aut (March) MW 1:15; sections M 10, 11, or 12

120. Organizational Decision Making—
(Same as Sociology 263 and Political Science 103.) An examination of the process of decision making in modern complex organizations, such as universities, schools, hospitals, business firms, armies, and public bureaucracies. The impact of information, power, resources, organizational structure, and the environment. Alternative models of choice and their implications.

4 units, Win (March) MW 1:15–3:05

200. History of Education—(Same as History 103.) Foundational course in educational history meeting advanced degree requirements. Survey; emphasis upon European backgrounds, educators, schools, covering period from “Golden Age” of Greece to twentieth century.

3–4 units, Aut (Gross) W 7–10 p.m.
3 units, Spr (Gross) Given 1976–77
3–4 units, Sum (Gross) MTWTh 1:15

201. History of Education in the United States—(Same as History 158.) Analysis of selected turning points in education in relation to such topics as religion, political socialization, race relations, immigration, and urbanization.

3 units, Win (Staff) MW 11 and one hour by arrangement

202. Contemporary Problems in Social Institutions—(Same as Sociology 180 and Political Science 280.) An examination of the social structure, process, problems, and ideology of a specific social institution. The institution to be considered varies each year.

4 units, Aut (March) T 7–10 p.m. and by arrangement

203. Models of the Child in Contemporary Educational Thought—This introductory course is intended to focus critical attention on a number of influential views of the child that have been formulated by psychologists, political theorists and philosophers, and to place them in historical and philosophical perspective. The discussions should be of interest not only to those who are specializing in the disciplines mentioned, but also to the teacher and educational administrator. The central themes will be rival environmentalist and hereditary models, deterministic models such as the behavioristic and the Freudian, and developmental models.

4 units, Aut (Phillips) MW 2:15–4:05

Sum (Phillips) MW 2:15–4:05

204A. Introduction to Philosophy of Education—This introductory course will focus on critical analysis of current generative themes and issues in education. Students will develop skills in conceptual analysis through small group discussion and the writing of several short philosophical papers. Major texts include readings from Plato, John Dewey, Paulo Freire as well as several other contemporary philosophical essays.

4 units, Win (Pacheco) MW 10–12

204B. Introduction to Philosophy of Education—The course is aimed at introducing students to current approaches and techniques in philosophy of education, but material has been selected also for its general relevance to students of education. Thus, the introductory philosophical material will be presented in the context of discussions of issues concerning the curriculum; in particular, the unifying theme of the course will be the various ways in which one can approach the selection of curriculum content.

4 units, Sum (Phillips) TTh 2:15–4:05

205. Comparative Ideologies and Education—This introductory course focuses on the philosophical examination of the concept of ideology and related concepts such as indoctrination, socialization, and cultural transmission with reference to early education and schooling. Readings will lead toward analysis of the concept of ideology as well as critical comparative analysis of ideology and educational practice in some representative countries (USA, Soviet Union, China, Israel).

4 units, Spr (Pacheco) Given 1976–77

208. Personality and Social Structure—(Same as Sociology 211.) Lectures and discussion of leading ideas, theories, and research on the relations of personality and social systems, with special emphasis on the ways in which personality modes influence the functioning of institutions. Among the issues reviewed are suicide, juvenile delinquency, recruitment to and performance in school and job, socialization, and political participation. Undergraduates with some background in personality theory or sociological analysis will be accepted. Enrollment limited to sixty-five.

3 to 5 units, Win (Inkeles) TTh 3:15–5:05

210. Research Problems in Sociology of Ed
Education—(Students planning to take this course during the autumn will take Education 310/210; see description under Education 310/210.) Topics include influence of social status on the social structure of schools, on classrooms and on school systems; the school as a formal organization; equality of educational opportunity; and classroom interaction.

4 units, Aut (Cohen) MW 9–11
Sum (——) MTWThF 1:15–2:05

211C. Foundations of Education: Social.
(See Curriculum and Teacher Education.)

216. Cultural Pluralism and Educational Policy—Review of theories affecting educational policy with regard to cultural differences in language, heritage, values, motivation and cognition.
3 units, Sum (Castañeda) MW 11–1 211C. Foundations of Education: Social.

218. Computer Models of Social Behavior—
(Same as Computer Science 127, Political Science 190M, Psychology 154, Sociology 273.) Models of human behavior in social situations. Particular attention is given to specifying simulation models, determining their properties, and testing them. Enrollment is limited to 20. Prerequisites: knowledge of at least one programming language, advanced courses in social science, consent of instructors.

4 units, Win (March, Feigenbaum) M 3:15–5:05, alternate years, given 1975–76

220C. The Social Sciences and Educational Administration: Introduction to the Sociology of Education. (See Administration and Policy Analysis.)

242. Bicultural Processes in Education. (See Curriculum and Teacher Education.)

254. Anthropological Research Methods with Implications for Education—(Same as Anthropology 192.) This course is intended for students whose research plans call for substantial employment of anthropological research methods, especially where the research will concern educational processes, practices, or problems. Some attention will be given to ethnological and formal comparativist approaches, but primary attention will be devoted to ethnographic methods and techniques, such as the collection of genealogies and life histories, the interviewing of key informants in depth, and various forms of participant observation. The coordination of such ethnographic approaches with more structured approaches will also be stressed. Students will be expected to participate in role-playing or other simulated field situations designed to develop empathy and sensitivity to overt and covert feedback. Students will be encouraged to collect and analyze their own field data.
4 to 7 units, Win (Textor) Th 7–10 and by arrangement

301. Colloquium on the Historiography of American Education—Analysis of the literature of American educational history, designed for students who wish to do further work in the field. In addition to weekly colloquium discussions, students will have an opportunity to pursue specialized topics in small group tutorial sessions.
3 to 5 units, Aut (Tyack) Given 1976–77

302. Colloquium on the History of American Urban Education—Historical analysis of bureaucratization, patterns of political control of schools, teachers’ and students’ perceptions of the system, some functions of mass schooling, and strategies for change today. Discussion of primary sources and contrasting interpretations. Enrollment limited to fifteen. Prerequisite: consent of instructor.
4 to 5 units, Spr (Staff) T 7–10 p.m. and by arrangement

303A. Philosophical Analysis: Cultural Pluralism—A topical seminar offering philosophical analysis of an educational problem. This seminar focuses on a critical analysis of the concept of cultural pluralism and related key concepts such as biculturalism, marginality, assimilation, and acculturation, with special reference to education and schooling. Students will explore differing philosophical assumptions implicit in alternative formulations and uses of the concept of cultural pluralism. Limited enrollment, sign-up required.
4 units, Aut (Pacheco) W 7–10 p.m. and by arrangement

303B. Philosophical Analysis: Ethnic Studies—A topical seminar offering philosophical analysis of an educational problem. This seminar explores the role of ethnic studies in the light of the traditional function and uses of the university, including an examination of how ethnic studies have evolved
in the university, the political and philosophical assumptions on which such courses and programs are based, and alternative models for such programs. Special attention is given to Chicano and Black studies. Limited enrollment, sign-up required.

4 units, Win (Pacheco) T 7–10 p.m. and by arrangement

304A. Philosophical and Educational Thought of the Pragmatists—(Same as Philosophy 216A.) The course is an introduction to the influential philosophical and educational writings of C. S. Peirce, William James, and John Dewey. The following topics will be discussed: (1) The philosophy of pragmatism — Peirce on meaning and chance; James on truth and the "biological view of mind"; Dewey on truth, knowledge, body and mind; (2) criticisms of pragmatism, especially those of G. E. Moore and Bertrand Russell; (3) the educational writings of James and Dewey; (4) the contemporary scene: Peirce, Dewey, and Popper; Dewey and the open classroom.

4 units, Aut (Phillips) TTh 2:15-4:05

304C. Philosophical Problems of Education as a Social Science—(Same as Philosophy 216C.) Important philosophical problems arise in the context of methodology and theory in the fields of psychology, sociology, anthropology, political science, and administrative studies. Several of these problems also arise in education, and they form the core of the present course: the possibility of a "science of man," the problem of rationality, holistic versus individualistic explanations (including systems theory, organicism, structuralism, and gestalt versus atomistic psychology).

4 units, Spr (Phillips) MW 1:15–3:05

305. Philosophy and Empirical Research—
This course is intended for those who are doing, or about to do, empirical research in education. Problems of relevance to the researcher will be explored from the point of view of the philosopher of science. During the course, several lucid works by philosophers of science—notably Karl Popper and Carl Hempel—will be discussed, but much of the material dealt with will have been written by researchers themselves.

4 units, Spr (Phillips) TTh 2:15–4:05

306C. Education and Sociocultural Change. (See International Development Education.)

308. The Social Psychology of Organizational Settings—(Same as Sociology 316.) An exploration of the human response to social climates, this seminar will treat the differential response which individuals and groups make to variation and alteration in the form of social organization in which they are involved. The participants will review available evidence in search of the answer to questions of this type: Do open classrooms increase teacher motivation and foster student development? Does a less restrictive atmosphere in prisons insure fewer riots and lower rates of recidivism? Can cooperative farming give traditional villagers a greater sense of personal efficacy? Settings to be studied will include, among others: schools, colleges, hospitals, factories, co-operative farms, housing developments, and villages. Strong emphasis will be placed on the theory and method for studying organizational climates and for judging the personal response to those climates. Open to graduate students with some preparation in sociology and psychology.

3 to 5 units, Spr (Inkeles) T 4:15-6:05 and by arrangement

309. The Social Psychology of Modernization. (See International Development Education.)

310/210. Research Problems in Sociology of Education—(Same as Sociology 341.) A course for both doctoral and master's level students. Lectures are the same, but assignments and discussion sections are separate. 210 is designed for students who would like to be consumers of research in sociology of education and be able to evaluate critically what they read. Education 310 is designed for the student who would like to produce research and wishes to know how to pose critical questions for applied research. Doctoral candidates who have never had background in research in behavioral or social sciences and who intend to carry out a dissertation using social science techniques, are advised to attend both sections. They may arrange for up to 6 units of credit. The course will give the student acquaintance with selected sociological concepts, theories and their application to critical applied problems in the field of sociology of education. The instructor will analyze educational problems from the perspective of status, norms, social structure and social interaction. These con-
cepts will be applied to problems of school organization, classroom interaction, ways in which the societal stratification system is reinforced by the social structure of the school, and the relationship between the technology and structure of teaching. Concepts and analysis will be presented in a form, applicable to settings other than the United States contemporary educational scene, i.e. there will be a strong cross-cultural emphasis. The consistent emphasis of the course is on learning about suitable conceptualization and methodology of applied research.

4 to 6 units, Aut (Cohen) MW 9-11

312A. The Low Status Student: Race and Social Class—(Same as Sociology 342A.) This course provides an attack on a problem of great contemporary interest in education from the point of view of sociological theory, research, and analysis. The relationship of research to policy formulation will be stressed. Relevant sociological theory and research will be covered from the areas of stratification, socialization, and race relations. Applications to “education for the disadvantaged” will be made. Because students must be prepared to contribute analyses and research formulations in class presentations, Education 310 or its equivalent is a prerequisite.  

4 units, Spr (Cohen) M 7-9 p.m. and by arrangement

312B. Interaction Processes in Education—(Same as Sociology 342B.) With increased use of group work as a classroom technique and the new developments in team teaching, the educational researcher can benefit from selected theory and research by sociologists and social psychologists in the small group setting. Topics will include the social processes of evaluation, influence, and role differentiation. The student should acquire skills in selecting theory and research from a heterogeneous behavioral science area that has some promise for problems in the educational setting. Methods for studying interaction in educational settings will be included. The course will involve some field work in observation and scoring of small groups in the educational setting. Because students must be prepared to contribute analyses and research formulations in class presentation, Education 310 or its equivalent is a prerequisite.  

4 units, Spr (Staff) TTh 3:15-5:05

315. Cultural Transmission—(Same as Anthropology 266.) Education in cross-cultural perspective: transmission of values; transmission of covert culture, implicit cultural assumptions; adolescent education; case studies of teachers in American schools. For advanced graduate students in education, anthropology, other behavioral sciences. Prerequisite: consent of instructor.  

5 units, Aut (Spindler) T 7-10 p.m. and by arrangement

327. Survey Design and Analysis—(Same as Sociology 385.) A basic course in the design of survey for social science research, including educational problems. Topics include: basic research cycle and judgments about when surveys are appropriate; variable language and indicators; construction of questionnaires (including simple indexes); strategies for interviewing and for mail questionnaires. A data analysis clinic will begin at the first of the course using existing data and will continue throughout the course. Prerequisite: basic statistics course.  

5 units, Aut (Staff) by arrangement

328. Change and Innovation Processes in Complex Organizations. (See Administration and Policy Analysis.)

330. Policy Research in the Social Sciences and Education—An analysis of the ways social science can be used to aid in policy decisions, especially in complex organizations and educational areas. The focus is on the marshalling of social science evidence and research that can be used to make practical policy decisions. Areas of concern include: problem identification and definition; searching for relevant, manipulable variables; gathering research upon which decisions can be made, offering alternative policy recommendations based on the same data; determining political and/or educational consequences of various recommendations. Students will work in teams, each selecting a different area for policy analysis.  

4 units, Spr (Staff) by arrangement

333. Leadership in Organizations. (See Administration and Policy Analysis.)

381. Practicum in Cultural Pluralism—The practicum will consist of two components. At designated intervals the practicum will include lectures by cooperating members of the faculty and professional educators in the area. The second component will require
the individual student to visit a school program which is in line with his or her interests and to discuss observations in the practicum.

3 units, Aut, Win, Spr (Castañeda)
MW 9:00–10:30

400. Seminar in History of Education—A seminar examining selected issues, topics, and sources in the history of education outside of the United States.

3 units, Win (Gross) given 1976–77

401B. Seminar in the History of American Education: Urban Education — Research seminar, focusing in 1975 upon urban school systems. Students will write and discuss seminar papers. Prerequisite: 302, which should normally be taken during winter quarter.

4 to 5 units, Spr (Tyack) Given 1976–77

404. Seminar in the Philosophy of Education — A seminar designed for majors in philosophy of education; others admitted on consent of instructor. In the autumn the seminar will focus on the philosophical analysis of the concepts of equality, equality of opportunity, and equal educational opportunity. In the winter, the seminar will focus on contemporary controversies in philosophy of education and on methodological issues. Recent articles in leading philosophy of education journals, and recent books, will be discussed. The aim will be to throw light on the types of arguments used and their validity, and the philosophical traditions which they appear to tap.

4 units, Aut (Pacheco) Given 1976–77
Win (Phillips) Given 1976–77

405. Philosophy and Theory — (Same as Philosophy 215.) An advanced seminar which focuses on philosophy of social science, including an examination of the bases for social science in the philosophical tradition. Readings will include the works of Plato, J. S. Mill, Marx, Weber, and Durkheim, as well as recent critiques of the relationship of philosophy to contemporary sociological theory. Prerequisite: consent of instructor.

4 units, Spr (Pacheco) T 7–10 p.m.

418A,B,C. Advanced Research in Organizations I, II, III—(Same as Sociology 365A,B,C and Political Science 304A,B,C.) A research seminar for advanced graduate students. Emphasis is placed on developing original theoretical formulations of major concepts in organization theory. Prerequisites: advanced courses in organizations, research methods, consent of instructor.

4 units, Aut, Win, Spr (March, Staff) by arrangement

SPECIAL COURSES, INDEPENDENT STUDY, DIRECTED READING, PRACTICA, RESEARCH, DISSERTATION

180. Directed Reading in Education—For Master's degree students.
2 to 4 units, any quarter (Staff) by arrangement

190. Directed Research in Education—For Master's degree students.
2 to 4 units, any quarter (Staff) by arrangement

375X. Organization and Style in Research Writing—Some major considerations in preparing formal reports of scholarship and inquiry, including doctoral dissertations. Emphasis on organization; the achievement of clarity; technical, ethical and legal matters in using quotations and copyright materials; preparation of figures and tables; alternative conventions in citations references, bibliographies and appendices; stylistic practices.

2 units, Win (Coladarci) given 1976–77

Any quarter (Staff) by arrangement

470. Practicum—For advanced graduate students.
By arrangement

480. Directed Reading—For advanced graduate students.
By arrangement

490. Directed Research—For advanced graduate students.
By arrangement
SCHOOL OF ENGINEERING

Dean: William M. Kays
Associate Deans: James L. Adams (Academic Affairs), John G. Linvill, L. Farrell McGhee, Robert L. Street (Research), Lauress L. Wise (Student Relations)
Assistant Deans: Kenneth S. Down, Edwin F. Laak
Secretary of the Faculty: James Douglas
Consulting Professor of Engineering: Hans M. Mark, Chauncey Starr

The School of Engineering offers four-year undergraduate programs leading to the degree of Bachelor of Science, or in the case of Architecture the Bachelor of Arts; five-year programs leading to both Bachelor of Science and Master of Science degrees; others leading to a Bachelor of Science with a Bachelor of Arts in a field of humanities or social science; dual degree programs with certain other colleges; and graduate curricula leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy.

The School includes nine academic departments: Aeronautics and Astronautics, Chemical Engineering, Civil Engineering, Electrical Engineering, Engineering-Economic Systems, Industrial Engineering, Materials Science and Engineering, Mechanical Engineering, and Operations Research. These departments are responsible for graduate curricula, research activities, and the departmental components of the undergraduate curricula. In research, where faculty interest and competence embraces both engineering and the supporting sciences, there are not only numerous programs within the School, but also there are several inter-School activities, including the Microwave Laboratory, the Center for Materials Research, the Institute for Plasma Research, the Radio Astronomy Institute, the Joint Institute for Aeroacoustics, the Institute for Electronics in Medicine, the Institute for Energy Studies, and the program in Product Design. An undergraduate program in Architecture is offered in the Department of Mechanical Engineering. In addition, Petroleum Engineering is offered through the School of Earth Sciences.

Instruction in engineering is offered during the autumn, winter, and spring quarters of the regular academic year. During the summer quarter a few undergraduate and graduate courses are offered.

UNDERGRADUATE ADMISSION

Students admitted to the University may declare a major in the School of Engineering if they elect to do so; there are no additional procedures, course requirements, or examinations for admission to the School.

PREPARATION RECOMMENDED FOR FRESHMEN

Students who enter as freshmen intending to major in engineering should take mathematics in high school to as high a level as is offered. (See page 416 for information on advanced placement in mathematics.) High school courses in physics and chemistry are strongly recommended but not required. Additional elective course work in English is also recommended.

PREPARATION RECOMMENDED FOR TRANSFER STUDENTS

Students who do the early part of their college work elsewhere and then transfer to Stanford to complete their engineering programs should follow an engineering or pre-engineering program at the first school, selecting insofar as possible courses applicable to the requirements of the School of Engineering, i.e., courses comparable to those discussed under “Undergraduate Programs of Study.” Some transfer students may require more than four years to obtain the B.S. degree. However, Stanford affords great flexibility in planning and scheduling individual programs, which makes it possible for transfer students having wide variations in preparation to plan full programs for each quarter and to progress toward graduation without undue delay.

Transfer credit will be given for courses taken elsewhere whenever the courses are equivalent or substantially similar to Stanford courses. The policy of the School of Engineering is to study each transfer student's preparation and make a reasonable evaluation of the courses taken prior to transfer. Inquiries may be addressed to the Dean of Engineering at Stanford.
THE UNDERGRADUATE COUNCIL

Responsibility for undergraduate curricula and for undergraduate courses designated "Engineering" has been delegated by the faculty of the School of Engineering to its Undergraduate Council. The Council is made up of faculty members with special interests in undergraduate education, most of whom teach undergraduate courses and advise undergraduate students. The Council approves curricula, supervises course offerings, initiates new courses, and recommends students for the degree of Bachelor of Science in General Engineering.

UNDERGRADUATE PROGRAMS OF STUDY

The principal objective of the undergraduate engineering curriculum is to provide opportunity for personal maturity and intellectual growth, for the attainment of professional competence, and for the development of social responsibility. The curriculum is quite flexible and decisions on individual courses, in general, are left to the student and the adviser. For a student with a well-defined educational goal, there is a great deal of latitude.

CURRICULUM COMPONENTS

As an aid in program planning, the curriculum is described in terms of 10 components: Writing, Humanities and Fine Arts, Social Sciences, Technology and Society, Mathematics, Science, Engineering Breadth, Engineering Depth, Free Electives, and the requirement of "Functional Balance" (see p. 91). By planning these components carefully and taking full advantage of the available advising services, a student can arrange a strong program to meet any one of a wide variety of educational objectives. Engineering majors are offered in three categories: Departmental Majors, Interdisciplinary Majors, and Innovative Majors. An Engineering and Society program is offered for those seeking a broad integration of engineering, science, and societal subjects.

Engineering students are subject to the University requirements outlined in the first pages of this bulletin. (The requirement in the area of mathematics, natural sciences, and technology will be satisfied automatically by the engineering program). Students who qualify for advance placement will receive credit toward fulfillment of the Engineering mathematics and science requirement.

Writing

Two courses of instruction in written composition are required by the University for graduation, except that some students may be exempt from all or part of this requirement (see the first section of this bulletin for details).

Humanities and Fine Arts

Three courses of at least 3 units each are required by the University for graduation (see the first section of this bulletin for details).

Social Sciences

Three courses of at least 3 units each are required by the University for graduation (see the first section of this bulletin for details).

Note: The School of Engineering requires that the total number of Humanities & Fine Arts and Social Sciences units be at least 23.

Technology and Society

Every engineer should have an appreciation of the role of technology in society in order to make the value judgments he or she must make as a responsible citizen-engineer. While this appreciation is gained in many ways, every engineering student is expected to take at least two courses specifically directed to the problems of technology and society (equivalent directed study or work outside the University is acceptable). A list of courses in this category is available from the office of the Dean of Engineering.

Mathematics (21 units minimum)

Engineering students need a solid foundation in the calculus of continuous functions, an introduction to discrete mathematics, and understanding of statistics or probability theory. The minimum preparation should normally include work to the level of Mathematics 43. Knowledge of ordinary differential equations and matrices is important in many areas of engineering, and students are encouraged to select additional courses in these topics. A list of courses appropriate for satisfying the Engineering mathematics requirement is available in the office of the Dean of Engineering.
Science (24 units minimum)

A strong background in the basic concepts and principles of physical science such as physics, chemistry, and biology is essential for engineering. The basic physics sequence beginning with Physics 51 normally is chosen by engineering students. An alternative to the mechanics covered in Physics 51 and Engineering 12 is the sequence Engineering 3, 4, and 5. These courses are aimed at giving the student contact with engineering during the first year. A list of courses appropriate for satisfying the Engineering science requirement is available in the office of the Dean of Engineering.

Engineering Breadth (30 units minimum)

Every undergraduate engineering program includes coursework selected from a variety of engineering disciplines.

Accordingly, each student chooses a minimum of 30 units of courses from at least five of the eight categories listed below. No more than 10 units in any one category can be counted toward satisfaction of the breadth requirement. On recommendation from his/her adviser, a student may request substitutions to this list by submitting a petition to the Curriculum Committee of the Engineering Undergraduate Council.

1. Mechanics of Solids and Fluids

* Completion of E3, 4, 5 is equivalent to having taken Physics 51 and E12; completion of only E3 or E3 and 4 does not allow exemption from either Physics 51 or E12. Credit toward the engineering science and breadth requirement is as follows: completion of E3 (1 unit of science, 2 units of breadth in Cat. 1); completion of E3, 4 (2 units of science, 4 units of breadth in Cat. 1); completion of E3, 4, 5 (4 units of science, 5 units of breadth in Cat. 1).

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Engr. 4</td>
<td>Applied Mechanics II</td>
<td>*</td>
</tr>
<tr>
<td>Engr. 5</td>
<td>Applied Mechanics III</td>
<td>*</td>
</tr>
<tr>
<td>Engr. 11</td>
<td>Applied Mechanics: Stress Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 12</td>
<td>Applied Mechanics: Dynamics</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 21</td>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>Chem. Engr. 140</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 140L</td>
<td>Fluid Mechanics Demonstration Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Mech. Engr. 33</td>
<td>Introductory Fluids Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Physics 110</td>
<td>Intermediate Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

More Advanced Courses

- Civil Engr. 107. Mechanics of Fluids
- Civil Engr. 114. Mechanics of Materials
- Mech. Engr. 131A. Thermosciences
- Physics 111. Intermediate Mechanics

2. Electromagnetism, Electric Circuits, and Devices

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Engr. 41N</td>
<td>Circuits</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 42N</td>
<td>Electronics</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 43</td>
<td>Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 44</td>
<td>Basic Electronics</td>
<td>5</td>
</tr>
</tbody>
</table>

More Advanced Courses

- Elec. Engr. 101. Circuits I
- Elec. Engr. 111. Electronics
- Elec. Engr. 141. Electromagnetic Fundamentals
- Physics 120. Intermediate Electricity and Magnetism

3. Thermodynamics

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Engr. 32</td>
<td>Introduction to the Thermosciences</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 171</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat. Sci. 181</td>
<td>Thermodynamics and Phase Equilibria</td>
<td>4</td>
</tr>
<tr>
<td>Physics 170</td>
<td>Thermodynamics, Kinetic Theory, and Statistical Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>

More Advanced Courses

- Mech. Engr. 131C. Thermosciences

4. Materials Science and Properties

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 50</td>
<td>Introductory Science of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Mat. Sci. 180</td>
<td>Atomic Arrangements in Solids</td>
<td>4</td>
</tr>
<tr>
<td>Mech. Engr. 111</td>
<td>Stress, Strain, and Strength</td>
<td>3</td>
</tr>
</tbody>
</table>

More Advanced Courses

- Civil Engr. 118. Materials Engineering
- Mat. Sci. 151. Materials Technology for Structural Applications
- Mat. Sci. 179. Intermediate Materials Science
- Mat. Sci. 185. Mechanical Behavior of Solids
- Mat. Sci. 188. Electrical, Optical, and Magnetic Properties of Materials
- Mat. Sci. 190. Polymer Science
- Mat. Sci. 191. Engineering Properties of Polymers
- Mat. Sci. 192. Biomaterials

5. Logic and Computer Systems

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp. Sci. 106</td>
<td>Introduction to Computing</td>
<td>4</td>
</tr>
<tr>
<td>Indus. Engr. 140</td>
<td>Introduction to Computers and Programming</td>
<td>4</td>
</tr>
<tr>
<td>Phil. 57A</td>
<td>Introduction to Logic</td>
<td>5</td>
</tr>
<tr>
<td>Phil. 160A</td>
<td>Symbolic Logic</td>
<td>3</td>
</tr>
<tr>
<td>Phil. 162</td>
<td>Theory of Automata</td>
<td>3</td>
</tr>
</tbody>
</table>

More Advanced Courses

- Comp. Sci. 103. Programming in Fortran
- Comp. Sci. 104. Programming in Algol W
- Comp. Sci. 111. Introduction to Computer Organization, Machine and Assembly Languages
- Comp. Sci. 140A,B. Systems Programming
- Comp. Sci. 156. Introduction to Mathematical Theory of Computation
- Comp. Sci. 206. Computing with Symbolic Expressions
- Elec. Engr. 182. Digital Computer Organization
Indus. Engr. 141. Computer Applications and Techniques 3
Phil. 160B. Symbolic Logic 3

6. SYSTEMS ANALYSIS AND CONTROL
Engr. 104. Dynamic Response 3
Engr. 105. Control System Analysis and Design 3

More Advanced Courses
Engr. 206. Control System Design and Simulation 4
Engr.-Econ. Sys. 201A,B. Dynamic Systems 3,3

7. MASS AND ENERGY TRANSFER
Chem. Engr. 20. Introduction to Chemical Engineering 3
Chem. Engr. 120. Separations Processes 3
Chem. Engr. 120L. Separations Processes Demonstration Laboratory 1
Chem. Engr. 150L. Energy and Mass Transport Laboratory 1

More Advanced Courses
Mat. Sci. 182. Rate Processes in Materials 3
Mech. Engr. 131B. Thermosciences 5
Mech. Engr. 250A. Heat Transfer 3

8. DECISION PROCESSES, ENGINEERING ECONOMY, AND DESIGN
Engr. 161. Engineering Economy 3
Mech. Engr. 103. Manufacturing Technology 4
Oper. Res. 151. Introduction to Operations Research I 3
Oper. Res. 152. Introduction to Operations Research I 3

More Advanced Courses
Engr.-Econ. Sys. 231. Decision Analysis 3
Indus. Engr. 160. Analysis of Production Systems 3
Indus. Engr. 164. Production Engineering Problems 3
Indus. Engr. 208. Man-Made Systems 3
Mech. Engr. 115A. Introduction to Product Design 3

Engineering Depth (36 units minimum)

The depth requirement is satisfied in one of three ways.

Departmental Majors. The student completes the sequence of courses recommended by one of the engineering departments (Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, Materials Science and Engineering, and Mechanical Engineering).

Interdisciplinary Majors (General Engineering). The student completes the sequence of courses recommended for one of the following programs: Aeronautics and Astronautics, Engineering and Society, Environmental Engineering, and Product Design.

Innovative Majors (General Engineering). Any student, aided by an adviser, may propose unique curriculum to attain particular career goals.

These three possibilities are described later in more detail under the heading "Engineering Majors." Not all of these curricula are accredited (see section "Accreditation" below). All programs must of course meet the School and University requirements as outlined in the ten components described herein.

Free Electives

Enough additional courses to bring the total to 180 units or more, typically between 30 and 40 units.

Functional Balance

Every engineering student should obtain experience in analysis, synthesis, experimentation, and communication. Analysis is concerned with the formulation and solving of mathematical models, primarily by use of deductive reasoning. Synthesis places emphasis on problem definition, ideation, inductive reasoning, and optimization. Experimentation involves the innovative applications of experimental equipment and techniques to discover relations and to answer questions. Communication skills include oral, written, and graphical expression, with emphasis on communication for a purpose. All these skills are essential in the successful practice of engineering.

The Engineering Breadth and Depth components of the curriculum will usually ensure adequate experiences in analysis. To round out the program, each student is expected to include the equivalent of at least 9 units each of synthesis and communication and 8 units of experimentation. It is not expected that this will require additional course work; instead, each student should keep in mind the necessity for functional
balance while selecting courses in the Science, Engineering Breadth, Engineering Depth, and Elective components of his/her curriculum.

Accreditation

The Engineers Council for Professional Development (ECPD) accredits college engineering programs on a nationwide basis. Accreditation is important in many areas of the engineering profession; students wishing more information about accreditation should consult their departmental office or the office of the Dean of Engineering.

The following undergraduate curricula are accredited: Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, Mechanical Engineering, and Petroleum Engineering (School of Earth Sciences). The Aeronautics and Astronautics curriculum is accredited at the Master's degree level.

ENGINEERING MAJORS

I. Departmental Majors

Satisfaction of the engineering depth requirement by completion of one of the departmental course sequences constitutes a major in that branch of engineering. A student wishing to deviate slightly from one of the departmental depth programs may submit his proposed program to the department for approval. Modified programs recommended by a department will normally be approved by the Undergraduate Council. Sample programs for departmental majors are available from the office of the Dean of Engineering.

Chemical Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 35.</td>
<td>Functional Groups and Stereochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 131.</td>
<td>Chemical Synthesis and Properties</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 132A.</td>
<td>Theory and Practice of Identification</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 173.</td>
<td>Physical Chemistry</td>
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</tr>
<tr>
<td>Chem. 174.</td>
<td>Physical Chemistry Laboratory</td>
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</tr>
<tr>
<td>Chem. 175.</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 120.</td>
<td>Separations Processes</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 120L.</td>
<td>Separations Processes Demonstration Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Chem. Engr. 130.</td>
<td>Chemical Kinetics: Theory with Applications to Reactor Design</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 140.</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 140L.</td>
<td>Fluid Mechanics Demonstration Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Chem. Engr. 150L.</td>
<td>Energy and Mass Transport Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>C.E. 107.</td>
<td>Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 114.</td>
<td>Mechanics of Materials</td>
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</tr>
<tr>
<td>C.E. 130.</td>
<td>Transportation</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 143.</td>
<td>Specifications and Contracts</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 160.</td>
<td>Water-Resources Engineering</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 170.</td>
<td>Man and His Environment</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 180.</td>
<td>Elementary Structural Analysis</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 190.</td>
<td>Geotechnical Engineering</td>
<td>4</td>
</tr>
</tbody>
</table>

At least one of the following:

- C.E. 196. Engineering Practice | 2 |
- C.E. 197. Engineering Synthesis | 4 |
- C.E. 198. Senior Report | 1 |

At least one of the following:

- Geol. 101. Framework of Geology | 4 |
- Geophys. 51. Physics of the Earth | 4 |
- C.E. 40. Elementary Surveying | 4 |
- C.E. 116. Plain Concrete | 3 |
- C.E. 118. Materials Engineering | 3 |

At least one of the following:

- C.E. 133. Introduction to Urban Planning | 3 |
- C.E. 171. Environmental Planning | 3 |
- C.E. 181. Design of Steel Structures | 3 |
- C.E. 182. Design of Reinforced Concrete Structures | 3 |

Special Requirement:

Any student who has not had exposure to drafting, either in high school or through work experience, should include ME 102A and at least 102B in his or her program.

Electrical Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 101, 102, 103.</td>
<td>Circuits and Networks</td>
<td>9</td>
</tr>
<tr>
<td>E.E. 111, 112, 113.</td>
<td>Electronics</td>
<td>9</td>
</tr>
<tr>
<td>E.E. 121, 122.</td>
<td>Laboratory</td>
<td>5</td>
</tr>
<tr>
<td>E.E. 141.</td>
<td>Electromagnetic Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 181.</td>
<td>Introduction to Computer Organization, Machine and Assembly Languages</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 126, 139, or 274 Laboratory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Restricted Electives (any Elec. Engr. courses)</td>
<td>4</td>
<td></td>
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</tbody>
</table>

Industrial Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.E. 100.</td>
<td>Organizations: Theory and Management</td>
<td>4</td>
</tr>
<tr>
<td>I.E. 120.</td>
<td>Quality Assurance</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133.</td>
<td>Industrial Accounting</td>
<td>4</td>
</tr>
<tr>
<td>I.E. 141.</td>
<td>Computer Applications and Techniques</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 144.</td>
<td>Information Systems and Simulation</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 160.</td>
<td>Analysis of Production Systems</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 164.</td>
<td>Production Engineering Problems</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 199.</td>
<td>Senior Seminar</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 161.</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 110.</td>
<td>Statistical Methods in Engineering and the Physical Sciences</td>
<td>4</td>
</tr>
</tbody>
</table>

Total: 36
Materials Science and Engineering
M.S. & E. 180. Atomic Arrangements in Solids 4
M.S. & E. 181. Thermodynamics and Phase Equilibria 4
M.S. & E. 182. Rate Processes in Materials 3
M.S. & E. 185. Mechanical Behavior of Solids 3
M.S. & E. 188. Electrical, Optical and Magnetic Properties of Materials 3
M.S. & E. 202A,B,C. Experimental Methods in Materials Science (Previous or concurrent registration in M.S. & E. 180 series or equivalent.) 6
Phys. 56. (Concurrent with Phys. 55) 1
Stat. 110. 4
Restricted Electives: (science or engineering courses approved by M.S. & E) 8

Materials Science and Engineering
M.S. & E. 180. Atomic Arrangements in Solids 4
M.S. & E. 181. Thermodynamics and Phase Equilibria 4
M.S. & E. 182. Rate Processes in Materials 3
M.S. & E. 185. Mechanical Behavior of Solids 3
M.S. & E. 188. Electrical, Optical and Magnetic Properties of Materials 3
M.S. & E. 202A,B,C. Experimental Methods in Materials Science (Previous or concurrent registration in M.S. & E. 180 series or equivalent.) 6
Phys. 56. (Concurrent with Phys. 55) 1
Stat. 110. 4
Restricted Electives: (science or engineering courses approved by M.S. & E) 8

Mechanical Engineering
M.E. 101. Visual Thinking 3
M.E. 103. Manufacturing Technology 4
M.E. 111. Stress, Strain and Strength 3
M.E. 112. Mechanical Systems 3
M.E. 113. Engineering Design 3
M.E. 131A,B,C. Thermosciences 14
Engr. 104. Dynamic Response or M.E. 161. Engineering Vibration 3
Any M.E. course in the 100 or 200 series 3

Environmental Engineering
An environmental engineering education stresses interdisciplinary work in social sciences such as economics, political science, and sociology as well as in the natural sciences, particularly biology and engineering. Students in this program are encouraged to seek a strong fundamental background, to become knowledgeable about a wide range of environmental issues, and to pursue knowledge in depth in areas which are most compatible with their future interests.

II. Interdisciplinary Majors (General Engineering)
General Engineering programs must be approved by the Special Programs Committee of the Engineering Undergraduate Council. Petitions for approval of special programs should be submitted during the junior year and should include a statement that describes a well-defined educational objective. Additional information and sample programs regarding these majors may be obtained from the office of the Dean of Engineering.

Aeronautics and Astronautics
Engr. 104. Dynamic Response 3
A.A. 100. Introduction to Aeronautics and Astronautics 3
A.A. 131. Experimentation in Aeronautics and Astronautics 4
Civil Engr. 114. Mechanics of Materials 5
Mech. Engr. 131A. Thermosciences: Thermodynamics 6
A.A. 200A. Engineering Analysis of Flight Vehicles 3
A.A. 192. Vector Analysis and Cartesian Tensors 3
Math. 130. Ordinary Differential Equations 3
A.A. 210A. Fundamentals of Compressible Flow 6
Restricted Electives 36

III. Innovative Majors (General Engineering)
General Engineering programs must be approved by the Special Programs Committee of the Engineering Undergraduate Council. A coordinated sequence of courses that provides mastery of the important principles and techniques in a well-defined field will ordinarily be approved. Petitions for approval of special programs should be submitted during the junior year and should include a statement that describes a well-defined educational objective. Programs such as Bio- or Premedical-Engineering, Urban Planning, Ocean Engineering, may be de-
veloped within the framework of the innovative major. For further information consult the office of the Dean of Engineering.

**Architecture Program**

The Design Division of the Department of Mechanical Engineering offers an undergraduate program in architecture leading to the degree of Bachelor of Arts. More details on this program can be found in the Mechanical Engineering section of this catalogue.

**Engineering in Biology and Medicine**

The bioengineer is one who can apply technology to the solution of biological and medical problems. To do this he must have a mastery of some branch of technology. For this reason, we recommend that engineering undergraduates interested in biomedical problems major in one of the established fields of engineering, while using their electives to build up a basic background in the biological sciences and the interconnection between engineering, man, and his environment. Engineering has also been found to be an excellent major for pre-medical students. Sample programs are available in the office of the Dean of Engineering.

**Co-terminal Degree Programs**

A Stanford undergraduate may work simultaneously toward Bachelor and Master degrees, i.e., A.B. and B.S., A.B. and M.S., A.B. and M.A., B.S. and M.S., or B.S. and M.A. The degrees may be granted simultaneously or at the conclusion of different quarters. Usually five years will be needed for a combined program.

1. **Co-terminal A.B. and B.S. Degree Program.** To qualify for both degrees, a student must: (1) complete the stated University requirements and departmental requirements for each degree, (2) complete 15 full-time quarters or 3 full-time quarters after completing 180 units, and (3) complete a total of 225 units (180 units for the first Bachelor's degree plus 45 units for the second Bachelor's degree).

2. **Co-terminal Bachelor/Master Program.** A Stanford undergraduate may be admitted to the University Division for the purpose of working simultaneously toward a Bachelor's degree and a Master's degree. To qualify for both degrees, a student must (1) complete 15 full-time quarters (or the equivalent) after completing 180 units; (2) complete, in addition to the 180 units required for the Bachelor's degree, the number of units required by his or her graduate department for the Master's degree (not fewer than the University minimum of 36 units); (3) complete the requirements for the Bachelor's degree (department, School, and University) and apply for the degree at the appropriate time at the office of the Registrar, and (4) complete the department and University requirements for the Master's degree and file candidacy forms through his/her graduate department.

3. **Procedure for Applying for Admission to the Co-terminal Degree Programs.** A Stanford undergraduate may apply (using the white University petition form) for admission to the Co-terminal A.B./B.S. Program during the student's tenth or eleventh quarter. The student may apply for admission to the Co-terminal Bachelor/Master Program after the beginning of the eighth quarter of undergraduate work and before the end of the eleventh quarter. Students seeking an undergraduate or graduate degree in engineering will apply through the office of the Dean of Engineering; all other students will apply through the Graduate Study Office (118 Old Union). All necessary forms are available in the office of the Dean of Engineering.

**Dual Degree Programs**

Stanford University cooperates with certain liberal arts colleges (presently Centenary College, Claremont Men's College, the College of Idaho, Knox College, Mills College, Pacific Lutheran College, Westmont College, Whittier College, and Willamette University) in providing a program that leads to concurrent award of the A.B. degree by the college and the B.S. degree by Stanford. These programs comprise three years of study at the college, with some emphasis on mathematics and science, followed by two years of study of engineering at Stanford.

A minimum of six quarters of residence at Stanford is required for dual-degree transfer students. Thus, such students may not receive the Stanford B.S. degree until at least 6 quarters of study have been completed here. However, 3+2 students also have the option of entering the combined
B.S.-M.S. program if they meet the requirements, in which case they may receive the Master’s degree as soon as all appropriate requirements are met, but not sooner than at the end of 6 quarters of study at Stanford.

Inquiries concerning this “three-two” program may be addressed to the Dean of Engineering at Stanford or to the above listed colleges. For a description of the four-two program, see the section titled “Master of Science.”

FOREIGN STUDY

In addition to the regular opportunity available to all Stanford engineering students for study at one of the Stanford overseas campuses, a special opportunity exists whereby engineering students may spend their junior year in residence at the Instituto Tecnologico y de Estudios Superiores de Monterrey in Mexico. The student pursues a regular program of engineering courses, so little if any delay results in graduation. Instruction is in Spanish, so adequate language preparation is needed—either one year of college Spanish or high school equivalent. The student achieves a genuine fluency in a second language, and an opportunity to live in a different cultural setting.

A similar opportunity exists in France, at the Ecole National Superieure de Mécanique of Nantes, to which substantially the same remarks apply.

GRADUATE ADMISSION

Application for admission with graduate standing in the School should be made to the Director of Graduate Admissions of the University; applications are reviewed by the appropriate department of the School before admission is authorized. Inquiries may be addressed to the Dean of Engineering or to the Chairman of the Department. While most graduate students have undergraduate preparation in an engineering curriculum, it is feasible to enter from other programs including chemistry, physics, or mathematics (see, for example, the Four-Two program described under “Master of Science”).

GRADUATE REGISTRATION

New graduate students should follow procedures for registration as listed in the Time Schedule. Adviser assignments can be obtained from the Department office.

GRADUATE PROGRAMS OF STUDY

Departments and divisions of the School offer graduate curricula, as follows:

AERONAUTICS AND ASTRONAUTICS
Acoustics
Aeroelasticity
Aerophysics
Aerospace Structures
Aerospace Systems Synthesis and Design
Analytical and Experimental Methods in Solid and Fluid Mechanics
Biomedical Solid and Fluid Mechanics
Energy Systems Studies
Flight Mechanics
Gaskinetics
Guidance and Control
Physical Gasdynamics
Propulsion
Transportation
Waves and Vibrations

ENGINEERING/ENGINEERING SCIENCE
Interdisciplinary Programs
Interdepartmental Programs

ENGINEERING IN BIOLOGY AND MEDICINE
Biomaterials
Biomathematics
Biomechanics
Biophysics
Biostatistics
Design for Medical Applications
Water Quality Control
Information Processing for Biomedical Systems
Information Processing in Biological Systems
Integrated Circuits for Medical Electronics
Transport Phenomena in Biological Systems

CHEMICAL ENGINEERING
Newtonian and Non-Newtonian Fluid Mechanics
Hydrodynamic Stability
Chemical Energy Conversion
Applied Chemical Kinetics
Surface Reactivity
Adsorption and Catalysis
Bioengineering
CIVIL ENGINEERING

Construction Engineering and Management
Civil Engineering Management
Civil Engineering Planning
Structures, Materials, and Geotechnical Engineering
Civil Engineering Materials
Earthquake Engineering
Foundation Engineering
Reliability and Risk Analysis
Soil Mechanics
Soil-Structure Interaction
Structural Analysis and Design

Water Studies
Environmental Engineering
Hydrology
Hydromechanics
Nuclear Civil Engineering
Water Resources

ELECTRICAL ENGINEERING

Computer Systems
Engineering in Medicine
Integrated Circuits and Systems
Lasers and Quantum Electronics
Microwave Acoustics
Plasmas
Radioscience
Space Engineering
Signal Processing Systems
Solid State Devices and Systems
Solid State Phenomena and Materials
Statistical Theory of Communication and Control

ENGINEERING-ECONOMIC SYSTEMS

Applied Economics
Decision Analysis
System Analysis
Long Range Planning
Public Decision Making

HYDROLOGY

See “Hydrology, Committee on,” page 590.

INDUSTRIAL ENGINEERING

Computer Utilization
Economic Systems Planning
Management Systems Design
Systems Analysis and Synthesis
Transportation Systems

MATERIALS SCIENCE AND ENGINEERING

Biomaterials
Electrical and Optical Behavior of Solids
Fracture
Imperfections in Crystals
Kinetics
Magnetic Behavior of Solids
Materials Synthesis and Processing
Mechanical Behavior of Solids
Phase Transformations
Physical Ceramics
Physical Metallurgy
Polymers
Solid State Chemistry
Structural Analysis
Thermodynamics

MECHANICAL ENGINEERING

Air Pollution
Biomechanics
Combustion
Composites, Fracture of Solids
Continuum Mechanics
Controls
Dynamics
Energy Conversion
Engineering Design
Environmental Measurements
Experimental Mechanics
Fluid Mechanics
Heat Transfer
High Temperature Gasdynamics
Kinematics
Nuclear Engineering
Optimization
Product Design
Solar Energy
Thermodynamics
Transport Processes

OPERATIONS RESEARCH

Applied Probability
Dynamic Programming and Mathematical System Theory
Inventory, Queueing, and Reliability Theory
Linear, Nonlinear, and Integer Programming
Networks, Graphs, and Combinational Theory

SPACE SCIENCE

See “Special Opportunities in Graduate Study,” page 592.

For further details about the above programs, see the department sections in this bulletin.

Related aspects of particular areas of graduate study are commonly covered in the
offerings of several departments and divisions. Graduate students are encouraged, with the approval of their departmental advisors, to select courses in departments other than their own to achieve a broader appreciation of their field of study. For example, most departments in the School offer courses concerned with properties of materials, and a student interested in an aspect of materials engineering can often gain appreciable benefit from the related courses given by departments other than his or her own.

**MASTER OF SCIENCE**

The degree of Master of Science (M.S.) is conferred on graduate students in engineering according to the University regulations stated elsewhere and is described in the various department listings. A minimum of 45 units is usually required in M.S. programs in the School of Engineering. However, the presentation of a thesis is not a School requirement in Engineering. Further information may be obtained from the particular department in which the student is interested.

_Four-Two program_ — Superior students who hold baccalaureate degrees in physical science with adequate physics and mathematics may complete the requirements for an M.S. in engineering at Stanford (in most of the curricula above) in two academic years (six quarters). Programs will be worked out in consultation with an adviser from the department in which the student wishes to study. Further information may be obtained from the department in which the student is interested.

**ENGINEERING AND ENGINEERING SCIENCE**

The degree of Master of Science in Engineering or Engineering Science is available to those who wish to follow a program of study of an interdisciplinary nature that does not conform to a normal graduate program in a department. The Engineering Science degree is appropriate when the program of study emphasizes the scientific background of some aspect of engineering (e.g. Bioengineering) and contains a high percentage of courses in Mathematics, Physics, Chemistry, etc. The Engineering degree is appropriate to all other cases, including programs in fields lying between two departments within the School of Engineering and programs involving a large amount of non-engineering course work in fields other than the physical sciences.

There are three School requirements for the M.S. degree in Engineering or Engineering Science: (1) the student's program must be a coherent one with a well-defined objective and be approved by a department within the School; (2) the student's program must include at least 21 units of courses within the School of Engineering with numbers 200 or above in which the student receives letter grades; (3) the program must include a total of at least 45 units. These programs are administered by the departments and of course must meet the standard of quality of the departments.

Applications for admission to the Engineering or Engineering Science programs should indicate the department in the School in which the student expects to take most of his or her courses, or, if undecided, indicate the Office of the Dean, School of Engineering. Transfer into this program is also possible from any department program within the School by application to the appropriate department.

**ENGINEER**

The degree of Engineer is awarded at the completion of a comprehensive two-year program of graduate study. It is intended for those who desire more graduate training than can be obtained in a Master of Science program. The program of study must satisfy the student's department and usually includes 90 units beyond the B.S. degree of which at least 60 must be devoted to advanced or graduate study in the major subject or closely related subjects. The presentation of a thesis is required. The University regulations for the Engineer degree are stated in the section "Degrees" in this bulletin, and further information will be found in the department sections following.

**DOCTOR OF PHILOSOPHY**

Programs leading to the degree of Doctor of Philosophy are offered in each of the departments and divisions of the School. Special Ph.D. programs which may be interdisciplinary in nature (e.g., Bioengineering) can be arranged. See "Graduate Division Special Programs" section in this bulletin. University regulations are given in the section "Degrees" in this bulletin, and further information will be found in the department sections following. Inquiries concerning pro-
grams in Bioengineering should be addressed to the Dean of the School of Engineering, Stanford University, Stanford, California 94305.

**Fellowships and Assistantships**

Each department and division of the School of Engineering awards fellowships, research assistantships, and teaching assistantships each year. Information and application blanks may be obtained from the chairman of the appropriate department or division.

**The Honors Cooperative Program**

A number of industrial firms, government laboratories, and other organizations participate in the Honors Cooperative Program (HCP), a plan which permits qualified professional employees to register for graduate Stanford courses on a part-time basis. Most of the students in the HCP are in the School of Engineering, though several departments in related fields also offer graduate degree programs under this plan. These include Petroleum Engineering which is in the School of Earth Sciences and Computer Science and Statistics which are in the School of Humanities and Sciences. The HCP is now augmented by the Stanford Instructional Television Network, a four-channel network which enables students to enjoy live lectures with talk-back privileges at their company plants. Further details can be obtained from the School of Engineering.

**Engineering**

Emeritus: Hugh H. Skilling (Professor)


Associate Professor: Bruce B. Lusignan

Assistant Professor: J. David Powell

The “Engineering” courses deal with subject areas within engineering which are, in their essential nature, broader than the confines of any particular branch of engineering. These courses are taught by professors from the several departments of the School of Engineering, under the supervision of those listed above.

Of the courses described in this section, many are of general interest to both engineering and non-engineering students. In addition, certain departmental courses are of general interest and without prerequisites.

Students interested in the interactions between technology and society should also consult the “Values, Technology, and Society” section of this bulletin.

**Courses of Interest Primarily to Undergraduates**

1. The Engineer in Modern Society—Lectures, demonstrations, experiments, case studies, and field trips planned to show what engineering is and what engineers do. Creativity, design, and decision making. Open to any student.

   3 units, Aut (Shevell) TTh 11 and T 1:15-3:05

2. PeopleDynamics Laboratory — This course studies methods by which the engineer can identify the human nontechnical components of a problem. The methods are demonstrated in a laboratory setting, the data for learning being the behavior, feelings, and reactions of the members of the class. The methods used in the course are experiential. Although attendance at all labs is mandatory, participation in individual experiments is optional. Does not fulfill the University Distribution Requirement for Math/Science/Technology. Pass/no credit.

   2 units, Aut, Win, Spr (Roth, Wilde)

3. Applied Mechanics I—The three courses, Engineering 3, 4, and 5, constitute a sequence for first-year students interested in engineering. The first course deals primarily with systems at rest on the earth and includes vector algebra, centroids and mass centers, and force systems. Prerequisites: none.

   3 units, Aut (Ashley) MWF 11
4. Applied Mechanics II—Continuation of
3. Differentiation of vectors, particle and rigid body kinematics, inertia, laws of motion. Prerequisites: 3, Math 10 or 41N.
3 units, Win (Ashley) MWF 11

5. Applied Mechanics III—Continuation of
4. Prerequisites: 4, Math 11 or 41N.
3 units, Spr (Ashley) MWF 11

7. Energy, from Nature to Man—(Same as VTS 141.) Nature provides an abundant supply of energy, mostly in forms not directly usable by man. The engineer has the problem of designing systems to convert this energy to usable forms, to transmit energy, and to use the energy in a socially responsible way. This course provides an introduction to the science of energy and to the technical aspects of energy supply. Open to all students who have taken some mathematics and science in high school. Sophomore engineering students should take Engineering 32 instead.
4 units, Spr (Reynolds) MWF 9

10. Aeronautics and Astronautics—The historical developments leading to controlled, powered flight; atmospheric flight beyond the sound and temperature barriers; and space flight are presented. The fundamental principles of atmospheric and extraterrestrial flight are explained physically, with minimum dependence on mathematics. Participatory discussion is generated on the social, economic, and political ramifications of the rapid growth, achievements, challenges, and potential of aeronautics and astronautics. Open to all students who have taken some mathematics and physics in high school.
3 units, Spr (Mayers) TTh 11–12:15

11. Applied Mechanics: Stress Analysis—Analysis of stresses, strains, deformations, and deflections of linearly elastic structural members under load. Tension and compression; shear; torsion; shear force and bending moment in beams; stresses and deflections of beams. Prerequisites: 3 or Physics 51, Math 21 or 42N.
4 units, Aut (Mayers) MWF 9; problem sessions by arrangement
Win (Mayers) MWF 9; problem sessions by arrangement
Spr (Richards) MTThF 9

12. Applied Mechanics: Dynamics—Principles of dynamics applied to engineering problems involving motions of particles, rigid bodies, and linearly elastic bodies; vibration and dynamic response of simple mechanical systems. Prerequisites: Mathematics 23 or 43 and Physics 51. (Credit is not given for both Engr. 5 and 12.)
4 units, Win (Breakwell) MWF 9, problem sessions by arrangement
Spr (Powell) MWF 9, problem sessions by arrangement

21. Mechanics of Fluids—Physical properties of fluids and their effect on flow behavior; the equations of motion for incompressible ideal flow, including the special case of hydrostatics; energy and momentum principles; the control volume analysis; real fluid effects—laminar and turbulent flows; specific engineering applications. Laboratory exercises. Prerequisite: 5 or 12, or Math 23 or 43, or consent of instructor.
4 units, Aut (Hsu) MWF 10; lab. M or T 1:15–4:05
Spr (Baganoff) MWF 9; lab. M or T 1:15–4:05

25. The Galactic Club: Intelligent Life in Outer Space—The course is concerned with the existence of intelligent life elsewhere in the galaxy, the significance of such life for human values and with the systematic application of relevant topics such as planetary formation, prebiological evolution, the origin of life, radio communication over interstellar distances, rocket travel, celestial mechanics, the colonization of interplanetary space and how to contact and communicate with nonhumans. Views of Sagan, Velikovsky and Von Däniken will be critically considered.
3 units, Win (Bracewell) MW 2:15–3:30

32. Introduction to the Thermosciences—Introduction to the concepts of energy and entropy from elementary considerations of the microscopic nature of matter. Use of the conservation of energy principle in the solution of engineering problems. Methods and problems in the socially responsible economic generation and utilization of energy in central power stations, automotive gas turbine engines, thermoelectric generators, refrigeration devices, life support systems, etc. Prerequisites: freshman calculus and physics.
3 units, Aut (Reynolds) MWF 8
Win (Eustis) MWF 8
41N. Circuits — Introduction to electrical signals, circuits, and analytical techniques. Circuit principles, natural and forced response, network theorems, block diagrams, and feedback. Prerequisites: Physics 53 and Mathematics 43.

3 units, Aut (Helliwell) MWF 9
Win (Smith) MWF 10

42N. Electronics — Electronic devices and circuits; linear and nonlinear applications. Digital devices and logic circuits; power, small-signal, and operational amplifiers. Prerequisite: 41N or equivalent.

4 units, Win (Helliwell) MWF 9; one 3-hour lab. weekly by arrangement
Spr (Smith) MWF 10; one 3-hour lab. weekly by arrangement

43. Electromechanics—Energy conversion, magnetic fields and devices, electromechanical devices, rotating machinery, automatic control. Prerequisite: 41N or equivalent.

3 units, Spr (Helliwell) TTh 10; one 3-hour lab. weekly by arrangement

44. Basic Electronics—Elementary electronics for the nonspecialist. Electrical quantities and circuit laws; electron ballistics and the CRO; semiconductor diodes and transistors; integrated circuits; digital devices and logic circuits; signal wave-forms and ac circuits; power, small-signal, and feedback amplifiers; operational amplifiers; modulation; instrumentation. Lectures and laboratory work. Not intended for those who take 41N. Prerequisite: calculus.

5 units, Aut (Smith) MWF 11; one 3-hour lab. weekly by arrangement

50. Introductory Science of Materials—Introduction to the physical basis of the mechanical, electrical, and magnetic behavior of solids. Electron theory, imperfections in solids. Relations between structural features and properties. Prerequisite: Mathematics 23 or 43.

3 units, Aut (Staff) MWF 11
Win (Sherby) MWF 11
Spr (Stevenson) MWF 10


3 units, Aut (Powell) MWF 11


3 units, Aut (Franklin) MWF 10
Spr (Staff) MWF 11

121. Solar Energy—The purposes of this new interdisciplinary course are: (a) To survey and put in perspective a number of systems for domestic use of solar energy, now being proposed or built, utilizing student reports of current literature; (b) To review quantitatively heat transfer, radiation, etc. as they apply to solar system components such as collectors, converters, controls, insulators, and storage devices. Prerequisite: a basic course in college or engineering physics.

3 units, Aut (Seifert) MWF 1:15

161. Engineering Economy—Economic decision making for alternative engineering designs. Use of compound interest and depreciation calculations to compare the relative economy of both technical investments and plant operating procedures before and after Federal income taxes. Several methods are employed for analysis of multiple alternatives, simple risk, retirement, replacement, resource allocation, and public works projects. May be taken by freshmen. Recommended for sophomores.

3 units, Aut (Ireson), Win (Staff) TTh 10; one hour by arrangement
Spr (Staff) TTh 11; one hour by arrangement
Sum (Staff) MTWTh 10

176. Nuclear Energy—Theory, design and applications of nuclear energy systems; radioisotope heat sources, fission chain reactors and concepts of fusion reactors. The
effects and the shielding of nuclear radiation emitted by these systems. The status of development of fission and fusion power technologies. Prerequisite: Mathematics 43.

3 units, Win (Connolly) MWF 11

199. Special Studies in Engineering—Special studies, laboratory work, or reading under the direction of a faculty member. Often research experience opportunities exist in ongoing research projects. Interested students are invited to make arrangements with individual faculty. By consent only.

1 or more units, any quarter (Staff) by arrangement

**Courses of Interest Primarily to Graduate Students**

206. Control System Design and Simulation—Sequel to Engineering 105. Theoretical material learned in 105 is applied to practical design. Two systems design projects will be used to motivate discussion of several new topics of use in handling nonlinear systems. These include describing functions, phase-plane analysis, analog computers in simulation and design, bang-bang control, and state-space design techniques. Different control techniques will be tested in the laboratory. Prerequisite: 105.

4 units, Win (Staff) MWF 1:15, lab. by arrangement

207. Digital Control I—Study of the computer as an element in feedback control systems. Sampling, z-transforms, discretization of continuous compensation, discrete compensation design, quantization errors, state variable design of discrete controllers and observers. Laboratory experiments on a mini-computer/analog computer system. Limited enrollment. Prerequisite: 105.

4 units, Win (Powell) TTh 11–12:15; lab. by arrangement

Spr (Franklin) TTh 11–12:15; lab. by arrangement

208. Digital Control II—Design of digital control systems including multivariable controller/observers, steady state optimal techniques, w-plane frequency response methods. Parameter identification, Kalman filter implementation. Laboratory projects on a mini-computer/analog computer system. Prerequisite: 207.

3 units, Spr (Powell) MW 10; lab. by arrangement

211. The Laboratory Plasma—Methods of forming laboratory plasmas. Collision processes, velocity distributions, the Boltzmann transfer equation, concepts of temperature and pressure, nonequilibrium velocity distributions. Macroscopic averages of the Boltzmann equation. DC and rf breakdown and avalanche phenomena, the effect of a magnetic field, the positive column at low pressure and medium pressure, ambipolar diffusion, the plasma sheath, and thermal plasmas. Fusion. Recommended: Electrical Engineering 243 or equivalent.

3 units, Aut (Staff) alternate years, given 1976–77 MWF 3:15

221. The Social Impact of Technology—The functions of science and technology in various cultures; historical development; underlying patterns and concepts. Unifying frameworks to enable simultaneous consideration of technical factors, human needs and ecological requirements. The adequacy of “traditional” and “scientific” philosophies as criteria for judging the satisfying of these needs. Systems, system methods, and their limits; the role of disciplines. Intended for graduate students in engineering and science; others by permission of instructor.

3 units, Spr (Kline) T 1:15–2:05, Th 1:15–3:05

235A,B. Engineering Systems Design—Fifty to seventy students mostly from engineering and science, but also from business, political science, law, etc., form a team to prepare a preliminary design of a complex system. Topics treated in previous years include: educational television satellites and cables, development of ocean resources, approaches to urban ghetto problems, and evaluation of alternative solutions to the energy crisis. Over twenty speakers from government agencies, universities, and industry give the necessary background and provide contacts for future implementation of the study proposals.

235A. 3 units, Win (Staff) T 1:15–3:05, Th 1:15; two hours by arrangement

235B. 3 to 5 units, Spr (Staff) TTh 1:15–2:05; two hours by arrangement
290. The Historical Context of Engineering—By looking at the past an attempt is made to understand the interplay of technological change and societal development generally. The course is conducted as a colloquium, with discussion based on readings in the history of technology. Consideration of the professional and social position of engineering inevitably arises. Primarily for graduate students; Values, Technology and Society 121 is recommended for undergraduates. Enrollment limited to 15; pass/no credit only.

3 units, Spr (Vincenti) T 7:30-9:30 p.m.

291. Management of Research Institutions—Interdisciplinary graduate level seminar dealing with organizations that perform research and development work. The history of these organizations will be discussed with a view toward understanding how their functions have evolved. A description of the impact that selected research laboratories have had on society will be presented. Techniques for evaluating the performance of research laboratories will be discussed and management procedures in finance, personnel and program planning will be described.

2 units, Aut (Mark) M 3:15-5:05

295. Computational Physics Seminar—a forum for the presentation and exchange of computational methods to solve physical problems encountered in applied science. Emphasis on computer modeling or simulation of media and continuous physical systems such as solids, fluids, the atmosphere, plasmas. Methods to be covered are, mostly, common to applications in several disciplines; interdepartmental and inter-school.

1 unit, Aut, Win, Spr (Buneman) F 3:15

297A,B,C. Cross-Discipline Seminar: Decision-Making in International Development—(Same as Education 274A,B,C, Political Science 140A,B,C, and Social Thought 197 A,B,C.) How engineering, education, and government interact with problems of population, food, natural resources, energy, technology, and human values. Decision-making and the concept of interdependence—between man and man, between man and environment, between nation and nation, and between present and future generations. Autumn: definition of the global and national problems related to human survival utilizing specialists from several academic disciplines. Winter: focus upon the ethics of development and strategies for change. Spring: concentration on the role of the individual in his society. (The course may be taken for 1 unit pass/fail or for more graded units with an individual project.)

297A. 1–3 units, Aut (McWhorter, Linvill, Lusignan and others: Cooper, Falcon, McAnany, Textor, North) M 7:30–9:30 P.M.

297B. 1–3 units, Win (McWhorter, Linvill, Lusignan and others) M 7:30–9:30 P.M.

297C. 1–3 units, Spr (McWhorter, Linvill, Lusignan and others) M 7:30–9:30 P.M.

298. Seminar in Fluid Mechanics—Interdepartmental seminar on problems in all branches of fluid mechanics, with talks by visitors, faculty, and students. Graduate students may register for one unit, without letter grade; a letter grade is given for students presenting talks.

1 unit, Aut, Win, Spr (Staff) T 4:15

299. Special Studies in Engineering—Special studies, laboratory work, or reading under the direction of a faculty member. By consent only.

1 or more units, any quarter (Staff) by arrangement

ENGINEERING IN BIOLOGY AND MEDICINE

Though Stanford does not have a formal department of bioengineering, there are approximately twenty-five faculty in the School of Engineering whose primary research activities are in the general area of bioengineering. These faculty are spread throughout the various departments of the School of Engineering, and a list of their names, together with a summary of their research interests, is available from the Committee Chairman. Students interested in pursuing graduate study in bioengineering apply for both admission and financial aid to the department appropriate on the grounds of their prior training and future interests, and their applications are judged on substantially the same grounds as other applicants to this department.

The research being conducted in the field of bioengineering within the various departments reflects the technological emphasis of those departments. For instance research on membrane transport and enzyme engineering is pursued in the Chemical Engineering Department, and bone elasticity, cardiovascular dynamics and haemodynamics in the Mechanical Engineering and Aeronautics and Astronautics Departments. In the Electrical Engineering department a superb integrated circuits facility is used in research on advanced medical instrumentation, such as ultrasonic imaging systems and Doppler-shift blood flowmeters and on micropower implantable electronics such as neural prostheses and biological microsensors. Also in Electrical Engineering advanced computer techniques are applied to various medical problems such as EKG and EEG recognition and X-ray image enhancement. In essentially all cases research in the School of Engineering is carried out in collaboration with faculty of the Medical School or members of the local medical community.

The typical graduate student in bioengineering first seriously confronts the medical or biological aspects of his or her education at the thesis research level. In preparation he or she will probably have devoted one quarter or one third of his or her curriculum to relevant courses in biology, physiology, etc. Such courses are spread across the departments and schools of the University. The student's adviser will assist him or her in constructing a program of study incorporating these courses and also satisfying the degree requirements of the department in which he or she is registered. Both the Master's degree and the Ph.D. degree are ordinarily awarded by a particular department, and the candidate must meet the degree requirements of that department. There are also available for special cases the degrees of Master of Science in Engineering and Master of Science in Engineering: Biology and Medicine. In these cases the study program must be approved by an interdepartmental committee. For the rare cases where a student's background makes it unrealistic to satisfy a departmental Ph.D. qualifying requirement, a faculty committee can be formed to supervise an appropriate qualifying and research program, as a Graduate Division Special Program.

Students accepted into the Biophysics program may choose to develop their specialization in the area of biomedical engineering and to work for the Ph.D. in Biophysics.

A student wishing to earn the M.S. in Engineering while pursuing the M.D. degree, must apply separately for admission to both schools. If the student is admitted to both, each school will encourage his or her pursuit of the other degree. The Medical School curriculum is now so flexible that medical students can devote half of their first two years of study to Engineering. Such students are usually advised to take technical science and engineering courses rather than to concentrate on bioengineering courses, since much of the biology will be treated in greater depth in their medical studies.

In addition to the financial support available through the departments in the form of fellowships, research assistantships and teaching assistantships, there are externally administered fellowship programs for the support of graduate study in health-related fields. In particular, both the National Institute of Health and the National Science Foundation offer such fellowships on the basis of national competition.

AERONAUTICS AND ASTRONAUTICS

Emeriti: Nicholas J. Hoff, Alfred S. Niles (Professors)
Hoff, Alfred S. Niles (Professors)
Chairman: Arthur E. Bryson
Vice Chairman: Daniel Bershader

Assistant Professor: J. David Powell

Adjunct Professor: Sotiris P. Koutsoyannis


Research Engineer: Richard A. Van Patten

Research Associate: Robert A. Clappier, Stuart W. Bowen

Offerings

This Department prepares the student for a professional career in aeronautics and astronautics by offering a comprehensive program of graduate teaching and research. Particular emphasis is given to structural, aeroelasticity, guidance and control, and propulsion problems of aircraft, missiles and spacecraft. Courses in the teaching program lead to the degrees of Master of Science, Engineer, and Doctor of Philosophy. Aeronautics and Astronautics offers two curricula for the Master of Science and Doctor of Philosophy—one oriented toward the sciences, the other emphasizing engineering. Specific programs are available in the following areas:

- Acoustics
- Aerospace Structures
- Aerospace Systems Synthesis and Design
- Analytical and Experimental Methods in Solid and Fluid Mechanics
- Biomedical Solid and Fluid Mechanics
- Energy
- Flight Mechanics
- Gaskinetcs
- Guidance and Control
- Physical Gas Dynamics
- Propulsion
- Transportation
- Waves and Vibrations

Requirements for all degrees include courses on basic topics in aeronautics and astronautics, as well as in mathematics, physics and applied mechanics.

The current research activities cover a number of advanced fields, with special emphasis on:

- Aerodynamic Noise
- Aeroelastic Optimization
- Astrodynamics
- Bio-Fluid Mechanics and Physiological Acoustics
- Differential Games
- Geophysics
- Inertial Instruments
- Lasers
- Nonequilibrium Flow
- Nonlinear Structural Mechanics
- Optimal Control and Estimation
- Plasticity and Viscoelasticity
- Structural Aeroacoustics
- Structures/Materials Systems Optimization
- Transportation Systems Analysis
- Wave Propagation

Facilities for Instruction and Research

The work of the Department is centered in the William F. Durand Building for Space Engineering and Science, completed and occupied in early 1969. This 120,000 square foot building houses advanced research and teaching facilities and concentrates in one complex the Department of Aeronautics and Astronautics as well as the activities of other engineering departments allied in space exploration and aerospace technology.

Included among the facilities in the building are structural laboratories for demonstrating and studying the behavior of high strength and stiffness, lightweight structures under programmed static, dynamic and thermal loads. In conjunction with the computing facilities available both in the new building and the Stanford Computation Center, test data may be obtained and reduced through automatic data acquisition and processing systems. Recent experimental studies of structural behavior have been centered on the effects of creep on stress distribution and structural stability, the buckling and postbuckling phenomena in high quality cylindrical and spherical shells obtained...
through the electroforming process and the development of techniques for obtaining ultra-small measurements of deformation in conjunction with the buckling process in thin-walled shells.

A new central laboratory for the School of Engineering has recently been constructed for the purpose of conducting structural tests on large-scale prototype structures in static, dynamic, and thermal loading environments. Specific facilities include a static/dynamic testing bed; a programmable, horizontal, sled-mounted crash simulator; a programmable, seismic-shock simulator; and a high-load rate, materials test system.

The guidance and control laboratories include a wide spectrum of specialized facilities for making and testing novel instruments of extremely high precision. The facilities include active table-leveling (0.1 arc sec); low-level accelerometer evaluation chamber ($10^{-4}$ to $10^{-10}$ g); space craft thrustor test stand with 10 kHz bandwidth; spherical gyro rotor alignment facility (optical-to-principal-axis alignment less than 1 arc sec); air cushion vehicle to simulate the Stanford Drag-Free Satellite in an orbital dynamic environment to 275 km altitude; air-bearing simulator for spinning-spacecraft attitude control to a few arc sees; plus facilities for a number of inertial instrument test stands on an isolated test pad having visual access to Polaris. Clean facilities, ultra-precision machining, and advanced electronics design and fabrication capability support the guidance, control, and instrumentation experiments using these facilities. Elaborate new cryogenic gyro test facilities are available in the nearby Varian Physics Building, and Electrical Engineering’s Integrated Circuit Fabrication Facility is adjacent. Three laser-research laboratories and the fluid controls laboratory also participate in the guidance and control programs. Testing of certain systems in Earth orbit is expected to begin this year.

The radiative gas dynamics laboratory houses a research facility to study the coupling between radiant energy and wave production in gases. The gas kinetics laboratory group conducts a program to study velocity distributions and spectral line shapes of selected levels and transitions in gases with the aid of a tuneable laser. The spectro-interferometric laboratory is being outfitted to do tuned-laser experiments on resonant refractivity in gas flows. Additional facilities include a 250,000 joule condenser bank for plasma acceleration work, and a special concrete housing for studies of explosively driven shocks. There is also a specially designed laboratory for studies of aerodynamic noise. Several student instructional laboratories include facilities to study supersonic jets, flame temperature by line reversal, supersonic flow fields with schlieren techniques, refractive index of gases with interferometer equipment, shock-wave development with a shock tube, gyroscopic behavior, vibration mode of a simulated wing, blunt-body flow with ballistic free-flight range equipment, and hot-wire application with a small low-turbulence air-flow apparatus. An experiment using laser holography is currently being designed. Newly completed for operation in 1971 is a continuous low-speed tunnel with an 18" x 18" working section and speeds to 200 feet per sec.

Adjacent to the Durand Laboratory is the interdepartmental Institute for Plasma Research whose aerophysics laboratory is operated by Aeronautics and Astronautics faculty, staff and students. Its main facility is a high-pressure, high Mach number shock tube for the production of high density, partially ionized plasmas under well-defined conditions. A major measurement technique is high-speed rotating mirror interferometry. Also in use is a diffraction-grating tunable laser for the study of molecular kinetics. Presently, a pulsed-laser scattering experiment is in progress to measure electron temperature behind an ionizing shock wave.

Service facilities in the building include a full machine shop, standards laboratory, chemistry laboratory, an expanded aeronautics library, several conference rooms, extensive digital and analog computer equipment, including several time sharing terminals. Attached to the building is a modern classroom building which is equipped for televising lectures and which contains a lecture auditorium.

The University’s Computation Center is complemented by a “satellite” computer facility on the lower level of the new building, which is readily available to Department researchers and students. From this area there are direct tie-lines to the IBM 360-67 Computer (in the University’s campus facility) and to an IBM 360-50 computer (at the nearby Stanford Medical Center) for on-line evaluation of experimental data. Terminals
provide for individual on-line, time-shared computation with either of the two IBM 360's, and laboratory data may be collected and transmitted directly to the IBM 360-50 through conduits provided throughout the laboratory area of the building for this purpose. A digital and several analog computers are also located in this 2,500 square foot area. This computer facility is contiguous to the major lecture hall, permitting classroom exhibition of computer results.

The Department sponsors a student branch of the American Institute of Aeronautics and Astronautics, which holds periodic meetings, including comprehensive faculty research-area seminars, and conducts visits to nearby research, government, and industrial facilities. A special consortium arrangement between Stanford and the nearby NASA-Ames Research Center makes available many of the unique NASA facilities to Stanford researchers.

A brochure describing and illustrating the facilities and programs of the Department is available on request to the Academic Secretary of the Department.

**ADMISSION AND REGISTRATION**

To be eligible for registration in the Department a student must have received the Bachelor's degree in engineering, physical science, mathematics, or an acceptable equivalent. Students with an aeronautical engineering background should be able to qualify for the Master's degree in three quarters of work at Stanford. Students with a Bachelor's degree in physical science, mathematics, or other areas of engineering may find it necessary to take certain prerequisite courses, which would lengthen the time required to obtain the Master's degree.

**PROGRAMS OF STUDY**

**MASTER OF SCIENCE**

The University's basic requirements for the Master's degree are outlined in the section "Degrees" in this bulletin. The following are Departmental requirements.

**Engineering Curriculum**—To secure the recommendation of the Department for the Master's degree with a specialization in aero- and astronautical engineering, a candidate must complete a minimum of 24 units of basic course work in aerodynamics, propulsion, aerospace structures, dynamics, guidance and control, and experimentation. In addition, 6 units of mathematics are required, plus 12 units of advanced courses in any aerospace-related area of specialization interest to the candidate, and 3 units of approved electives, making in all 45 units of course work. A detailed list of the requirements can be obtained upon request to the Department. No thesis is required. A minimum grade point average of 2.75 is expected.

**Science Curriculum** — To secure the recommendation of the Department for the Master's degree with a specialization in aero- and astronautical sciences, a candidate must complete 24 units of basic course work to be selected from the same areas as listed for the Engineering Curriculum, 9 units of mathematics, 9 units of advanced physical science courses in an aerospace-related area of specialization interest to the candidate, and 3 units of approved electives, making in all 45 units of course work. A detailed list of the requirements can be obtained upon request to the Department. No thesis is required. A minimum grade point average of 2.75 is expected.

For those students who do not wish to meet the Department's specific requirements for the Master's degree, less specialized programs are available leading either to a Master of Science in Engineering or a Master of Science in Engineering Science. These programs are described on page 96 of this bulletin.

**ENGINEER**

The University's basic requirements for the Engineer degree are outlined in the section "Degrees" in this bulletin. The following are Departmental requirements. The candidate's study program must fulfill the Department's requirements for the Master's degree or their substantial equivalent. Beyond the Master's degree, a total of 45 units of work is required, including a minimum of 30 units of courses. The 30 units beyond the Master's degree are chosen as follows: (1) 24 units of approved electives, of which 9 shall be in mathematics and the remainder usually selected from one of the following fields: (a) Acoustics, (b) Aeroelasticity, (c) Aerophysics, (d) Aerospace Structures, (e) Aerospace Systems Synthesis and Design, (f) Analytical and Experimental Methods in
Solid and Fluid Mechanics, (g) Biomedical Solid and Fluid Mechanics, (h) Energy, (i) Flight Mechanics, (j) Gas Kinetics, (k) Guidance and Control, (l) Physical Gas Dynamics, (m) Propulsion, (n) Transportation, (o) Waves and Vibrations; and (p) 6 units of free electives. A list of courses currently accepted as approved electives can be obtained upon request to the Department. Candidates for the degree of Engineer will be expected to have a minimum grade point average of 3.00 for work in courses beyond those required for the Master’s degree.

Doctor of Philosophy

The University’s basic requirements for the Ph.D. degree are outlined in the section “Degrees” in this bulletin. The following are Departmental requirements.

Qualification for candidacy for the Doctor’s degree is contingent on: (a) the student’s having fulfilled the Department’s requirements for the Master’s degree or its substantial equivalent, (b) the student’s having completed three units of a directed research problem (Course AA290), and (c) in the second year of graduate study, the student’s passing an oral examination given by the Department during the first week of spring quarter. Detailed information about the nature and scope of the Ph.D. Qualifying Examination can be obtained from the Department. Research on the doctoral dissertation may not be formally started prior to passing this examination.

Beyond the Master’s degree, a total of 90 additional units of work is required, including a minimum of 45 units of courses.

Engineering Curriculum—The 45 course units beyond the Master’s degree are chosen by the candidate and the adviser from a list of courses which can be obtained upon request to the Department and must include 12 units of advanced mathematics.

Science Curriculum—The 45 course units beyond the Master’s degree are chosen by the candidate and the adviser from a list of courses which can be obtained upon request to the Department and must include 15 units of advanced mathematics.

Fellowships and Research Assistantships

Both fellowships and research assistantships are available to qualified graduate students. For fellowships sponsored by Gift Funds, Stanford University, and Industrial Affiliates of Stanford University in Aeronautics and Astronautics carry grants of $5,500 or more for the nine-month academic year. Students who have demonstrated research capability during a period at Stanford may qualify for half-time research assistantships. The minimum stipend for half-time research assistants, on the basis of 20 hours of work per week, is $300 per month, plus tuition. Research assistants are normally given the opportunity of full-time summer employment at the minimum rate of $600 per month. They may use their work as the basis for a thesis and for University credit toward an advanced degree.

Further information and application forms may be obtained upon request to the Department.

Undergraduate Program in Aeronautics and Astronautics

An interdisciplinary program in Aeronautics and Astronautics leading to the Bachelor of Science degree in Engineering is available in the form of 36 units of electives to constitute the engineering depth requirement for the B.S. degree.

Courses

10. Aeronautics and Astronautics — (Enroll in Engineering 10.)
100. Introduction to Aeronautics and Astronautics—Explanation of principles of flight and propulsion. Concise discussion of the creation of lifting forces, aerodynamic performance, trajectories outside the atmosphere, and the problems of reentry. Remarks on the history of aeronautics and astronautics. Prerequisite: Mathematics 43 or Engineering 21.

3 units, Aut (Seifert) TTh 11:00-12:15

104. Dynamic Response — (Enroll in Engineering 104.)
105. Control System Analysis and Design— (Enroll in Engineering 105.)
121. Solar Energy— (Enroll in Engineering 121.)
129. Colloquium on Life Science Problems in Space Exploration — Basic physiological principles with special emphasis on the car-
diovascular, respiratory, metabolic and endocrine systems and their responses to space-related environmental stresses. Aspects of life-support protective systems and habitability of spacecraft. Human behavior under flight conditions. Recent advances in space biology will be included.

3 units, Win (Billingham, Klein, Oyama, Vernikos-Danellis, Young) TTh 3:15–4:30

131. Experimentation in Aeronautics and Astronautics—Principles and importance of experimental methods used in aeronautics and astronautics; experimental design, performance, evaluation and reporting of results; laboratory experiments selected from the major areas, including fluid dynamics, structural mechanics, guidance and control, and propulsion.

3 units, Win (Bershader, Baganoff) lec. Th 1:15–2:05; lab. Th 2:15–5:05 or T 1:15–4:05

132. Optical Methods in Engineering Science—Introduction to nature of light, its propagation through various media and the design and analysis of optical systems for engineering studies, especially in fluid mechanics. Material will include fundamentals of laser action in gases, and such applications as interferometry, schlieren, holography, Ramen and other laser methods for species identification and velocimetry.

3 units, Aut (Bershader) alternate years, given 1977–78

135. Introductory Acoustics—The objective of this course is to introduce the student to the basic concepts of acoustics and their applications, on the basis of one-dimensional acoustic motion. The presentation will consist of lectures with experimental demonstrations: one-dimensional acoustic motion of a homogeneous inviscid fluid; wave equation and its general solution; travelling plane sound waves; speed of sound in gases and liquids; sound energy density, flux, and intensity; intensity and pressure levels and the decibel scale; one-dimensional sound propagation in an elastic solid; monochromatic waves; frequency, wave length, wave number and phase speed; reflection and transmission of sound between different media; mass law of transmission through walls; acoustic impedance of surfaces and sound absorption; spherical and cylindrical waves; acoustic source and dipole radiators; analysis of acoustical systems—electrical and mechanical analogies; acoustic resistance, inductance, capacitance and impedance; combinations of various acoustic elements; filters and transformers; measurement of impedance and absorption coefficients; propagation through a rigid duct of varying cross-section; introduction to acoustical measurements; remarks on the effects of friction and heat-flow, and of motion of the medium on sound propagation.

3 units, Aut (Chang) MWF 10:00

138. Noise Pollution—(Enroll in Mechanical Engineering 138.)

192. Vector Analysis and Cartesian Tensors with Applications—Vector algebra. Differentiation and integration of scalar and vector fields. Gradient, divergence and curl. Theorems of Gauss, Stokes, and Green. Cartesian index notation. Cartesian tensors: algebra and calculus. Dyadics. Selected applications. (All students taking graduate courses in Aeronautics and Astronautics are expected to be familiar with the basic subject matter covered in this course.) Prerequisite: Mathematics 44.

3 units, Aut (Chao) TTh 9:30–10:45

200A. Engineering Analysis of Flight Vehicles—Examination of the dynamic, aerodynamic, propulsive-system, and structural considerations which govern the configurations of flight vehicles, including atmospheric cruisers, rotorcraft, boosters, and entry gliders. Discussion of illustrative examples. Equations of motion for the rigid vehicle and significance of terms therein. Forms of aerodynamic data. Review of vehicle performance, stability and response. Aerodynamic theory of airfoils and wings at subsonic and supersonic speeds. Homework assignments designed to expand on textual material, encourage the exploration of new ideas and take advantage of Stanford's computation facilities. Prerequisite: 100 (may be taken concurrently) or equivalent.

3 units, Aut (Ashley) MWF 9

augmentation. Static stability, trim, control and static performance. Prerequisite: 200A.

3 units, Win (Ashley) MWF 8

200C. Engineering Analysis of Flight Vehicles—Continuation of 200B: dynamic performance. Boost into orbit from nonrotating and rotating planets. Staging and propulsion requirements. Aerodynamic theory of bodies and results needed for the analysis. Atmospheric entry. The uses of optimization, including prediction of optimal flight-vehicle trajectories. Prerequisite: 200B.

3 units, Spr (Ashley) MWF

201A. Fundamentals of Acoustics—Acoustic equations for a stationary homogeneous fluid; wave equation; sound energy density, flux, intensity, and power; r.m.s. pressure; plane, spherical, and cylindrical waves; harmonic (monochromatic) waves; simple sound radiators; reflection and transmission of sound at interfaces between different media; multiple analysis of sound radiation—monopole, dipole, and quadrupole distributions; inhomogeneous wave equation; Kirchoff integral representation; scattering and diffraction of sound; propagation through ducts—dispersion, attenuation, group velocity; sound in enclosed regions—reverberation; elements of sound propagation in an elastic solid. Prerequisite: first year graduate standing in Engineering, Mathematics, Sciences, or consent of instructor.

3 units, Win (Karamcheti) MWF 10:00

201B. Fundamentals of Acoustics—Continuation of 201A with emphasis on the acoustics of moving and inhomogeneous fields. Effects of friction and heat flow on sound propagation in a homogeneous fluid initially at rest—equations, and boundary conditions; energy considerations; simple examples of plane wave propagation—longitudinal and transversal waves; general considerations introducing the notions of dilatational and rotational waves; effects on propagation in ducts; comments on sound absorption and dispersion owing to relaxation processes; radiation from moving sources and dipoles; Doppler effect; propagation through a uniformly moving fluid—equations and energy relations; plane wave propagation in such a fluid; reflection and transmission at the interface of two differently moving fluids; radiation from a source in a uniformly moving fluid in a duct; acoustics of an inhomogeneous nonuniformly moving fluid; geometrical or ray acoustics; propagation in the atmosphere and the ocean. Prerequisite: 201A or equivalent or consent of instructor.

3 units, Spr (Chang) MWF 11:00

202. Aerodynamic and Hydrodynamic Noise—Lighthill’s formulation of the theory of generation of fluid mechanical noise; Lighthill’s equation; representation of solution in unbounded and bounded regions; monopole, dipole, and quadrupole radiations; some general results; consideration of stationary and moving surfaces and source distributions; problem of a systematic theory of generation and propagation of aerodynamic noise—recent approaches; generation of discrete frequency noise—vortex tones and different kinds of edgetones generated by shear layers such as jets, wakes, and separated boundary layers interacting with surfaces; noise generation by turbulence—relevant description of turbulent motion, analysis of the random noise field in terms of the characteristics of the turbulent field; subsonic and supersonic jet noise theory and comparison with experiments; current developments in jet noise theory; jet noise suppression; noise radiation from boundary layers on bodies and on duct walls; analysis of noise generated by propellers, helicopter rotor blades, and blades or rotating machinery; noise radiation from bodies in motion; airfoil and hydrofoil noise; noise from bodies such as those of aircraft shape; sonic boom; current topics in aerodynamic noise. Prerequisite: 201A and B or equivalent or consent of instructor.

3 units, Win (Chang) MWF 1:15

203. Acoustic Measurements Laboratory—Lecture/laboratory course designed to teach the fundamental concepts and laboratory techniques for the measurement of the physical properties of sound fields in fluids and solids, noise criteria and measurement practice, and thus to familiarize the student with basic acoustic instrumentation such as microphones, audio-oscillators, sound level meters, acoustic spectrum analysers, and recorders. Experiments include the following topics: classification, calibration, and frequency response of microphones; speed of sound in fluids and solids; reflection, refraction, and absorption coefficients; sound wave propagation in composite and bounded media; filters and resonators; reverberation
time; diffraction, scattering, and dispersion of sound; Doppler effect; analysis of discrete frequency sound fields; analysis of random sound fields: power spectral density and correlation functions; demonstration of advanced measurement techniques using laser interferometry and acoustic holography. Prerequisite: 135 or 201.

3 units, Spr (Koutsoyannis) MWF 9 plus lab. by arrangement

204. Mechanics of Hearing—(Enroll in Mechanical Engineering 283.)

206A. Fluid Dynamics—(Enroll in Mechanical Engineering 258A.)

206B. Fluid Dynamics—(Enroll in Mechanical Engineering 258B.)

207. Mechanics of Viscous Flow—(Enroll in Mechanical Engineering 259.)


3 units, Aut (Chang) MWF 10, alternate years, given 1975-76

210A. Fundamentals of Compressible Flow—Fundamentals of the flow of a compressible gas with selected applications to problems in aeronautics; kinematics of fluid motion, vorticity, conservation laws, general theorems, development of the basic field equations for flow with friction and heat transfer, thermodynamic considerations. Emphasis is placed on the development of the full three-dimensional nonsteady field equations and the associated constitutive relations representing the working fluid. Examples are given for the specialization of the equations for flows in one and two-dimensions; compressible Couette flow, unsteady one-dimensional flow, finite waves, oblique shock waves, the shock polar, Prandtl-Meyer flow, flows with shock waves, supersonic two-dimensional flow about thin airfoils. Prerequisites: 192 (may be taken concurrently) and Mechanical Engineering 131A or equivalents.

3 units, Aut (Baganoff) MWF 1:15

210B. Fundamentals of Compressible Flow—Continuation of 210A with emphasis on more general flow geometry. General properties of irrotational flow; linearized potential equation for subsonic and supersonic flow; applications to similarity laws, thin wings, swept wings, drag of slender bodies, and lifting surface theory. Elements of the theory of characteristics and method of solution for two-dimensional and axisymmetric flows; nozzle design; extension to nonisentropic flow. Analysis of Prandtl's boundary layer equations and the origin of turbulence and the basis for the stability of laminar flow— the Orr-Sommerfeld equation. Prerequisite: 210A.

3 units, Win (Baganoff) MWF 1:15

211A. Physical Gas Dynamics—(Enroll in Mechanical Engineering 262A.)

211B. Physical Gas Dynamics—High-speed, high-temperature flow of gas mixtures in local thermodynamic and chemical equilibrium, including effects of viscosity and heat conductivity; application to boundary-layer heat transfer in hypervelocity flight; introduction to rate process analysis for treating flows with vibrational and chemical non-equilibrium.

3 units, Spr (Bershader) alternate years, given 1977-78

214. Numerical Methods in Fluid Mechanics—Presents methods for the numerical solution of problems involving the Eulerian- and Navier-Stokes equations. The relation between time-accurate and relaxation techniques is discussed, as well as higher order implicit and explicit methods combined with splitting. Accuracy, stability and programming complexity are considered.

2 units, Win (Lomax) TTh 9, alternate years, given 1976-77

217. Geophysical Fluid Dynamics—(Enroll in Mechanical Engineering 280.)

218. Similitude in Engineering Mechanics—(Enroll in Mechanical Engineering 206.)

219. Perturbation Methods in Engineering
Mechanics—(Enroll in Mechanical Engineering 207.)

222. Holographic and Other Optical Methods in Engineering Science—Fundamentals of coherent image formation and other relevant features of wave interactions, with applications to holography. Selected applications of holography and other optical methods, including laser diagnostics of gases.

3 units, Aut (Bershader) TTh 1:15–2:30, alternate years, 1976–77

224A. Rate Processes in Gas Flow—Reaction rate coefficients are derived in terms of inelastic collision cross sections. Effects of excited states on overall rate coefficients are considered. Collision induced vibrational excitation is treated classically, semiclassically, and quantum mechanically, for both small and large perturbation conditions. Effects of rotation coupling are discussed, and approximations for simple available energy theories of dissociation are presented. Applications to gasdynamic flows and gas lasers are considered.

1 unit, Win (Hansen) Th 11 or dhr

225. Stochastic Processes in Aeronautics—Applications of probability theory to problems in aeronautics: analysis of a linear system subject to a random forcing function; correlation function; power spectrum; difference and differential equations for probability densities; Fokker-Planck equation with application to diffusion; Ehrenfest model and approach to thermodynamic equilibrium; random walk model for vibrational relaxation; introduction to the statistical theory of turbulence.

3 units, Spr (Baganoff) TTh 2:15–3:30, alternate years, given 1975–76

227. Atmospheric and Space Physics—Introduction to selected topics of geophysics and astronomy with emphasis on conditions in the solar and planetary atmospheres, interplanetary space, and on solar-terrestrial relations. Elements of gravitational theory and orbital mechanics with application to determination of density of the upper atmosphere and the shape and internal structure of the Earth. Properties, time variations, and theoretical representation and interpretation of the upper atmosphere, ionosphere, magnetic field, and magnetosphere of the Earth, the photosphere, chromosphere, the corona of the Sun, and the solar wind in interplanetary space. Theory of Motion of a charged particle in electric and magnetic fields with application to Van Allen particles and cosmic rays. Outline of the principal features of the interaction of the solar wind with the Earth and other objects in the Solar System.

3 units, Win (Spreiter) TTh 8:35–9:50, given 1976–77


3 units, Aut (Chang) MWF 10–11, alternate years, given 1974–75

230. VTOL/STOL Aircraft—Various VTOL and STOL configurations are examined and evaluated as regards their appropriate mission application. Dynamic and aerodynamic characteristics of the classical rotor as the optimum hovering device are considered. Special high-lift devices for STOL operation are emphasized.

3 units, Spr (Carlson) MW 3:15–4:30, alternate years, given 1975–76


240A. Analysis of Structures—Elements of one- and two-dimensional linear and nonlinear elasticity theory; reduction to strength of materials theory; strain-functional variational principle; direct and indirect methods of the calculus of variations applied to deflection and stability analysis of beam, ring, plate, and shell elements. Prerequisite: Civil Engineering 114 or equivalent.

3 units, Aut (Mayers) MWF 11

240B. Analysis of Structures—Effects of deflectional, rotational, and extensional elastic restraint; introduction of Lagrangian multiplier, Dirac delta function, and Galerkin
methods; bending/torsion of plates with non-uniform planforms; stress-functional variational principle with applications to redundant structures, torsion of thin-wing sections, and shear lag in "sheet-stringer" construction; thermal effects; introduction to stress/strain functional (Reissner) variational principle and application to stress/deflection analysis of beams, plates, and pressurized shells. Prerequisite: 240A or consent of instructor.

3 units, Win (Mayers) MWF 11

240C. Analysis of Structures—Unified approach to structural analysis; inertia effects; bending, buckling and postbuckling of stiffened, sandwich and composite structures; application of variational principles to kinematically and constitutively nonlinear analysis of beam, plate, and shell structures under static, dynamic, and thermal loadings. Influence coefficients; use of finite difference and finite element methods. Prerequisite: 240B.

3 units, Spr (Shevell) MWF 10

241A,B,C. Introduction to Aerospace Systems Syntheses and Analysis—The total development of new aircraft systems is explored with emphasis on commercial aircraft; the underlying economic and technological factors that create markets for new aircraft from both rational and historical viewpoints; methods of determining market demands and system mission performance requirements; techniques of optimizing configurations to comply with requirements with emphasis on the interaction of the various disciplines such as aerodynamics, structures, propulsion, guidance, payload, and ground support; parametric studies; applied aerodynamic and design concepts for use in configuration analysis including airplane layout, wing design, high lift systems, drag, stability and control requirements, and tail sizing. Application to a hypothetical aeronautical system; applied structural fundamentals with emphasis on fatigue and fail-safe considerations; design load determination; weight estimation; propulsion system performance and installation; engine types; environmental problems such as noise and smoke; performance estimation including take-off, climb, cruise, and landing. Direct and indirect operating costs prediction and interpretation; future types of aircraft including V/STOL, supercritical wing, uncompromised cargo and SST; aircraft functional systems such as hydraulic, electrical, environmental control; avionics; importance and achievement of aircraft reliability and maintainability.

241A. 3 units, Aut (Shevell) MWF 2:15
241B. 3 units, Win (Shevell) MWF 3:15
241C. 3 units, Spr (Shevell) MWF 2:15

242. Classical Dynamics—Acceleration and rotation reference frames. Kinematics of rigid body motion; Euler angles. D'Alembert's principle, equations of motion. Inertia properties of rigid bodies. Dynamics of coupled rigid bodies. Lagrange's equations and their use. Dynamic behavior and simple stability, including small departures from equilibrium or steady motion, are considered throughout the course. Prerequisite: Engineering 12 or equivalent.

3 units, Aut (DeBra) MWF 12


3 units, Win (Chao) TTh 2:45-4:00

244A. Structural Dynamics—Eigenvibrations and dynamic response of elastic systems including beams, membranes, plates, and shells. Discussion of approximate methods for analyzing complex built-up structures, such as collocation, lumped parameters, and finite elements. Free vibration and normal coordinates. Forced response to various types of excitations. Applications to fundamental flight-vehicle structures. Prerequisites: 243, 240C, or equivalents.

3 units, Aut (Ashley) MWF 3:15
alternate years, given 1976-77

244B. Aeroelasticity—Presentation of the field of aeroelasticity from a unified viewpoint applicable to all types of flight vehicles. Introduction to aeroelastic operators and unsteady aerodynamics. Forced response, static and dynamic eigenvalues of a simplified system. Aeroelastic analysis of representative one-dimensional and two-dimensional structures. Prerequisite: 244A or equivalent.

3 units, Win (Ashley) MWF 3:15
alternate years, given 1976-77
245A. Theory of Elasticity—(Enroll in Mechanical Engineering 238A.)
245B. Theory of Elasticity—(Enroll in Mechanical Engineering 238B.)
245C. Theory of Elasticity—(Enroll in Mechanical Engineering 238C.)
246. Theory of Plates—(Enroll in Mechanical Engineering 241A.)
247. Theory of Shells—(Enroll in Mechanical Engineering 241B.)
249A. Introduction to Nonlinear Continuum Mechanics—(Enroll in Mechanical Engineering 242A.)
249B. Introduction to Nonlinear Continuum Mechanics—(Enroll in Mechanical Engineering 242B.)
248. Thin Shell Analysis—(Enroll in Mechanical Engineering 241C.)
253. Waves and Vibrations—(Enroll in Applied Mechanics 203.)
3 units, Spr (Chao) TTh 1:00-2:15, alternate years, given 1975-76
259. Experimentation in Structural Mechanics—(Enroll in Engineering 250.)
270. Introduction to Linear System Theory—(Enroll in Electrical Engineering 363.)
3 units, Spr (Breakwell) TTh 9:30-10:45
271B. Automatic Control of Space and Aerospace Vehicles—Study in further depth of the systems introduced in 271A; attitude control system design comparing modern optimal synthesis and estimation and classical techniques. Space vehicle gyrocompassing, aircraft stability and response in three axes. Autopilot design and autolanding systems. Prerequisite: 271A. Recommended: 200B and 278A.
3 units, Aut (Bryson, DeBra) MWF 8, alternate years, given 1975-76
3 units, Win (DeBra) MWF 8, alternate years, given 1975-76
3 units, Spr (DeBra) TTh 11:00-12:15, alternate years, given 1975-76
273A. Digital Control I—(Enroll in Engineering 207.)
273B. Digital Control II—(Enroll in Engineering 208.)
275. Fluid Power Control—(Enroll in ME 229.)
276. Control Systems Analysis and Design—(Enroll in Engineering 206.)
3 units, Spr (DeBra) MWF 8, alternate years, given 1976-77
278A. Optimal Control of Dynamic Systems—Optimization problems for dynamic sys-

3 units, Win (Bryson) MWF 9


3 units, Spr (Seifert) TTh 11:00-12:15


3 units, Aut (Breakwell) MWF 11, alternate years, given 1975-76

279A. Space Mechanics — Orbits of near-earth satellites and interplanetary probes; transfer and rendezvous; decay of satellite orbits; influence of earth's oblateness. Stabilization by gravity gradient.

3 units, Win (Bryson) MWF 12

279B. Advanced Space Mechanics—Effects of several centers of attractions; restricted three-body problem; libration points; Encke's method for accurate orbit computation; expansion matching for lunar and interplanetary orbits. Hamilton's principle and elements of the calculus of variations; canonical perturbation theory; application to non-linear oscillations and orbital analysis; non-linear resonances. Prerequisite: 279A.

3 units, Spr (Breakwell) MWF 10, alternate years, given 1976-77

280A. Rocket Propulsion Fundamentals — Introductory rocket dynamics; fundamentals of nozzle flow; use of performance parameters; thermochemical calculation of performance; heat transfer in rockets; basic design procedures. Prerequisites: thermodynamics or elementary gas dynamics equivalent to 210A, Mechanical Engineering 131A; or consent of instructor.

3 units, Win (Seifert) MWF 11

280B. Advanced Space Propulsion—Topics selected from hybrid rockets, combustion, gas-particle flows, ablative heat transfer, thrust vector control, and basics of electric propulsion. Prerequisite: 280A or equivalent.

3 units, Spr (Seifert) TTh 1:15-2:30, alternate years, given 1976-77

283. Aircraft Propulsion — Aircraft characteristics which influence propulsion performance. Physical parameters of airbreathing propulsors, including ramjets, turbojets, and turbofans. Supersonic inlet and nozzle design. Performance calculations of engines and review of selected items of current propulsion research literature. Prerequisite: Fundamental fluid mechanics equivalent to 210A or Mechanical Engineering 131A.

3 units, Spr (Seifert) TTh 11:00-12:15

284. Introduction to Partially Ionized Gases — (Enroll in Mechanical Engineering 251.)


3 units, Spr (Chang) MWF 10, alternate years, given 1976-77
290. Problems in Aeronautics and Astronautics—Investigation, experimental or theoretical, of problems in aeronautics and astronautics. Offers opportunity to students to work in any field of special interest.

1 to 5 units, any quarter (Staff) by arrangement

291A. Linear Transforms and Their Applications to Engineering Problems I—Introduction to linear integral transforms: Fourier, Laplace, Hankel, Mellin transforms. Applications to boundary value problems in solid and fluid mechanics, heat conduction, wave propagation. Inverse transformation, contour integration, approximations. Methods of steepest descent and stationary phase. Prerequisite: Mathematics 106 (may be taken concurrently).

3 units, Win (Chao) T 9 and Th 9:35-10:50, given 1976–1977


3 units, Spr (Chao) T 9 and Th 9:35-10:50, given 1976–77

294A. Introduction to Nonlinear Continuum Mechanics—(Enroll in Mechanical Engineering 242A.)

294B. Introduction to Nonlinear Continuum Mechanics—(Enroll in Mechanical Engineering 242B.)

295. Seminar in Solid Mechanics — (Enroll in Mechanical Engineering 295.)

296. Seminar in Space Science and Technology—Survey of Space Science and Technology intended for undergraduate and graduate students. Includes basic concepts such as rocket propulsion and orbit theory, discussion of results of manned and unmanned space flights that have been carried out, planetary exploration and practical applications of orbiting space vehicles such as communications and weather observations will receive special attention.

2 units, Spr (Mark) M 3:15-5:05

297. Seminar in Flight Control and Guidance—Problems in all branches of vehicle control, guidance and instrumentation. The major purpose of the seminar is to give students who are planning or engaged in thesis research an opportunity to become acquainted with the work of other researchers, both on and off the campus. Students engaged in or anticipating research activity in these areas normally attend. Others are invited. Registration for a unit of credit, without letter grade, is optional; a letter grade is given for students who make presentations.

1 unit, Aut, Win, Spr (DeBra) W 4:15

298. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)


2 to 15 units, any quarter (Staff) by arrangement


2 to 15 units, any quarter (Staff) by arrangement

420A,B. Interdisciplinary Transportation Analysis—(Enroll in Graduate Special 420 A,B.)

CHEMICAL ENGINEERING*

Chairman: Michael Boudart

Professors: Andreas Acritos, Michel Boudart, David M. Mason

Consulting Professors: Richard F. Balzhiser, Alan S. Michaels

Associate Professors: Channing R. Robertson, Robert J. Madix

Assistant Professor: George M. Homsy

Lecturer: Robert H. Schwaar

Affiliated Faculty:


* The curriculum leading to the B.S. degree in Chemistry is described elsewhere in this bulletin.
**Programs of Study**

**Bachelor of Science**

The B.S. Chemical Engineering program consists of the basic 36-unit engineering depth requirement (described under the "Departmental Majors" section elsewhere in this Bulletin) which provides a broad background in the fundamentals of chemistry as well as basic training in separations processes, engineering thermodynamics, transport phenomena, applied chemical kinetics and plant design. In addition, this program is supplemented with courses in physics, mathematics, chemistry, and basic engineering, as well as optional advanced chemical engineering courses. With the exception of these certain basic courses and the engineering depth sequence, there is no set program which all undergraduate students follow.

A sample B.S. program is available through the Department of Chemical Engineering advisers or the Dean’s Office, School of Engineering. It is recommended that the student discuss his or her prospective program with an adviser, especially if he or she is transferring to the program from chemistry, physics, or another field in engineering. The student can usually arrange to attend one of the overseas campuses with little difficulty.

**Master of Science in Chemical Engineering**

The M.S. program is intended for students who wish to engage primarily in course work in Chemical Engineering and related sciences and is normally pursued by students wishing to qualify for the Ph.D. degree, as described below. The M.S. degree is awarded without a formal thesis after a minimum of three quarters of study subject to the following restrictions:

**Unit and Course Requirements**—A minimum of 36 units is required for the M.S. degree, at least 21 of which must be chosen from among the graduate-level lecture course offerings in Chemical Engineering. The remaining courses may include graduate or advanced undergraduate technical courses in the basic sciences or the School of Engineering. Credit toward the M.S. will not be given for courses normally required for the B.S. degree or for Chemical Engineering 270 through 277 and 300.

Under some circumstances, the student may apply up to six units of Graduate Research (Chemical Engineering 290) toward fulfilling the M.S. requirement. A written report describing the results of this research must be approved by his or her research adviser. Students electing this program are required to take at least 18 units of graduate-level Chemical Engineering lecture courses and the remainder in the basic sciences or technical courses offered in the School of Engineering, as described above.

**Grade Requirements**—Courses taken to satisfy the graduate Chemical Engineering course requirement must be taken for letter grades. The remaining courses may be taken either for letter grades or pass/no credit, subject to the approval of the departmental graduate committee.

**Doctor of Philosophy**

The Ph.D. degree is awarded upon completion of a minimum of nine quarters of study plus the following requirements:

**Unit and Course Requirements**—A total of 45 units of course work is required, 21 of which must be chosen from among the graduate-level lecture course offerings in Chemical Engineering. The remaining 24 units may be chosen from graduate or advanced undergraduate courses in the basic sciences and in the School of Engineering and may include up to three units of Chemical Engineering 270–277. Credit will not be given for courses normally required for the B.S. degree nor for Chemical Engineering 300.

**Thesis Requirements**—In addition, the degree of Engineer requires the satisfactory completion of graduate research (Chemical Engineering 290) equivalent to approximately one year’s full-time work. A formal acceptable thesis is required.
Chemical Engineering 270 through 277. No credit will be given for Chemical Engineering 300, undergraduate Chemical Engineering courses, or courses usually required for the B.S. degree. The student should take all Chemical Engineering lecture courses for letter grades.

**Qualifying Examination** — In order to be advanced to candidacy for the Ph.D. degree, the student must pass a qualifying examination. This is carried out in two steps. First, the student’s performance in course work during his first two quarters is reviewed by the faculty and, if found satisfactory, the student then chooses a research advisor and begins his research. The second stage of the process consists of an oral presentation by the student covering his progress in research and an in-depth examination of the presentation by the faculty. This examination is usually held at the beginning of the fifth quarter of the student’s residence.

**Thesis Requirement** — A dissertation based on a successful investigation of a fundamental problem in Chemical Engineering is required, and the student normally enrolls in Chemical Engineering 290 during the course of his research. It is expected that normally in three to four calendar years the student will have fulfilled all the requirements for the Ph.D. including submission of a completed thesis to his research adviser. At this time an oral examination based upon the candidate’s thesis research will be held in the form of a public seminar followed by private questioning by an examining faculty committee. Upon satisfactory performance in the examination, the Ph.D. degree is awarded.

**Research Activities**

Research investigations are currently being carried out in the following fields: Newtonian & Non-Newtonian Fluid Mechanics, Hydrodynamic Stability, Chemical Energy Conversion, Applied Chemical Kinetics, Surface Reactivity, Adsorption and Catalysis, and Bioengineering. A brochure describing research projects currently being pursued in these areas is available from the Department upon request.

**Fellowships and Assistantships**

A number of fellowships and assistantships are awarded each year to incoming students. Application forms may be obtained upon request to the Department. The completed application should be received no later than February 15 preceding the start of the academic year for which the award is to be made.

**Courses Primarily for Undergraduate Students**

20. Introduction to Chemical Engineering — This course is intended to provide an overview of the field of chemical engineering through discussion and engineering analysis of physical and chemical processes. Concepts of mass and energy transport in equilibrium processes are developed in the first part of the course. Their utility is illustrated by a number of typical examples. These will include methane and methanol synthesis, energy from municipal refuse, coal gasification, and others having an impact on U.S. energy resources. Rate processes are introduced in the second part of the course. Heat and mass transport are discussed, and application is made to the design of artificial-kidney devices and the analytical approaches commonly employed to predict operating efficiencies. Several commercially available artificial-kidney systems are discussed in detail. This course is intended for freshmen and sophomores. May be taken by upperclassmen with consent of instructor. Prerequisite: Chemistry 31, 33 recommended but not required.

3 units, Spr (Homsy, Robertson) TTh 9:30–10:45

20L. Introduction to Chemical Engineering Laboratory — The laboratory section consists of a small number of local plant trips. These include visits to a municipal waste reclamation facility, a major oil refinery, a large petrochemical facility, and the renal dialysis unit at the Stanford University Medical Center. Pass/no credit. To be taken concurrently with 20.

1 unit, Spr (Homsy, Robertson) by arrangement

110. Equilibrium in Thermodynamic Systems — Review of the postulates of thermodynamics; properties of nonideal systems including mixtures; phase equilibria and chemical equilibria; flow processes; heat engines and refrigeration. Prerequisite: Chemistry 171 or Engineering 32.

3 units, Win (Madix) MWF 10
120. Separations Processes—Application of the equilibrium-stage concept to design of mass-transfer devices; phase relationships; countercurrent multistage extraction and distillation processes, simplified graphical and computer design methods; chromatographic separations, thermal diffusion, reverse osmosis, zone refining. Prerequisite: 110 or equivalent.

3 units, Spr (Acrivos) MWF 10

120L. Separations Processes Demonstration Laboratory—Experiments in separations processes. To be taken concurrently with 120.

1 unit, Spr (Acrivos) by arrangement


3 units, Spr (Mason) TTh 2:15-3:30

140. Fluid Mechanics—The flow of isothermal fluids from a momentum transport viewpoint. Continuum hypothesis; scalar fields; fluid statics; deformation of continuous media; non-Newtonian fluids; the equations of motion; creeping flow; potential flow; boundary layer theory; turbulence; macroscopic momentum, mass, and energy balances; free-surface phenomena. Prerequisites: Mathematics 150 or equivalent. Mathematics 131 recommended.

3 units, Aut (Robertson) TTh 9:30-10:45

140L. Fluid Mechanics Demonstration Laboratory—Experiments include: linear shear flows, boundary layer visualization, internal and external flows, non-Newtonian fluids, laser-Doppler velocimetry, fluidics, and the motion of free surfaces. To be taken concurrently with 140.

1 unit, Aut (Robertson) by arrangement

150. Energy and Mass Transport—A basic course in the transport of energy and mass in flowing systems. Fourier's law, heat transfer in solids, laminar flow, forced and free convection, boundary layer heat transfer, the equations of change for non-isothermal systems, energy transport by radiation, Fick's Law, binary diffusion, the equation of convective diffusion, mass transfer with chemical reaction, transport in turbulent flows, heat and mass transfer analogies. Prerequisite: 140 or equivalent.

3 units, Win (Homsy) MWF 9:00

150L. Energy and Mass Transport Laboratory—Experiments in heat and mass transfer. Unsteady state thermal conduction, boiling heat transfer, forced and free convection, radiation, and convective diffusion in liquids. To be taken concurrently with 150.

1 unit, Win (Homsy) by arrangement

160. Chemical Engineering Plant Design—Lectures given by design engineers from Stanford Research Institute include: flow sheets and material balances; equipment selection for separation processes, chemical reactions, and other energy and mass transfer operations; estimation of capital expenditures and production costs; construction in the chemical industry; optimization techniques. Open to seniors in chemical engineering or by consent of instructor.

3 units, Spr (Schwaar) M 3:15-5:05 and one hour by arrangement

190. Undergraduate Research in Chemical Engineering—Laboratory or theoretical work for undergraduate students under the direct supervision of a faculty member. This might involve research in one of the graduate research groups or could be focused on a special project in the demonstration laboratory.

(Staff) by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

(In addition to the courses listed below, graduate students in chemical engineering would be expected normally to enroll in some of the graduate courses offered by the other engineering departments, as well as the Departments of Mathematics, Physics, and Chemistry.)

200. Applied Mathematics in Chemical Engineering—A course treating mathematical problems commonly arising in continuum mechanics with applications in modeling of separations processes, heat and mass transfer, fluid mechanics and chemical reactor design. Some emphasis is put on the computational aspects of modeling, and the student is expected to write and run a number of computer programs during the course. Topics covered include applications of matrix
theory, numerical solution of ordinary differential equations, perturbation techniques, expansion and finite-difference solutions of partial differential equations. Prerequisites: Mathematics 113, 130, 131 or equivalent; knowledge of Fortran.

3 units, Aut (Homsy) MWF 9:00

201. Bioengineering — This course covers the analytical and experimental aspects of selected biological and physiological problems as viewed from a chemical engineering perspective, with emphasis on transport phenomena. Topics to be treated are: the design of immobilized enzyme reactors; experimental and theoretical approaches to renal transport mechanisms; nonequilibrium, thermodynamic treatment of membrane transport in synthetic and biological systems.

3 units, Win (Robertson) TTh 1:15-2:30

204. Kinetics of Chemical Processes—Elementary steps; sequences at the steady-state. Reaction networks. Theoretical principles and application to the study of chain and catalytic reactions.

3 units, Win (Boudart) WF 2:15-3:30

205. Transport in Reacting Systems—Physical problems of engineering interest where transport of mass, energy and momentum in multicomponent systems is accompanied by homogeneous or heterogeneous chemical reactions. Selected topics include behavior of non-isothermal porous catalysts, thermal properties of reacting fluids, combustion and electrode processes; oscillatory reactions.

3 units, Aut (Mason) TTh 2:15-3:30

210A,B. Viscous Flow Theory (with Applications to Heat and Mass Transfer) — An intensive course dealing with the fundamental principles of momentum, heat and mass transfer and their application to problems of physical interest. Derivation and analysis of the Navier-Stokes equations, the energy equation, and the equation for mass transport; flows at small Reynolds numbers and Stokes’ law; the method of matched asymptotic expansions; laminar boundary layer theory; hydrodynamic stability and the Orr-Sommerfeld equation; interfacial instability.

210A. 3 units, Win (Acrivos) TTh 8:00-9:15

210B. 3 units, Spr (Acrivos) TTh 8:00-9:15

213. Applied Solid State Chemistry — The chemistry of the solid state is discussed as it pertains to environments encountered in chemical engineering. The emphasis of the course will be on generally applicable concepts as opposed to specific reaction systems; however, specific examples will be used throughout. Typical topics representative of the course material are: chemical transport reactions, vapor-solid equilibrium, vaporization and crystal growth, semi-conductivity, defects in solids, non-stoichiometric solids, corrosion and oxidation of metals, solution of gases in solids, decomposition of solids, corrosion and passivity, and solid surfaces and surface reactivity.

3 units, Aut (Madix) TTh 11:00-12:15

214. Advanced Topics in Applied Mathematics — A special topics course intended for advanced graduate students desiring a treatment of variational calculus and the method of weighted residuals, and their application to problems in hydrodynamic stability, turbulence, and creeping flow. Topics include variational inequalities in suspension rheology, Ritz-Galerkin methods in stability theory, the method of energy, and the boundary theory of turbulence. Prerequisite: an introductory course in applied mathematics, e.g., 200, Mechanical Engineering 200A,B, or equivalent.

3 units, Spr (Homsy) by arrangement

215. Special Topics in Applied Chemistry and Chemical Engineering—In many separation processes involving the transfer of energy and/or mass between phases, phenomena involving surface or interfacial forces, or special molecular organization at phase boundaries, have profound effects upon interphase momentum, heat, and mass-transport kinetics. This seminar will examine in depth a few industrially important “interface-governed” phase-transfer processes, to illustrate the roles of interfacial dynamics and adsorption phenomena in separation operations. Cases to be studied include (1) surface/interfacial tension gradients and their effects on gas absorption by liquids, distillation, and liquid/liquid extraction; (2) nucleation and phase-transformation processes (condensation and crystallization); (3) gascand vapor-transport through monomolecular films on liquids; (4) foam- and froth-fractionation; and (5) membrane-transport and separation processes.

3 units, Spr (Michaels) by arrangement
270–277. Research Seminars in Chemical Engineering—Discussion of recent developments and current research in specialized fields. Open to qualified students with consent of instructor; units by arrangement.
   Aut, Win, Spr (Staff) by arrangement

270A,B,C. Fluid Mechanics (Acrivos)
271A,B,C. Adsorption and Catalysis (Boudart)
272A,B,C. Applied Chemical Thermodynamics and Kinetics (Mason)
273A,B,C. Bioengineering (Robertson)
275A,B,C. Surface Reactivity (Madix)
277A,B,C. Stability of Fluid Motions (Homsy)

270. Graduate Research in Chemical Engineering—Laboratory and theoretical work for graduate students on chemical engineering problems leading to partial fulfillment of requirements for an advanced degree. Credits are not given until the student has satisfied the specific report or dissertation requirement.
   (Staff) by arrangement

289. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)

300. Colloquium—Students enrolled in this course will be expected to attend the colloquia of the Department of Chemical Engineering. Must be taken every quarter by candidates for advanced degrees in Chemical Engineering.
   1 unit, Aut, Win, Spr (Staff) by arrangement

**CIVIL ENGINEERING**

Emeriti: Jack R. Benjamin, Rolf Eliassen, Wilhelm Flüge, Eugene L. Grant, Miklós Hetényi, Ray K. Linsley, Alfred S. Niles, Clarkson H. Oglesby, Victor K. Thompson (Architecture), James B. Wells, Harry A. Williams, Donovan H. Young (Professors); Eugene V. Ward (Lecturer)

Chairman: Robert L. Street
Associate Chairman: Joseph B. Franzini

Consulting Professors: Irwin Mussen, James L. Sherard
Associate Professors: G. Wayne Clough, James O. Leckie, Leonard Ortolano
Assistant Professors: Helmut Krawinkel, Boyd C. Paulson, Jr., Lily Y. Young
Lecturers: John W. Alltucker, John A. Blume, H. Edward Clifton, Oscar Hoffmann, E. Garrison Kost, Gilbert M. Masters, Robert W. Medearis, Keshavan Nair, Bennet R. Raffin

**PROGRAMS OF STUDY**

The undergraduate Civil Engineering Major provides a preprofessional program stressing the fundamentals common to many special fields of civil engineering. Free elective units, plus the proper selection of courses for the requirements in Technology and Society, Mathematics, Science, and Engineering Breadth, permit the student to obtain either a broad general civil engineering education or a more specialized education in a specific branch, such as construction, environmental engineering, hydraulics, transportation, public works administration, structures, or a great variety of other branches. Laboratory facilities are available to the student in fluid mechanics, environmental engineering, materials, soil mechanics, structural and earthquake engineering, and experimental stress analysis.

At least one year of graduate study is essential for the professional practice of civil engineering and is strongly recommended. Students who contemplate advanced study at Stanford should discuss their plans with their advisors early in the senior year. The opportunity to participate in the co-terminal B.S.-M.S. program should be explored by students desiring an integrated five-year program.

The Civil Engineering Department, in collaboration with other departments of the University, offers graduate programs with particular strength in:

- Construction Engineering and Management
- Civil Engineering Management
- Civil Engineering Planning
Structures, Materials and Geotechnical Engineering
Civil Engineering Materials
Earthquake Engineering
Foundation Engineering
Reliability and Risk Analysis
Soil Mechanics
Soil-Structure Interaction
Structural Analysis and Design
Water Studies
Environmental Engineering
Hydrology
Hydromechanics
Nuclear Civil Engineering
Water Resources

Research work under these programs is carried out in the following facilities—the hydraulics laboratory, the George Havas Building which houses water quality and environmental engineering laboratory facilities, the materials laboratory, the concrete laboratory, the soil mechanics laboratory, and the structural engineering laboratory. Research in earthquake engineering is conducted in the John A. Blume Earthquake Engineering Center. Office space is provided for most of the graduate students who are acting as research or teaching assistants.

PROGRAMS IN CIVIL ENGINEERING

Construction

The objective of the program in Construction Engineering and Management is to prepare technically qualified students for responsible roles in the construction industry. Coursework concerns the management of people, money, and equipment to accomplish engineering construction competently and profitably. Subjects offered within the program include costs and estimates; equipment and methods; planning, scheduling, and control; administration; human resource management; work improvement; labor relations; equipment replacement policy; and computer applications. Additional related coursework is available from other programs within the Department, from other engineering departments, and from other schools in the university such as Earth Sciences and the Graduate School of Business. Each student, together with his advisor, can design a curriculum to meet individual educational goals. The program is primarily an M.S.-level one although a few students continue post-Master's coursework and research leading to the Engineer or Ph.D. degree. Close contacts are maintained with industry, and all students participate in weekly discussions with industry representatives.

Civil Engineering Planning

The program focuses on the engineer as a planner of civil engineering systems which ultimately have a significant influence on the development of cities and regions. They include water resources and water quality projects, transportation systems, urban facilities and other developments. Heavy emphasis is on the social, economic, institutional and environmental aspects of planning.

Students design their programs by selecting an appropriate mix of courses from the planning core, analytical series and a specialty area. Core courses cover social, economic, institutional, financial and environmental aspects of public works. The analytic series includes quantitative methods and techniques useful to planners. Courses making up the specialty may emphasize one or more of the following areas: water resources, water quality, transportation, environmental planning and urban and regional planning. Emphasis is on planning as a discipline, and men and women are prepared for all levels of career positions with private industry, consulting firms and government agencies.

Structures, Materials, and Geotechnical Engineering

Instructional programs and research opportunities are provided in the areas of structural engineering, civil engineering materials, and geotechnical engineering. Particular emphasis is given to earthquake engineering, risk and reliability analysis, computer-aided structural analysis and design, structural dynamics, finite-element methods, foundations and earth structures soil-structure interaction, and materials engineering (cements and concretes). Flexible programs enable students to prepare for careers as consulting engineers or as engineers in industry, government, and universities. The John A. Blume Earthquake Engineering Center provides support and facilities for instruction and research in earthquake engineering and structural dynamics.

Water Studies

Water studies is a broad and integrated group of graduate degree programs which
have a major focus on water but also cover much broader aspects of environmental concern and planning activities. Thus, the chemistry, biology, nuclear, and engineering aspects of water quality and water pollution control can be covered in depth in environmental engineering, and additional study is available in air pollution, noise pollution, environmental aspects of power generation, and environmental planning and impact assessment. The hydromechanics, hydrology, and environmental engineering programs represent individual specialties, but can be integrated with appropriate offerings under Civil Engineering Planning to give water resources and environmental programs with technical emphasis, planning emphasis, or a combination of these two important activities. The programs are kept flexible to foster interaction among students and to encourage the development of individual programs suitable for a broad range of engineering and science backgrounds and career goals.

DEGREES

BACHELOR OF SCIENCE

Students who major in Civil Engineering must complete the requirements for the BS degree given previously under the School of Engineering, "Undergraduate Programs of Study." Suggested courses to be taken in satisfaction of the requirements in Technology and Society, Mathematics, Science, and Engineering Breadth are available from the Civil Engineering Department office or from the office of the Dean of Engineering. Free elective units may be used in any way the student desires, including additional studies in civil engineering. Because the undergraduate engineering curriculum is designed to insure breadth of study, students who intend to enter the professional practice of civil engineering must obtain their professional education at the graduate level.

MASTER OF SCIENCE

Programs are available leading to the degree of M.S. in Civil Engineering with special designation on the diploma as follows: Management, Materials, Construction, Environmental Engineering, Hydrology, Hydromechanics, Planning, Nuclear Civil Engineering, Reliability Engineering, Geotechnical Engineering, Soil Mechanics and Foundations, Structural Engineering, Structural Mechanics, Earthquake Engineering, and Water Resources. A general M.S. in Civil Engineering without special designation is also given. Detailed statements of the requirements for all Master's degrees and the specific course requirements for a degree with special designation may be secured by request to the Civil Engineering Department.

Students having undergraduate degrees in civil engineering normally can satisfy requirements for the M.S. degree with three quarters of graduate work of satisfactory quality. Students with undergraduate degrees in other fields may need longer residence for the M.S. degree in order to make up specified basic undergraduate civil engineering subjects. The specific requirements differ depending upon the M.S. degree sought. For example, in environmental engineering, students with undergraduate degrees in science or other fields of engineering generally can complete course requirements within three quarters. Students desiring to do so may take an additional 45 units of course work to qualify for a second M.S. degree in Civil Engineering in an area other than that of the first degree providing they also fulfill the specific requirements for the second degree.

A minimum 2.7 LGI and a program of at least 45 quarter units are required for candidates to be recommended for the M.S. degree. The program of study must be approved by the faculty of the Department and shall include at least 40 units of courses in engineering, mathematics, science, architecture and related fields unless it can be shown that other work is pertinent to the student's objectives.

ENGINEER

A minimum of six quarters (90 units) of graduate work including a thesis (12 to 15 units) is required for the degree of Engineer in Civil Engineering. This degree is recommended for all students desiring more graduate education than is provided by the Master's degree, especially for those planning a career in professional practice. The student normally should start his thesis in the first quarter of graduate work beyond the M.S. degree. Programs leading to the degree of Engineer are offered in the fields of specialization mentioned above. A minimum "B" average (3.0 LGI) is required for candidates to be recommended for the degree. The pro-
gram of study must be approved by the faculty of the Department.

**Doctor of Philosophy**

The degree of Doctor of Philosophy is offered under the general regulations of the University as set forth in the section “Degrees” in this bulletin. This degree is recommended for those who expect to engage in a professional career in research, teaching, or technical work of an advanced nature in planning, design, and analysis. The Ph.D. program is rigorous and should be undertaken only by students with ability for independent work. It requires a minimum of three years (nine quarters) of graduate study, at least two years of which must be at Stanford. Experience has shown that few students complete the Ph.D. within the minimum residence period. Prospective doctoral students should anticipate the possibility of at least one extra year. Further information about Ph.D. requirements and regulations will be found in the Department handout entitled “Information and a Typical Timetable for the Ph.D. Degree.”

The first year is represented by the M.S. program described above. The second year will be devoted partly to additional courses of graduate study and partly to the preliminary work toward a dissertation. The third and subsequent years will be applied to further course work and to the completion of an acceptable dissertation. Dissertation research in absentia is not permitted.

The program of study will be arranged by the prospective candidate at the beginning of the second year with the advice of a faculty committee whose members are nearest in the field of interest to that of the student. The chairman of the committee will serve as the student's pro tem. adviser until such time as a member of the faculty has agreed to direct the dissertation research. Insofar as possible the program of study is adapted to the interests and needs of the student within the framework of the requirements of the Department and the University. In the second year of graduate study the student is expected to pass the Departmental General Qualifying Examination to be admitted to candidacy.

**Financial Assistance**

The Department maintains a large and continuing program of financial aid for graduate students. Fellowship or scholarship awards range from $500 to $6,200. A generous student loan program is available. John A. Blume Fellowships are available in the areas of earthquake engineering and dynamics of structures.

Teaching assistantships (normally awarded only to Engineer and Ph.D. candidates) carry stipends for as much as one-third time work as teaching aides during the academic year. Research assistantships are also available. Engineer and Ph.D. candidates may be able to use research results as a basis for a thesis. Assistantships and other basic support may be supplemented by fellowship and scholarship awards or loans. Continued support is generally available for further study toward the Engineer or Doctor of Philosophy degree subject to performance of the student, availability of research funds, and requisite staffing of current projects. Detailed information may be obtained by writing to the Department of Civil Engineering.

**Admissions**

Admission as a graduate student in Civil Engineering is obtained by applying to the Office of Graduate Admissions. Each successful applicant will be advised as to the degree for which he or she is admitted. If, after enrollment at Stanford, the student wishes to continue toward a degree beyond the one for which he or she was originally admitted, a written application must be made to the Department of Civil Engineering.

**Undergraduate Courses**

40. Elementary Surveying — Care and use of instruments; leveling; topographic surveying; triangulation; horizontal and vertical curves; engineering astronomy. Enrollment limited to 27 to each lab.
4 units, Aut (Douglas) TTh 8; lab. TTh 1:00-5:30
Spr (Douglas) TTh 11; lab. MW 1:00-5:30 or TTh 1:00-5:30

107. Mechanics of Fluids — Dimensional analysis and principles of similarity, including application to hydraulic modeling, open channel flow, elementary hydrodynamics. Prerequisite: Engineering 21.
3 units, Win (Hsu) MWF 10

4 units, Win (Richards) MTThF 9

116. Plain Concrete—Testing of aggregates, design of concrete mixes including statistical mix design, testing of concrete samples, and physical characteristics of Portland cement concrete. Student reports and project. Course consists of lecture followed by laboratory. Enrollment limited to 24 students.

3 units, Aut (Parker) T 1:15-5:05 plus Th 1:15-4:05


3 units, Aut (Richards) TTh 10; lab. M 1:15-3:05

130. Transportation—Planning, design, and operation of all modes of transportation. Organization and functions; analysis of demand, including relationships to land uses and economic activities; choices between modes; supply of physical facilities, including location and design of plant and equipment in relation to operating philosophies. Interrelationships with institutional, economic, engineering-economy, financial, personal, business, environmental, aesthetic, and social considerations. Open to all students.

3 units, Win (Roggeveen) TThF 2

133. Introduction to Urban Planning — A survey of the basic principles for understanding cities by analyzing selected contemporary American issues. The planning process and how it operates to solve urban problems—economic, physical, and social. Technology’s contribution and engineering’s role in urban society.

3 units, Aut (Loewenstein) TTh 11:00-12:15

140. Advanced Surveying—Additional study of surveying. Prerequisite: 40 or equivalent.

1 to 3 units, Aut, Spr (Douglas) by arrangement

143. Specifications and Contracts — Principles of contract law as applied to civil engineering; legal problems in preparing and administering construction contracts; varieties of construction contracts; specification organization and interpretation; engineer-client relationships. Prerequisite: junior standing.

3 units, Aut (Fondahl) TTh 11-12:15
Win (Fondahl) MWF 9

144. Construction Engineering and Management—Forms of construction organizations, labor relations, estimating construction costs, planning and scheduling, safety, cost accounting and control, residential construction.

3 units, Aut (Paulson) MWF 9
Spr (Paulson) MWF 9

145. Construction Equipment and Methods—Construction procedures, methods, equipment; selection and efficient use of excavation and hauling equipment, related problems.

3 units, Aut (Douglas) MW 8, plus M 1:15-4:05. Note: This period usually a one hour lecture, but time reserved for several afternoon field trips.

160. Water-Resources Engineering — Hydrologic measurements, runoff relations, groundwater, water law, reservoir design, frequency analysis, hydraulic structures, planning of water-resources projects. Prerequisites: 107, Engineering 161.

4 units, Spr (Franzini) MWF 11 and T 2:15-4:05

170. Man and His Environment—An introduction to the problems of the engineering control of the pollution of the air, water, and land environment with which man interacts. The course stresses the causes, effects, and controls of air, water, and land pollution and covers such fields as disease, noise, power generation, water resources, transportation, land use planning, and solid waste management. (Intended for both science and non-science majors.)

3 units, Aut (Masters) MWF 3:15

171. Environmental Planning — Environmental policies, goals and objectives; land use planning and environmental quality control; alternative pollution abatement strategies; environmental impact assessment for public works projects; and environmental quality issues in developing nations. De-
172. Air Pollution—(Enroll in Mechanical Engineering 137.)

173. Energy and Society—(Enroll in Mechanical Engineering 180.)

174. Noise Pollution—(Enroll in Mechanical Engineering 138.)

175. Environmental Measurements — (Enroll in Mechanical Engineering 139.)

180. Elementary Structural Analysis—Analysis of beams, trusses, frames; influence lines for beams, girders, trusses; 3-dimensional trusses; deflections by virtual work, moment-area, elastic loads; indeterminate analysis by superposition equations, slope-deflection, moment distribution. Introduction to matrix methods. Prerequisites: Engineering 11 and C.E. 114.

4 units, Aut (Gere) MWF 9 and W 2:15-4:05

181. Design of Steel Structures — Concepts of elastic design of structures; types of loading; structural systems for buildings and bridges; elastic design and analysis of structural elements, i.e., tension members, compression members, beams, beam-columns, and connections; design of trusses and moment resisting frames; introduction to plastic design. Prerequisites: Engineering 11 and CE 180 or equivalent.

3 units, Win (Krawinkler) TTh 11 plus T 2:15-4:05

182. Design of Reinforced Concrete Structures—Properties of concrete and reinforcing steel; behavior of structural elements subjected to bending moments, shear forces, torsion, axial loads, and combined actions; design of beams, slabs, columns, footings, and retaining walls; ultimate strength design and serviceability requirements; design of simple structural systems for buildings. Prerequisites: Engineering 11 and CE 180 or equivalent.

3 units, Spr (Krawinkler) MW 10 plus Th 2:15-4:05

190. Geotechnical Engineering—Principles of soil mechanics employed in the analyses of earth retaining structures, structural foundations, earth dams and embankments, and landslides. Course includes design-type laboratory projects. Prerequisite: Engineering 11.

4 units, Aut (Clough) MWF 11; lab. to be arranged

196. Engineering Practice—Visits to engineering offices including public agencies, consultants and corporations. Limited enrollment with preference given to fourth and fifth year civil engineering bachelors candidates. Normally one unit pass-fail; but may be taken for two units (graded) by preparing a paper that counts as a Senior Report (CE 198).

1 or 2 units, Win (Wise) M 1:15-5:05

197. Engineering Synthesis — Utilization of students’ previous course work and creative abilities with objective of producing problem solutions and workable designs for a comprehensive project. Stress placed on job planning, coordination and efficient use of group talent. Enrollment limited to 8. Prerequisite: senior standing.

4 units, Win (Douglas, Staff) TTh 1:15-2:05 plus two hours by arrangement

198. Senior Report—Practice in execution of a simple engineering investigation, preparation of a written report on the investigation. Required of all candidates for the Bachelor’s degree who do not take 196 for 2 units or 197. Must be taken during either of the last two quarters before graduation.

1 unit, Win, Spr (Staff) by arrangement

199. Directed Reading and Special Studies in Civil Engineering—Open to senior students by consent.

1 or more units, any quarter (Staff) by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

203. Statistical Models in Civil Engineering —Applications of probability and statistical analysis to civil engineering; model construction from probability theory; descriptive statistics; estimation with small samples; recognition of variation including professional elements; models for reliability studies of civil engineering designs; construction of complex models. Prerequisite: graduate standing.

4 units, Aut (Shah) TTh 9 and Th 1:15–2:05
206. Stochastic Processes and Decision Statistics for Civil Engineers—Description of stochastic processes; transportation models; hydrologic models; structural dynamics models; harmonic analysis of stochastic processes; application of Markov chain models to civil engineering problems; statistical decision theory; Bayes' theorem; utility functions; optimization of decisions under uncertainties; economic analysis; system analysis. Prerequisites: a course in statistics and 233.
4 units, Win (Shah) TTh 10 plus W 1:15-2:05

214A. Experimental Stress Analysis — (Enroll in Mechanical Engineering 249A.)
214B. Advanced Work in Experimental Mechanics—(Enroll in Mechanical Engineering 249B.)

3 units, Spr (Richards) TTh 11:00-12:15

219. Flood Plain Management — Alternatives for flood damage mitigation; control by zoning; flood-proofing; structural controls; flood insurance; methods of evaluating alternatives; use of alternatives in time sequence.
2 units, Win (James) MW 1:15

221. Social Aspects of Public Projects—Social implications of public works, and urban and environmental development or conservation efforts. The course will deal with research methods and problems in the application of social/behavioral research to public decision-making. Critical examination will be made of case studies from California, other states, and abroad.
3 units, Win (Mussen) TTh 4:15-5:30

222. Water Resources Planning — Integration of technical, economic, political and social factors in decisions relating to water resources management. Prerequisites: 160 or 268.
3 units, Aut (James) MWF 1:15

223. Economics of Public Works — A descriptive and conceptual approach to economic theory relevant to environmental planning, engineering, and design. Applications to transportation, public utilities, urban and regional planning, water and air quality, water resources, and other public works. Micro- and macro-economics. Costs, prices, markets, demand, supply, and consumer choice. Input-output, national and regional income analysis, taxation, resource allocation, welfare economics, regional economics, economic development. Benefit-cost, cost-effectiveness, and program budgeting concepts.
3 units, Aut (Rogers) MWF 11

224. Institutional Setting of Public Works —The roles and interactions of all institutional factors affecting different kinds of public works. Government, including organization, legislation, and operation at the federal, state, and local levels. Interest groups, technical experts, and the public. Behavior of organizations, officials, and other individuals. Extensive use is made of cases giving detailed descriptions of actual controversies.
3 units, Win (Roggeveen) TTh 11 and F 3

3 units, Spr (Roggeveen) MWF 10

226. Quantitative Planning Techniques — Selected aspects of operations research with an emphasis on determining the relevance of these techniques for civil engineers engaged in planning. Topics include Lagrange multipliers, and linear and dynamic programming. Recent applications will be discussed. Prerequisites: Mathematics 43 or equivalent and elementary matrix algebra.
3 units, Aut (Ortolano) MWF 10

227. Economics and Engineering Planning —Applications of quantitative economics in public sector project planning and evaluation. A survey of basic elements from the theories of demand, production, welfare economics, externalities, and benefit-cost analysis. Multiple objective planning and environmental quality issues are also considered. Prerequisites: 223 or Econ. 1 and Math 43.
3 units, Win (Ortolano) MWF 11
228. Environmental Planning — Same as 171, with additional assignments for students who desire graduate credit.

229. Seminar on Environmental Impact Assessment — An examination of alternative techniques useful for the analysis and evaluation of environmental impacts of public works projects. Enrollment will be limited to 20 students. Prerequisite: 228.

3 units, Spr (Ortolano) T 1:15-3:05 and 1 hr by arrangement

230. Transportation—Same as 130, with additional assignments for students who desire graduate credit. Open to any University graduate student.

3 units, Win (Roggeveen) TTh F 2

232. Transportation Planning and Engineering — More detailed attention to selected topics. Particular emphasis upon airports, railroads, rapid transit, port development, new technology, multi-modal transport. This course complements the highway emphasis of 231. Prerequisite: 130 or 230.

3 units, Spr (Roggeveen) MWF 1:15

233. Techniques of Urban Planning—Steps in plan preparation; economic and demographic analysis model building; research procedures; environmental, social, physical, economic determinants of land use and their interface with transportation and water resource planning; the General Plan; Urban Gaming; institutional restraints; political considerations; planning theory.

3 units, Win (Loewenstein) TTh 9:30-10:50

234. Land Use Planning — Implementation of land plans in the face of local growth and land use controls; project planning and site analysis; location and space requirements; carrying capacities of land; legal issues; cost/revenue aspects; methods to manage growth; land use regulations. Prerequisite: 233.

3 units, Spr (Loewenstein) TTh 9:30-10:50

236. Urban Planning Internship—Work experience in the planning offices of local governmental agencies and private consultants. Requires one full day per week in an office.

2 units, Aut, Win, Spr (Staff) by arrangement

237A. Field Problems in Urban Planning I —Case studies in the urban planning process, with student analysis of selected urban problems, and preparation of plans for future urban development. Prerequisite: 133 or 233.

3 units, Win (Staff); not given 1975-76

237B. Field Problems in Urban Planning II —A continuation of 237A.

3 units, Spr (Staff); not given 1975-76

238. Transportation Problems — Individual investigation. Prerequisite: 130, 230, or equivalent and consent of instructor.

2 or more units, Aut, Win, Spr (Roggeveen) by arrangement

239. Transportation Seminar — Visitors, field trips to operating facilities, reports on current research, presentations by students, and discussions.

1 unit, Spr (Roggeveen) M 4:15-6:05

240. Operations Analysis for Work Improvement in Construction — Application of crew balance, process charts, time-lapse motion pictures, and operations research techniques to construction operations. Accident prevention. Prerequisite: graduate standing.

3 units, Aut (Parker) W 1:15 and F 1:15-3:05

241. Construction Planning and Scheduling — Planning, scheduling, and progress control of construction operations. Emphasis on the Critical Path Method including network diagramming, calculations based on time data, and scheduling variations to optimize cost. Manpower and equipment leveling. Course includes both non-computer and computer techniques. Prerequisite: graduate standing.

3 units, Aut (Fondahl) MWF 10 Spr (Fondahl) MWF 10

242. Project Control — Analytical techniques for bringing a project to completion within budget, on time and according to specifications, including study of cost engineering, schedule and resource control, procurement, and quality control. Prerequisite: CE 241.

3 units, Win (Paulson) MWF 9

Analysis, design and implementation of a network-based information and control system. Human and organizational factors. Prerequisite: CE 241 and computer programming.

3 units, Win (Paulson) TTh 1:15 plus Th 2:15

244. Construction Equipment Policy — Application of sound management principles in establishing equipment policy; treats depreciation and obsolescence, standardization, preventive maintenance, and fiscal aspects of equipment ownership; includes use of computer for economic analysis of equipment problems. Prerequisites: Engineering 161 and computer programming.

3 units, Win (Douglas) TTh 9 plus T 10

246. Construction Administration — Business and management aspects of construction: industry profile, company organization, contracting methods, bonding and insurance, subcontracts, cash flow, and markup. Prerequisites: 143, 144, and 145.

3 units, Win (Fondahl) MWF 1:15

247. Legal Problems in Construction — Advanced studies in legal aspects of construction administration. Prerequisite: 246.

2 units, Spr (Fondahl) W 2:15-4:05

248. Construction Financing in Real Estate and Land Development — This course is a study of the interrelationships between all of the variables that make up a successful real estate project with heavy emphasis on the financial aspects involved in land acquisition, land development, construction, and permanent lending and project management. In addition, we will discuss various aspects of joint venturing, including the control functions and equity financing. Enrollment limited to 30. Prerequisite: graduate standing.

3 units, Spr (Medearis) MF 8 plus one hour by arrangement

249. Labor and Industrial Relations in Construction — Study of the laws, institutions and social and economic forces affecting labor and industrial relations in construction. Prerequisite: CE 144.

3 units, Aut (Paulson) MWF 11

250. Human Factors in Construction and Engineering Management — Seminar dealing with the problems of working and communicating with individuals and groups. Enrollment limited to 15 students per section with preference to those from the graduate Construction and Planning Programs.

2 units, Win (Parker) MT or W 3:05-5:15

252. Heavy Construction Estimates — Estimating and bidding construction work, with emphasis on procedures adapted to large engineering projects. Prerequisites: 144, 145, 254 or equivalent in general knowledge of construction methods and equipment, and graduate standing in construction option.

4 units, Spr (Parker) TTh 1:15-3:05

253. Estimating for Building Construction — Estimates and costs attached to construction of large buildings, such as apartment houses, warehouses, and other commercial and industrial type structures. Limited enrollment. Prerequisites: 143 and 144; graduate standing in construction option.

3 units, Spr (Staff) by arrangement

254. Advanced Construction Equipment and Methods — Methods and equipment selection and application in heavy construction. Excavation, tunneling, conveyors, rigging, underwater foundations, pile driving, contractor’s temporary facilities. Prerequisite: 190.

3 units, Spr (Parker) MWF 8

255. Concrete Construction — Economy and procedures in plant and equipment selection and application in heavy construction. Special techniques in forming and handling concrete. Prerequisite: graduate standing.

3 units, Spr (Parker) MWF 11

256. Waterfront Construction — Wharves and piers of timber and concrete; sea walls, bulkheads, moles and groins; dredging and channel construction; factors affecting design, construction of waterfront facilities. Prerequisite: 190.

3 units, Spr (Douglas) TTh 10 and F 1:15-4:05

258A,B,C. Seminar in Construction Engineering and Management — Weekly evening discussion of special topics with speakers from industry and government. Normally taken by construction graduate students each quarter for three quarters.

258A. 1 unit, Aut (Parker) by arrangement

258B. 1 unit, Win (Fondahl) by arrangement
258C. 1 unit, Spr (Paulson) by arrangement

259. Construction Problems — Analysis of individually selected problems in construction techniques, equipment, or management, followed by preparation of oral and written reports. Students are expected to consult specialists from construction industry as well as make use of University facilities. Prerequisites: graduate standing in construction and consent of instructor.

1 to 3 units, Spr (Paulson) by arrangement

261. Environmental Fluid Mechanics I — Technological and ecological problems such as ocean waste disposal, thermal pollution, and water quality in fresh water distribution systems. Course includes basic theory, applications, construction of numerical models and use of the computer related to: diffusion and disposal in rivers, estuaries, and the ocean environment; thermal transfers in rivers, lakes, and cooling ponds; fluid mechanics and diffusion modeling parameters; design concepts; pipeline network analysis. Prerequisites: fundamental knowledge of fluid mechanics (e.g., Engineering 21) and of computer programming; basic science background (e.g., B.S. degree); or consent of instructor.

4 units, Win (Street) TTh 8 and F 1:15-3:05

262. Environmental Fluid Mechanics II — Designed to provide further technical background for the analysis and solution of environmental problems; an extension of 261, but 261 is not a prerequisite. Water waves. Continental shelf, shoreline, and estuary processes. Modeling including hydraulic (physical) modeling, dimensional considerations, and case studies and examples from estuary and coastal problems. Special topics, such as environmental impacts of offshore development, as time permits. Prerequisite: knowledge of fundamentals of fluid mechanics (e.g., Engineering 21) or consent of instructor.

4 units, Spr (Street and Clifton) TTh 8 and WF 12

263. Fluid Mechanics of Closed Conduits—Review of fundamental principles of turbulent flow and application to closed conduits; pipe systems and branching of pipes; unsteady flow in pipes, flow establishment, application of methods of characteristics to water hammer problems. Prerequisite: Engineering 21 or consent of instructor.

3 units, Spr (Hsu) MWF 10


3 units, Spr (Franzini) MWF 9

265. Seminar in Fluid Mechanics — (Enroll in Engineering 298.)

266. Engineering Hydrology—The hydrologic cycle; runoff relations, unit hydrographs, flood routing, probability in hydrology, hydrologic simulation, stochastic methods in hydrology. Application to typical water-resources planning problems.

4 units, Aut (James) MWF 9; lab. W 2:15-4:05

267. Advanced Hydrology — Application of hydrologic simulation and stochastic methods in hydrology. Review of significant current literature in hydrology with emphasis on new developments. Prerequisite: 266 or a previous hydrology course.

4 units, Win (James) MWFTh 1:15; lab. W 2:15-4:05

268. Water Resources Development—The planning and design of physical facilities and other measures for the control and utilization of water. Special features of irrigation, water supply, hydropower, river navigation, and flood-damage reduction projects. Prerequisite: 266 or a previous hydrology course. Background in fluid mechanics and engineering economy.

4 units, Win (Franzini) MWF 10; lab. T 2:15-4:05

269. Water Studies Seminar — Discussions by faculty and students on study and Stanford research of water problems. All students in water studies are expected to attend.

0 units, Aut (P. Kruger) W 4:15-6:05

270. Water Quality in Water Resource Development—Effects of organic, nutrient, and thermal pollution on the ecology and chem-
eral quality of streams, lakes, reservoirs, and estuaries; cause and control of eutrophication; in-place control of natural water quality; quality requirements for various beneficial uses.

3 units, Aut (McCarty) MWF 8

271A. Water Quality Control I — Unit operations and processes for control of water quality, including desalinization, for municipal and industrial use. Prerequisite: 270 and 273 or equivalent.

3 units, Win (Leckie) TTh 11:00-12:15

271B. Water Quality Control II — Chemical and biological unit processes for the treatment of sewage and industrial wastes; advanced methods of wastewater treatment including nutrient removal and physicochemical methods. Prerequisite: 274 or equivalent.

3 units, Spr (McCarty) MWF 8

271C. Water Quality Control III — Analysis of advanced or specialized wastewater treatment flowsheets, emphasizing industrial problems, and (if interest justifies it) of processes used or proposed for correcting pollution of natural waters. Emphasis on identification of problem, objective, alternative solutions and deciding factors in each case. Use of resulting flowsheet design concepts in predesign analysis of unsolved problems. Course is conducted as a seminar and workshop based heavily on student participation in class. Prerequisite: 271B which may be taken concurrently.

2 units, Spr (Parks) T 2:15-5:05

272. Environmental Biology — Discussion on selected topics in aquatic biology including current problems in water pollution, marine biology, limnology, microbial ecology. Prerequisite: 274 or equivalent.

3 units, Spr (Young) TTh 11-12:15

273. Water Chemistry — A systematic presentation of chemical principles and application of those principles to the analysis and solution of problems in aqueous geochemistry (temperatures near 25° C and atmospheric pressure). Particular attention is given to the analysis of natural water systems and to the understanding and solution of specific chemical problems in water purification technology and water pollution control. Thermodynamics is used for prediction of direction and extent of chemical processes such as precipitation/dissolution, hydrolysis, complex formation and oxidation/reduction. Prerequisite: Chem. 5 or equivalent.

3 units, Aut (Leckie) TTh 9 plus F 2:15

273A. Water Chemistry Laboratory — Laboratory application of techniques for the analysis of natural waters and wastewaters; special emphasis on instrumental techniques. Limited enrollment. Prerequisite: consent of instructor.

2 units, Aut (Leckie) M 2:15-5:05 or Th 2:15-5:05

274. Water Microbiology — Fundamental aspects of microbiology and biochemistry of stream pollution and water quality control; microorganisms as pollutants and as purifying agents; microbial identification and ecology as related to the aquatic environment. Prerequisite: 273.

2 units, Win (Young) TTh 10

274A. Water Microbiology Laboratory — Experimental approach to understanding fundamentals of microbiology; topics include morphology, metabolism, microbial interactions and water quality parameters. Prerequisite: 273.

1 or 2 units, Win (Young) T 2:15-5:05 or W 2:15-5:05

275A. Water Quality Control Processes I — Laboratory and pilot plant studies of physical and chemical processes for the treatment of water and wastewaters. Prerequisites: 273 and 273A.

3 units, Win (Leckie) M 1:15-5:05 and Th 1:15-4:05

275B. Water Quality Control Processes II — Laboratory and pilot plant studies of biological processes for the treatment of water and wastewaters. Prerequisite: 274 and 273A or equivalent.

3 units, Spr (McCarty) M 1:15-5:05 and Th 1:15-4:05

276A. Nuclear Methods in Environmental Engineering — The use of nuclear technology in the study and control of environmental processes. Basic principles of radiation: effects, chemistry, and measurement methods; radiochemistry; isotope dilution and activation analysis; and tracer methods: radioactive, environmental, and activable isotopes. Nuclear dating and field logging methods. Environmental processes of origin,
behavior, dispersion, transport, concentration, and ultimate fate of pollutants. Applications in air pollution, water pollution, hydrology, and waste disposal.

3 units, Aut (P. Kruger) TTh 10 plus lab by arrangement

276B. Environmental Impact of Power Generation—Analysis of the environmental impact of power production from commercial energy resources. Basic considerations of pollution forms: chemical and radionuclide effluents, thermal and noise discharges, seismic activity and land subsidence; environmental aspects of fuel cycle: on site, transportation, and distribution; comparative environmental impact from fossil fuels, nuclear fission and fusion reactors, geothermal, solar, and other potential sources of energy. The concept of benefit/risk ratio and environmental impact statements.

3 units, Win (P. Kruger) MWF 10

276C. Environmental Radioactivity — The biological importance of environmental radiation and the radiation protection standards. Sources of radioactivity and radiation in man's environment. The natural radiation background from space and terrestrial radioactivity. Effluents from the nuclear industries: nuclear power reactors, fuel reprocessing and waste disposal; radioisotope utilization, and nuclear explosions. Redistribution processes of environmental radioactivity.

3 units, Spr (P. Kruger) MWF 9


1 unit, Spr (Leckie, Young) W 4:15-6:05

280A. Matrix Analysis of Structures—Analysis of statically and kinematically indeterminate framed structures by matrix methods; flexibility and stiffness methods developed, with orientation toward solution by digital computer. Optional concurrent registration in 280B. Prerequisites: elementary structural analysis (or mechanics of materials) and elementary matrix algebra.

3 units, Aut (Carter) MWF 9


1 or 2 units, Aut (Carter) M 3:15-4:30

281A. Finite-Element Method of Structural Analysis—Theory of finite elements applied to problems in continuum mechanics; plates in plane stress, plane strain, or bending; axisymmetric and general solids; shells; linear and nonlinear analysis. Optional concurrent registration in 281B. Prerequisite: 280A or equivalent.

3 units, Win (Carter) MWF 11


1 or 2 units, Win (Carter) M 3:15-4:30

282A. Earthquake Engineering I — Earthquake phenomena, faulting, ground motion; study of past major earthquakes; effects of earthquakes on man-made structures; response spectra; Fourier spectra; structural dynamics; analysis and design of structures; building codes; current research in earthquake engineering.

3 units, Win (Gere) MWF 9

282B. Earthquake Engineering II—Earthquake motions and their engineering interpretations; strong ground motion studies; design spectrum; importance of dynamic analysis of structures; geologic and soil engineering problems; soil liquefaction; soil-foundation-structure interaction; stability of dams and natural slopes; design of structures to minimize earthquake damage; risk analyses. Prerequisite: 282A or consent of instructor.

3 units, Spr (Shah) MWF 9

285. Design of Structures I—Steel Design: inelastic behavior of structures; limit analysis and limit design; ultimate strength of structural elements; collapse loads for frames. Reinforced Concrete Design: columns—axial load plus biaxial bending; equivalent frame method for slab systems; yield line analysis of slabs; design of shear walls. Prerequisites: basic courses in design of steel and reinforced concrete structures.

4 units, Aut (Krawinkler) TTh 10 plus W 2:15-4:05
286. Design of Structures II—General aspects of design; serviceability and failure criteria; types of loading; methods of design; structural systems for buildings; elastic and plastic analysis and design of high rise buildings for gravity loads and lateral loads; earthquake resistant design; effects of dynamic loading on strength and ductility of structural elements. Laboratory experiments on structural elements and frame models. Prerequisites: basic courses in design of steel and reinforced concrete structures.

4 units, Spr (Krawinkler) MW 1:15–3:05

289. Structures, Materials and Geotechnical Engineering Seminar — Guest speakers on topics in these fields.

1 unit, Aut (Carter) Alternate W 4:15–5:15
Win (Shah) Alternate W 4:15–5:15
Spr (Gere) Alternate W 4:15–5:15

290. Soil Mechanics — Re-examination of basic principles with emphasis on the mechanics of soil behavior. Discussion of stress-strain relations and shear strength; deformation analyses; two-dimensional consolidation; theories of elasticity and plasticity. Prerequisite: 190 or equivalent.

3 units, Win (Clough) TTh 11:00–12:15

291. Foundation Engineering — Types and characteristics of foundations; design criteria; soil exploration; improvement of soil to support structures; dewatering; earth retaining structures; deep excavations; analyses of settlements and bearing capacity; shallow and deep foundations; earthquake effects; field instrumentation; case studies. Prerequisite: 190 or equivalent.

3 units, Win (Clough) MWF 10

292. Earth Structures — Earth dams, embankments, and natural slopes; site investigation; soil properties and compaction; analyses of seepage and slope stability, seepage control and landslide prevention; earthquake effects; performance observations; case studies. Prerequisite: 190 or equivalent.

3 units, Spr (Clough) TTh 9; one hour by arrangement

293. Experimental Soil Mechanics — Laboratory testing with triaxial, direct shear, and simple shear equipment. Model experiments and special projects to suit individual or class interest.

2 units, Spr (Clough) TTh 10


2 units, Spr (Clough) by arrangement

296A. Structural Dynamics I—Vibrations and dynamic response of simple structures to periodic and arbitrary loadings; support motion; response spectra; two-degree-of-freedom systems. Prerequisites: 180 and Engineering 12.

3 units, Aut (Gere) MWF 10

296B. Structural Dynamics II—Vibration and dynamic response of complex framed structures and discretized continua using matrix methods; linear analysis by normal-mode and direct extrapolation methods; nonlinear analysis with step-by-step approximation formulas; numerical methods for the eigenvalue problem. Optional concurrent registration in 296C. Prerequisites: 280A and 296A or equivalents.

3 units, Spr (Carter) MWF 11

296C. Computer Programming for Structural Dynamics—Implementation of matrix methods for structural dynamics on a digital computer; application of normal-mode and numerical approximation methods; automatic computation of dynamic response for complex structures. Mandatory concurrent registration in 296B.

1 or 2 units, Spr (Carter) M 3:15–4:30

297. Random Vibrations — Characterization and transmission of random vibrations; failures due to random vibrations; multi-degree of freedom systems; non-stationary random inputs and response; nonlinear systems; earthquake-type loads. Prerequisite: 296A or equivalent.

3 units, Win (Shah) given 1976–77

298. Stability Problems — Beam-columns; elastic buckling of columns; non-prismatic columns; inelastic bending and buckling of bars; torsion of bars of open section; lateral buckling of beams; buckling of frames. Prerequisite: 114.

3 units, Spr (Gere) MWF 10

299. Independent Study in Civil Engineering — Directed study for graduate students
on subject of mutual interest to student and staff member. Student must obtain faculty sponsor.

1 to 3 units, any quarter (Staff) by arrangement

300. Thesis — Investigation of some engineering problem; required of candidates for Degree of Engineer.

Aut, Win, Spr (Staff) by arrangement

310. Post-Master's Seminar—For post-Master's students to serve as orientation to the selection of a research topic.

1 unit, Aut, Win, Spr (Staff) by arrangement

399. Advanced Engineering Problems—Individual projects on selected topics. Provides for independent graduate work under the direction of a faculty member on a subject of mutual interest. Student must find faculty sponsor. A written report is usually required.

1 to 5 units, any quarter (Staff) by arrangement


Aut, Win, Spr (Staff) by arrangement

**ELECTRICAL ENGINEERING**

**Emeriti:** Leland H. Brown, Joseph S. Carroll, Gerald L. Pearson, William R. Rambo, William Shockley, Hugh H. Skilling, Frederick E. Terman (Professors)

**Chairman:** John G. Linvill

**Associate Chairmen:** Ralph J. Smith, James B. Angell

**Assistant Chairman:** Harry T. Garland


**Visiting:** F. Paul Carlson

**Associate Professors:** Clayton W. Bates, Malcolm R. Beasley, Robert M. Gray, Martin E. Hellman, Bruce B. Lusignan. Consulting: Noel P. Thompson

**Visiting:** François Duval


**Lecturers:** Michael S. Frankel, Otis L. Frost, Harry T. Garland, Frank Herman, Victor H. Grinich, Marcian E. Hoff

**Adjunct Professors:** William L. Beaver, Donald L. Carpenter, Thomas A. Croft, Aldo V. da Rosa, H. Taylor Howard, John P. Katsusfrakis, William R. Kincheloe, Albert Macovski, G. Leonard Tyler, James F. Young

**PROGRAMS OF STUDY**

**UNDERGRADUATE**

Students desiring to specialize in Electrical Engineering during their undergraduate period may do so by following the depth sequence given earlier in the general discussion of the School of Engineering. An accelerated program leading to a higher level of achievement in four years is available to highly motivated students with well-formulated objectives. Interdisciplinary Majors providing work in electrical engineering combined with study in another department are available. Attention is also called to the Innovative Major, and Engineering and Society programs in the same general section. Note that it is possible for a Stanford undergraduate to work simultaneously toward the B.S. and M.S. degrees. Information on this program is available in the Office of the Dean of the School of Engineering.

**GRADUATE**

The Electrical Engineering Department offers graduate courses in the following areas: Bioelectronics
Communications and Information Theory
Computer Applications
Computer Systems
Electromagnetic Theory and Microwaves
Electronic Circuits and Devices
Integrated Circuits
Modern Optics and Optical Devices
Network Theory
Plasmas
Quantum Theory and Applications
Radioscience
Solid State Materials and Properties
Systems and Control Theory

Descriptions of courses will be found in the following pages.

ADVANCED DEGREES

The practice of the profession of Electrical Engineering demands a strong foundation in physical science and mathematics, a broad knowledge of engineering techniques, and an understanding of the relation between technology and man. Curricula at Stanford are planned to offer the breadth of education and depth of training necessary for leadership in the profession. For those who wish to engage in this profession with competence, four years of undergraduate study and at least one year of postgraduate study are strongly recommended. For those who plan to work in highly technical development or fundamental research, additional graduate study is desirable.

A one-year program of graduate study in electrical engineering may lead to the degree of Master of Science. A two-year program, offering wider selection of engineering course work, more opportunity for study in the related fields of physics, mathematics, and engineering, and in particular more independent work and individual guidance, additional graduate study is desirable.

A one-year program of graduate study in electrical engineering may lead to the degree of Master of Science. A two-year program, offering wider selection of engineering course work, more opportunity for study in the related fields of physics, mathematics, and engineering, and in particular more independent work and individual guidance, may lead to the degree of Engineer.

The degree of Doctor of Philosophy is offered under the general regulations of the University. The doctoral program, requiring a minimum of three years (nine quarters) of graduate study, should be considered by those with the ability and desire to make a life work of research or teaching.

MASTER OF SCIENCE

University regulations governing the degree of Master of Science are described in the "Degrees" section in this bulletin; note that this Department has waived the thesis requirement. Applications for admission with graduate standing in Electrical Engineering are made to the Director of Admissions of the University and are reviewed by this Department. Inquiries may be addressed to the Associate Chairman, Admissions, Department of Electrical Engineering.

Modern electrical engineering is a broad and diverse field, and graduate education in this Department may satisfy a great variety of objectives. Students with undergraduate degrees in physics, mathematics, or related sciences, as well as in various branches of engineering, are invited to apply for admission. Such students will ordinarily be able to complete the Master’s degree in one calendar year. Students with undergraduate degrees in other fields may also be admitted for graduate study (see below).

The Master's degree program may provide advanced preparation for professional practice or for teaching on the junior college level, or it may serve as the first step in graduate work leading to the degree of Engineer or Doctor of Philosophy. The faculty does not prescribe specific courses to be taken. Each student with the help of a program advisor prepares an individual program and submits it to the faculty for approval. This should be done as soon as possible and must be done before completion of the first 12 units of graduate study (modifications may be made later). A Supplementary Information Sheet providing detailed instructions, and including a worksheet for preparing a program proposal, is available in the Department Office.

Programs of at least 42 quarter units that meet the following guidelines will normally be approved:

1. A sequence of three or more electrical engineering courses numbered above 200, to provide depth in one area. (See preceding list of graduate course areas.)

2. At least one electrical engineering course numbered above 200 in each of three additional areas, outside of the area selected under item 1, to provide breadth.

3. Enough additional units of electrical engineering courses so that items 1 through 3 total at least 21 units of graded electrical engineering courses numbered above 200, including at least 9 units of such courses numbered 300 or 400. Some 700 level summer courses may also be considered for inclusion in the M.S. Program.
4. At least three courses in departments other than electrical engineering.

5. At least three quarters of 201, 200 Seminar, unless there is a schedule conflict, with the total amount of plus credits, including 201, 200, not to exceed 6 units in the basic 42 units.

6. Additional courses, such as undergraduate electrical engineering courses, to bring the total to 42 or more quarter units, at least 36 units of which must be courses in which letter grades are given.

It is emphasized, however, that any properly prepared student with a specific objective in mind may submit for approval a program which meets his or her particular needs but does not conform to the normal pattern. Such a program should be accompanied by a clear statement of objective and a description of how the proposed program achieves the stated objective and should carry the endorsement of the student's program adviser.

Able students without formal undergraduate preparation in electrical engineering may also be admitted for graduate study. Such students may have graduated in any field and may hold either the B.S. or A.B. degree. Each student, with the help of an adviser, prepares a program of study to meet his or her particular needs and submits it to the faculty for approval. A student with adequate preparation in mathematics through calculus and college physics including electricity can usually complete the M.S. degree requirements within two academic years. A student with some additional preparation in electrical engineering may be able to complete the M.S. requirements in only one academic year.

Graduate study in Electrical Engineering is demanding and it is essential that students be adequately prepared in physics, mathematics, circuits, fields, electronics, digital systems, and laboratory work. The ability to take advantage of modern computing facilities is an essential skill for electrical engineers, and an increasing number of our courses routinely require it. Every student should acquire this skill early in the program, either by taking one of the regular Computer Science courses or one of the special "short courses" given by the Computation Center, or by self-study.

It is the student's responsibility, in consultation with an adviser, to determine whether the prerequisites for advanced courses have been met. Prerequisite courses ordinarily taken by undergraduates may be included as part of the graduate program of study. However, if the number of these is large, the proposed program should contain more than the typical 42 to 45 units, and the time required to meet the degree requirements may be increased.

Engineer

The degree of Engineer requires a minimum of two academic years of study beyond the B.S. degree (three academic quarters beyond the M.S.). University regulations governing the degree of Engineer are described in the "Degrees" section in this bulletin.

Work toward the degree of Engineer in Electrical Engineering is more individual and independent than work toward the Master's degree. The applicant has almost complete freedom of selection of courses beyond the requirements for the M.S. degree. The equivalent of approximately one quarter is devoted to independent study and thesis work with faculty guidance. The thesis is often of the nature of a professional report on the solution of a design problem. The degree of Engineer differs from the Ph.D. primarily in looking toward professional engineering work rather than toward theoretical research.

Permission to study beyond the Master of Science degree must be obtained from the appropriate Department committee. The decision of the committee is based on its evaluation of the applicant's academic record, performance in independent work, and potential for advanced study, and on the ability of the faculty to support and supervise such study.

A tentative application for candidacy, including a proposed program of study, must be filed in the Department Office before the end of the first quarter of post-M.S. study at Stanford. The program of study is prepared by the student with the help of an adviser and submitted to the faculty for approval. A formal application for candidacy including the signature of a thesis supervisor must be filed in the Department Office before completion of 25 units of work beyond the Master's degree. Approval of formal application will normally be dependent on completion of courses at Stanford with a satisfactorily high record.
DOCTOR OF PHILOSOPHY

A complete statement regarding the degree of Doctor of Philosophy will be found in the section "Degrees" in this bulletin. The requirements are administered by the University Committee on the Graduate Division.

Admission to the graduate school does not imply that the student is a candidate for the Doctor of Philosophy degree. Advancement to candidacy requires superior academic achievement, satisfactory performance on a qualifying examination, and sponsorship by two faculty members. Enrollment in E.E.391 Special Studies is recommended as a means for getting acquainted with a faculty member who might be willing to serve as a sponsor.

Not later than the first autumn quarter after receiving the Master of Science degree the applicant should submit an application to take the Department qualifying examination (given each Winter quarter). Upon successful completion of the qualifying examination and after securing agreement by two faculty members to serve as dissertation advisers, the student should file an Application for Doctoral Candidacy. Only after receiving departmental approval of that application does the student become a candidate for the Doctor of Philosophy degree.

Requirements may be summarized as follows: The student is to complete successfully (1) a minimum of three years of residence with graduate standing, one year of which must be in residence at Stanford; (2) one or more qualifying examinations given by the faculty of the Electrical Engineering Department; (3) an approved program of courses in electrical engineering and allied subjects; (4) an oral examination near the completion of the doctoral program; (5) a dissertation, based on research, which must be a contribution to knowledge.

About one-fourth of the program of graduate study should be in departments other than Electrical Engineering. Courses shall be selected to form an integrated program, to be approved by the Department. A student wishing to fulfill the requirements for a formal minor may elect to do so.

Ph.D. Minor — For a minor in Electrical Engineering, the student candidate will take 15 quarter units of course work in the Electrical Engineering Department following a program to be approved by the Department committee on doctoral candidates.

SPECIAL PROGRAMS

Computer Engineering — The degree of Master of Science in "Electrical Engineering: Computer Engineering" may be conferred upon students who wish to develop a competence in the design of substantial software-hardware computer systems. This degree will be administered by the Committee on Computer Engineering, composed of faculty from the Electrical Engineering and Computer Science Departments. Present members include Vinton G. Cerf, Chairman, Edward J. McCluskey, and Joseph Oli- ger.

A student should indicate preference for this degree at the time of applying for admission. Programs of at least 42 quarter units that meet the following guidelines will normally be approved:

1. A required sequence of courses in Computer Science and Electrical Engineering to provide depth in hardware and software design. This sequence includes C.S.140A,B and one of the following: (a) E.E.381A,B, and C.S.311; (b) E.E.381A,B, and C.S.246; (c) E.E.182, C.S.246, and C.S.311.

2. At least one course in mathematical foundations for computer engineering. Acceptable courses: C.S.150; C.S.155; C.S.156; E.E.284.

3. At least one course in numerical analysis. Acceptable courses: C.S.135 or both C.S.137A and C.S.137B; alternatively at least one course in finance or accounting at the Graduate School of Business. Acceptable courses: 210 Management Accounting I, or 220 Business Finance I.


6. At least 3 units of seminar with a total not to exceed 6 units. Acceptable courses: E.E.380; E.E.385; C.S.300, C.S.319.

7. Additional courses to bring the total to 42 or more units, at least 36 units of which must be in courses in which letter grades are given. These courses may be in departments other than Computer Science and Electrical Engineering.
Computer engineering programs that deviate from one or more of the above guidelines in order to meet the valid objectives of individual students will be considered by the Computer Engineering Committee on an individual basis. The student should submit a written statement of his or her individual objectives and indicate how the program and previous preparation meet these objectives.

This program is open to students with a scientific bachelor's degree (a B.S. in Engineering, Mathematics, Statistics, or Physics); or with a degree having a mathematical background (courses in calculus, a knowledge of linear algebra, and probability). Some knowledge of programming will be required.

Students with very little background in programming should enroll in the basic programming course, Computer Science 106, during the summer quarter preceding entrance into this program.

The Computer Engineering program will begin in autumn quarter each year to enable a full-time student to complete the degree in one academic year. It is advisable, however, for the student to plan on remaining for a complete calendar year with the thought of completing the laboratory courses in the summer term. Honors Cooperative students able to take two courses each quarter should be able to complete the program in two academic years and one summer quarter.

The degree of Master of Science in “Electrical Engineering: Computer Engineering” is intended as a terminal degree. Students who plan to be candidates for the Ph.D. degree are advised to enroll in the regular Master of Science in Electrical Engineering program.

Electrical Engineering Administration — The Master's degree carrying the distinction “Electrical Engineering: Administration” on the diploma is conferred upon students who combine not less than 25 units of study in electrical engineering with about 25 units of study in industrial engineering or business. Four academic quarters are required to complete this program, which combines the technical education that is represented by the Master’s degree in electrical engineering with a substantial amount of work in industrial engineering or business.

The degree of Engineer is also offered for an administration program. Six academic quarters are required, and a thesis is to be written. Work toward this degree is usually divided about evenly between business and engineering. The thesis may be in either department, with proper approval.

Students wishing a degree with the designation “Electrical Engineering: Administration” should so indicate on the application for candidacy for the degree.

Medical Electronics Program — The Master of Science degree carrying the designation “Electrical Engineering: Medical Electronics” on the diploma may be conferred upon students who wish to combine training in biological or medical sciences with an electronics program in the Department of Electrical Engineering. Such a student should so indicate when submitting his or her application for candidacy for the degree. The proposed program of study for the degree should show at least 42 units of work.

The minimum amount of time required to obtain this degree is one academic year. Candidates with inadequate preparation in mathematics, physics, and electrical engineering will require more time. A candidate with a Bachelor of Science degree in electrical engineering would normally devote approximately half time to graduate courses in electrical engineering and the balance of time to courses in biology or medicine. A candidate for the Doctor of Medicine degree who plans to apply the academic year of “University Time” toward this Master's degree would devote about half time to undergraduate courses in electrical engineering, mathematics or physics, and the other half to graduate courses in Electrical Engineering.

For further information, the student should read the bulletin entry on “Engineering in Biology and Medicine,” noting especially the data on Information Processing in Biological Systems, Information Processing for Biomedical Systems, and Integrated Circuitry for Medical Electronics.

FINANCIAL ASSISTANCE

The Department annually awards a number of fellowships, teaching assistantships, and research assistantships to graduate students. The fellowships are usually awarded only to first-year graduate students. Most of the awards to Engineer and Ph.D. candidates are research assistantships. Research assistantships are awarded by the individual
faculty research supervisors and not by the Department as a whole.

Applicants for all three forms of assistance should obtain the necessary application forms from the University Admissions Office. It is helpful for post-Master's degree applicants for research assistantships to contact directly the faculty member under whom they would like to work, in addition to making formal application to the Department.

Research Assistants can, and normally do, carry out their thesis work and write their thesis as an integral part of the commitments of their assistantship.

AREAS OF RESEARCH

Candidates for advanced degrees participate in the research activities of the department as paid research assistants or as students of individual faculty members. At any one time, certain areas of research will have more openings than others. A new applicant should express a second choice of research interest in the event that there are no vacancies in the primary area of interest. At present faculty members and students are actively engaged in research in the following areas.

RADIOSCIENCE
Generation and Propagation of Radio Waves in the Ionosphere and Magnetosphere
Solar-Terrestrial Interactions
Radio Astronomy and Radio Telescopes
Radar Astronomy
Space Science and Engineering (also see Index)
Tropospheric Propagation: Microwave, Optical, and Acoustic

SOLID STATE
Amorphous Materials
Semiconductor and Solid State Physics
Electronic, Magnetic, and Optical Properties of Solids
Crystal Preparation: Epitaxy and Ion Implantations
Solid State Devices
Applications to Medical Electronics
Surface Properties of Solids

INTEGRATED CIRCUITS
Bipolar, MOS and Charge-Coupled Devices
Linear, Digital, and Optoelectronic Integrated Circuits

Ultrasonic & Optical Imaging Arrays
Large Scale Integration
Micropower Electronics
Computer-Aided Analysis & Design
Applications to Medical Electronics

PLASMAS
Plasma Waves and Instabilities
Plasma Heating and Turbulence
Computer Simulation
Geophysical and Astrophysical Plasmas

QUANTUM ELECTRONICS
Laser Devices and Laser Physics
Nonlinear Optical Devices
Coherent UV and X-Ray Sources
Laser Applications
Holography

MICROWAVE PHYSICS AND ELECTRONICS
Microwave Acoustics
Microwave Semiconductor Devices
Solid State Plasmas
Nonlinear and Parametric Devices
Magnetoacoustic and Acoustooptic Phenomena
Acoustic Microscopes

INFORMATION SYSTEMS
Statistical Communication Theory
Information and Coding Theory
Detection, Estimation, and Identification
Statistical Signal Processing
Finite Memory Data Processing
Pattern Recognition and Complexity
Control Theory and Optimization
Diagnostic Imaging
Fourier and Statistical Optics
Adaptive Systems
Real-Time Computer Applications
Biomedical Signal Analysis
Network Theory

DIGITAL SYSTEMS
Fault Tolerant Computing
Performance Measurement and Modeling
Computer Architecture
Computer Networks
Operating Systems

COURSE NUMBERING SYSTEM

Electrical engineering courses are numbered according to the year in which the courses are normally taken:
111, 112, 113. **Electronics**—Basic electronic devices and circuits and an introduction to their applications in electronic systems. 111: Careful description of the physical principles of charge motion in semiconductors leading to operating principles and circuit models for MOS devices (transistors, gates, CCD's). Basic circuit and system design using both discrete and integrated MOS components. 112: Operating principles and circuit models of pn junction diodes and transistors. Basic circuit design using primarily discrete junction devices. 113: Applications of discrete and integrated circuits in the design of communications equipment including the design of rectification, detection, modulation, amplification, oscillation, switching, and wave-shaping circuits. Prerequisite: previous or concurrent registration in 101 (or consent of instructor, in special cases).

111. 3 units, Aut (Gibbons), MWF 8
   Win (da Rosa) MWF 11
112. 3 units, Win (Gibbons) MWF 8
   Spr (da Rosa) MWF 11
113. 3 units, Aut (da Rosa) MWF 11
   Spr (Gibbons) MWF 8

121, 122. **Laboratory** — Circuit design and measurement techniques for circuits, and electronic devices, supplementing lectures in 101, 102, 103 and 111, 112, 113. Normally taken by Electrical Engineering students in third year. Prerequisite for 121: prior or concurrent registration in 111. Prerequisites for 122: 121 and prior or concurrent registration in 113.

121. 2 units, Win (Frankel) Th 1:15 and 3-hour lab. weekly by arrangement
122. 3 units, Aut, Spr (Frankel) T 1:15 and 3-hour lab. weekly by arrangement

126. **Electronic and Microwave Measurements** — Laboratory experiments selected from: Measurement of frequency, attenuation, impedance of circuit components at radio and microwave frequencies; power sources, modulation; crystal and bolometer characteristics and their use in standing wave detectors and power meters; resonators and radiation. Normally taken in fourth year. Prerequisites: 113, 122, and 142 (142 may be taken concurrently).

3 units, Win, alternate years, given 1976-77

139. **Design Project**—A laboratory course
in which individuals or small teams design, build and test special circuits or simple systems. Projects are proposed by students or the professor. Ideally two students would make a team and propose a project. The requirements include a short report, giving the details of the project and the test results, a presentation to the class of the design features, and the constructed (and hopefully, working) project.

3 units, Win, Spr (McWhorter) Th 1:15 and lab. by arrangement

141. Electromagnetic Fundamentals — The field concept, vector analysis, boundary-value problems, electrostatics, computation of fields, magnetostatics, dielectric and magnetic media, time-varying fields, Maxwell’s equations, plane waves. Prerequisite: Physics 53 and Math 43.

3 units, Aut (Waterman) MWF 8
Win (Quate) MWF 9

142. Electromagnetic Waves — Continuation of 141. Emphasis on waves—plane waves and waves in simple guided systems—largely in vacuum but also in non-conducting and conducting media. Phenomena of reflection, refraction, standing waves, transmission of energy, and radiation of energy. Transmission lines, waveguides, antennas.

3 units, Win (Waterman) MWF 8
Spr (Quate) MWF 9

181. Introduction to Computer Organization, Machine and Assembly Languages — The organization of a simple digital computer. Binary arithmetic. Instruction execution. Machine language programs. Symbolic assembly language. The assembly process. Subroutines and coroutines. Simple data structures: arrays, stacks, queues. Input-output programming. Interrupts. Introduction to the IBM System/360. Students will program and operate a small computer such as the HP 2116. Enrollment limited to 50. (Same content as Computer Science 111.) Prerequisite: Computer Science 105 or 106 or equivalent.

3 units, Aut (Gill) MWF 1:15
Win (Buneman) MWF 10
Spr (Siegmam) MWF 10


3 units, Aut, Win (Flynn) MWF 9

190. Special Studies or Projects in Electrical Engineering—Independent work under the direction of a faculty member for which no letter grade is given. Individual or team activities involving laboratory experimentation, design of devices or systems, or directed reading.

By arrangement

191. Special Studies and Reports in Electrical Engineering—Independent work under the direction of a faculty member; a written report or a written examination is required and a letter grade is given. If a letter grade based on written work is not appropriate, student should enroll in 190.

By arrangement

192. Special Seminars—Seminars associated with and supplementing various courses are offered when there is sufficient interest.

COURSES FOR UNDERGRADUATE OR GRADUATE STUDENTS

200A,B,C. Seminar—Special section of 201 A,B,C (see description below) open to students holding assistantships and registering under limited tuition grants.

200A. 0 units, Aut (Staff) Th 11
200B. 0 units, Win (Staff) Th 11
200C. 0 units, Spr (Staff) Th 11

201 A,B,C. Seminar — Weekly discussion of special topics of current interest in electrical engineering. Normally taken by graduate students each quarter for 3 quarters.

201 A. 1 unit, Aut (Staff) Th 11
201 B. 1 unit, Win (Staff) Th 11
201 C. 1 unit, Spr (Staff) Th 11

202. Medical Electronics—The physiologic parameters of interest for medical diagnostic and monitoring purposes and the techniques and instruments required to measure them. Electrical, chemical, and mechanical transducer systems and the appropriate accompanying electronics and displays. Constraints peculiar to medical electronics. Prerequisite: familiarity with circuits and electrical instru-
mentation techniques at an intermediate level—e.g. 113.

3 units, Aut (Thompson)

203. Basic Human Physiology for Engineers—(Enroll in Mechanical Engineering 280.)

204. Special Studies in Cardiovascular Physiology—(Enroll in Physiology 211.)

208. Biological Information Processing—Generation and propagation of signals in the sensory and motor nervous systems. The neuron, synapses, and neural networks. Excitation and inhibition. Signal processing in the nervous system and in the brain with special attention to the auditory and optical sensory systems.

3 units, Spr (White) TTh 9:30–10:45

211. Principles of Pulse and Timing Circuits—Switching, timing, wave-shaping, and logic circuits to generate the diversity of waveforms and functions used in pulse systems, instrumentation, and computers. Emphasis on techniques of analysis and obtaining appropriate circuit models for solid state devices in these highly nonlinear circuits. Prerequisite: 113 or equivalent.

3 units, Aut (McWhorter) MWF 10
Spr (Staff) MWF 11

214. Two-Port Network Theory—Development of the network theory relevant to the synthesis of coupling and terminating networks for amplifiers. Synthesis of lossless ladder matching and interstage structures using the insertion loss theory with computer aid. Illustrative examples using contemporary devices characterized by their scattering parameters over the required frequency band. Discussion of amplifier stability and potentially unstable devices. Prerequisite: Undergraduate electronics and network theory.

3 units, Aut (Linville, Mellor)
TTh 9:30–10:45

216. Principles and Models of Semiconductor Devices—Physical principles of operation of the p-n junction, MOS capacitor, MOS field effect transistor, and bipolar junction transistor. Junction and surface effects in the p-n junction and MOS capacitor. Fundamentals of carrier transport, charge storage, and generation-recombination; application to the operation of MOSFET and BJT. First-order models that reflect phenomena of device operation and serve as useful tools for circuit analysis and design. Device modeling with emphasis on features and constraints of integrated circuit technologies. Prerequisites: 111, 112 for undergraduates, none for graduates.

3 units, Aut (Dutton) TTh 8:00–9:15
Aut (Angell) MWF 1:15
Win (Linville) MWF 9

221A. Linear Active Networks—The general small-signal properties of active devices and the use of the devices in amplifiers and oscillators. Various forms of two-port network parameters and their properties. The relation between these parameters and various models for active devices. Properties and design of common ac and dc amplifier and oscillator configurations. Prerequisite: an undergraduate electronics sequence.

3 units, Win (McWhorter) MWF 10

221B. Linear Active Networks—Introduction to the common network functions for approximating constant gain in a desired band (lowpass and bandpass). Implementation of these functions by active filters and LC networks. General concepts relating to effects in multiple-stage amplifiers. The origin of amplifier noise; means for maximizing the signal-to-noise ratio in single and cascaded stages. Prerequisite: 221A.

3 units, Spr (McWhorter) MWF 10

231. Introduction to Lasers—Introductory survey of laser devices and applications (no quantum mechanics background required). Prerequisites: electromagnetic theory at a level similar to 142, and an undergraduate level course in atomic or modern physics.

3 units, Aut (Siegman) TTh 9–10
and W 3:15

232. Introduction to Lasers—Continuation of 231. More detailed coverage of selected topics in lasers, optics, quantum electronics. Prerequisite: 231.

3 units, Win (Siegman) TTh 9–10
and W 3:15

233A,B,C. Laser and Quantum Electronics Laboratory—Opportunity for individual, self-initiated laboratory projects in lasers, optics, atomic resonance, parametric devices. Recommended: 231 or 232 (may be concurrent).

1–6 units any quarter (Siegman)
by arrangement

238. Electric and Magnetic Properties of Solids—The electric and magnetic proper-
ties of solids from a fundamental point of view, with the necessary elementary concepts of quantum mechanics. Free electron theory, introduction to band theory, surface states, dielectric and ferroelectric materials, magnetic materials, ferromagnetism, and superconductivity. Emphasis on physical understanding. Prerequisites: Physics 57 and preferably 111 or Engineering 50.

3 units, Aut (Spicer) TTh 1:15–2:30

239A. Solid-State Physics—(Enroll in Applied Physics 239.)

239B. Solid-State Chemistry—(Enroll in Applied Physics 240.)

241N. Waves—Exploration of a variety of waves and wave phenomena as they appear in widely different physical systems. Examples selected from acoustics, aquatics, atmospherics, electromagnetics, mechanics, neurobiology, quantum mechanics, and seismology to illustrate the basic concepts common to all forms of wave propagation. Prerequisite: 142 or equivalent.

3 units, Win (Eshkman) MWF 10

243. Electromagnetic Theory — Electrostatics: Bessel and Legendre functions, boundary value problems. RF effects: Maxwell’s equations, plane waves, guided waves, fiber optics, anisotropic media, nonlinear effects, resonators and interferometers. Prerequisite: graduate standing or 141.

3 units, Aut (Pantell) MWF 10

261. The Fourier Transform and Its Applications—A discussion of the topic from a moderately advanced point of view, with emphasis on applications to physical situations. Fourier’s theorem, convolution, impulse and related functions, other transforms; applications to electric networks, sampling, numerical filtering, antennas, television image formation, statistics, noise waveforms, heat flow. Prerequisite: 102.

3 units, Aut (Goodman) MWF 2:15

262. Environmental Systems Analysis—Procedures used for environmental planning. The systems approach to complex social, economic, and physical problems; economic aspects of environmental decision making; how to measure policy impacts; modeling and optimization. Examples considered include air and water pollution, ecosystems, waste management, and land use. For senior or graduate students. Students outside the School of Engineering are encouraged to enroll.

3 units, Win (Pantell) TTh 2:45–4:00

263. Digital Filtering—An introduction to computer-implemented signal processing systems. Digital impulse response and transfer functions; convolution; sampling theory, z-transforms; digital and ”fast” Fourier transforms; filters; generation of stochastic signals; quantization theory and roundoff; digital filter synthesis; communication; imaging, and biomedical signal processing. Prerequisite: Familiarity with Fourier and Laplace transforms.

3 units, Aut (Widrow) MWF 9

266. Introduction to Network Synthesis—A one-quarter survey of the principal ideas of network theory, for both passive and active networks. Properties of networks, practical limitations on their performance, and procedures for their synthesis, with and without computer assistance, as appropriate. Prerequisite: 103 and ability to use digital computation facilities.

3 units, Spr (Bracewell) MWF 2:15


3 units, Win (Tuttle) alternate years, given 1976–77

274. The Computer as a Laboratory Instrument—Practical experience on a small, real-time digital computer system. Minicomputer architecture, I/O programming techniques, data acquisition, digital signal processing, automatic circuit testing, and computer-generated displays. "Hands-on" experience in these subjects is acquired by completing a series of laboratory assignments. Limited
enrollment. Prerequisite: 181 or equivalent assembler programming experience.

3 units, Aut, Spr (Widrow, Staff)
TTh 10 and 3-hour lab. by arrangement
Win (Widrow, Staff) MW 2:15
and 3-hour lab. by arrangement
Sum (Widrow, Staff) MWF 9 or
TTh 10 and 3-hour lab. by arrangement


278. Introduction to Statistical Signal Processing — Review and elaboration of elementary probability theory: Expectation, random variables, density and distribution functions, characteristic functions (transforms), limit theorems. Introduction to random processes: definitions and properties, covariance and spectral density, time averages, stationarity, ergodicity, and linear system relations. Prerequisite: some acquaintance with elementary linear systems, transforms, and probability.

3 units, Aut (Gray) TTh 2:45–4:00
Win (Goodman) TTh 2:45–4:00

279. Information Transmission and Modulation — Signals and circuits for information transmission in electronic systems; analog and digital modulation and demodulation, frequency conversion, multiplexing, noise and quantization; spectrum, envelope, and instantaneous frequency relations; heuristic discussion of comparison of systems from an information theory standpoint. Prerequisites: 261 and 278 or equivalent.

3 units, Win (Gray) TTh 2:45–4:00

280A,B. Computer Applications Laboratory — "Hands-on" experience in innovative, real-time applications of digital computers as signal processors or portions of control systems. Previous topics include pattern recognition with computer-controlled TV camera, and bloodpressure control using a computer-simulated model of an animal reaction to a pressure-elevating drug. Experimental research projects are developed in cooperation with Electrical Engineering, the Medical School, and other research laboratories. Should be taken for two consecutive quarters. Limited enrollment. Prerequisite: 181 or equivalent programming experience. Corequisite: 274.

3 units, Win, Spr (Widrow, Staff) by arrangement

282. Digital Logic Laboratory — Experiments in digital logic design using TTL integrated circuits, including SSI gates and flip-flops, MSI registers and ALU’s and LSI memories. Choice of projects including: basic combinational and sequential circuits, various sequential machines, D/A converters and CRT displays, integrators, arithmetic processors, rudimentary stored-program processors, game-playing machines. Prerequisite: 182 or 381A. Recommended: 381B.

3 units, Aut (Wakerly) Th 9:00 plus
4-hour lab by arrangement
Win, Spr, Sum (Wakerly) T
11:00 plus 4-hour lab by arrangement


3 units, Spr (Peterson) TTh 1:15–2:30

284. Introduction to Discrete Mathematics — An introduction to the algebra and combinatorics required for theories of sequential machine and coding, and advanced study of digital systems and computer science. Sets, relations, functions and homomorphisms. Semi-groups and relevance to sequential machines. Groups and relevance to coding. Fields and relevance to linear sequential machines and codes. Prerequisite: Mathematics 113.

3 units, Win (Staff) MWF 9

286A,B. Systems Programming — A two-quarter sequence intended to develop competence in the design of complex program systems. Review of fundamental concepts such as systematic program design, modular programs, program verification, data structures, algorithms for sorting and searching, and translators including compilers and interpreters with emphasis on basic ideas illustrated through programming assignments. Specific systems programs and problems: macro facilities, bootstrapping and portability, linkers and loaders, text editors, debugging systems, input/output systems and file
systems. Facilities and structure of an operating system. (Same as Computer Science 140A,B.) Prerequisite: 181 or equivalent. Corequisite: Computer Science 104.  
286A. 3 units, Aut (Cerf) TTh 1:15–2:30  
286B. 3 units, Win, Sum (Cerf, Staff) 1:15–2:30  

288. Computer Systems Laboratory—Individual and group projects on the design and implementation of computer systems consisting of programs and/or logic circuits. Emphasis on the design process and design evaluation. Logic subsystem design, interfacing, systems programming, and operating systems. Students are encouraged to suggest and define their own topics. A written report is required. Limited enrollment. Computer facilities including a PDP-11 computer are available. Prerequisite: previous or concurrent registration in one of the following: 286B, 381B, 386, Computer Science 144A,B or 240B.  
3 units, Aut (Bredt) Th 2:45  
Win (Bredt) W10  
Spr (Cerf) W10  
Sum (Staff) W 10  
and by arrangement  

292. Special Seminars—Each year special seminars and experimental courses are given on topics of current interest. See the Time Schedule and bulletins in the Department Office for detailed announcements.  

COURSES FOR GRADUATE STUDENTS  

305. Seminar on Electronics in Medicine—Weekly seminars on the application of electronics technology to problems of medical practice or research featuring speakers from educational institutions or industries.  
1 unit, Aut, Win (White)  

310. Integrated Circuits Technology and Design Seminar — In-depth treatment of technology and circuit design problems. Content will roughly parallel topics of interest from 313 and 314.  
1 unit, Win, Spr (Dutton)  

312. Integrated Circuit Technology—Fundamental principles of monolithic integrated circuit technology. Technological limitations on integrated circuit design. Lectures and laboratory instruction including photolithography, oxidation, diffusion, and epitaxial deposition. Laboratory portion is limited in enrollment. Prerequisite: 113.  
2 to 3 units, Aut, Spr (Meindl)  

3 units, Win (Dutton)  

3 units, Spr (Angell)  

315. Solid State Circuits Laboratory—Laboratory exercises on the design of high-performance circuits using state-of-the-art solid state components including microprocessors and custom integrated circuits. Prerequisite or corequisite: 211 or 221A,B or equivalent.  
3 units, Aut, Win, Spr, Sum (Garland)  

320. Solid State Seminar—Discussion by guest specialists, faculty, and students of research topics and current literature in solid state physics.  
1 unit, Aut, Win, Spr (Spicer)  

322A. Basic Quantum Mechanics — Introduction to the concepts of quantum mechanics; the postulates of quantum mechanics; observables, wave functions, and probability density; the Schrödinger equation; complementary variables and the uncertainty principle; the harmonic oscillator and particles in a box; the hydrogen atom; angular momentum; the matrix formulation of quantum mechanics; the Dirac notation. Prerequisites: introductory atomic physics, classical mechanics, differential equations. Recommended: linear algebra.  
3 units, Aut (White)
322B. Basic Quantum Mechanics—Time independent perturbation theory; time dependent perturbation theory; transition probabilities; spin, identical particles, and exchange; energy levels of atoms; elementary band structure; the symmetry properties of wave functions. Prerequisite: 322A.

3 units, Win (White)

323. Applications of Acoustic Devices—Introduction to the wide range of applications of acoustic devices. Topics covered include wave propagation in isotropic materials, piezoelectric transducers, acoustic holography, acoustic imaging devices, surface acoustic waves, and signal processing. Prerequisite: 322A.

3 units, Aut (Kino) alternate years, given 1976–77

324. Applications of Quantum Theory — A unified approach involving the density matrix to lasers, semiconductors, Raman effect, field quantization, and multiple quanta effects. Emphasis on the techniques for obtaining the appropriate equations of motion, rather than on detailed investigation of specific devices. Topics included are photoconductivity, rate equations, spontaneous emission, laser action, infrared absorption, and multiple photon absorption. Prerequisite: 322B or Physics 231.

3 units, Spr (Pantell)

326A. Wave Phenomena in Electronic Devices I—(Enroll in Applied Physics 250.)

326B. Wave Phenomena in Electronic Devices II—(Enroll in Applied Physics 251.)

328A,B. Physics of Semiconductor Devices — Emphasis on the physics of semiconductor devices rather than circuit properties. Familiarity with the principles of the transistor and basic solid state physics of semiconductors is assumed. Analysis of the pn junction, traps and surface states is treated at a more sophisticated level than in EE216. The Schottky diode, the MIS diode, the MOSFET, the Gunn oscillator, the charge coupled device, hot electron effects, phonon interactions, transit time effects, charge control concepts, avalanche breakdown, and surface state theory are treated in detail. 328A deals with bulk devices. 328B emphasizes the MOSFET and other surface type devices.

3 units, Win, Spr (Kino)

329A,B. Solid State Electronics Laboratory — Experimental projects on semiconductor crystal growth, gaseous diffusion of impurities, Hall effect, minority-carrier diffusion and drift mobility, thermoelectricity, electroluminescence, Gunn effect, optical absorption, plasma reflection, Schottky barriers, etc. Registration by consent of instructor. Prerequisite: 238, or 328A,B or Physics 172, or Materials Science and Engineering 181.

3 units, Win, Spr, Sum (Pearson)

330. Photoelectronic Materials and Devices Laboratory—Experimental projects on measuring the spatial frequency response (MTF) of low light level image intensifiers, preparation of conventional semi-transparent semiconductor photocathodes and measurement of their spectral response, excitation, emission and optical absorption spectra of luminescent phosphors, secondary emission coefficient of surfaces, etc. Registration by consent of instructor. Prerequisite: Physics 161 or Materials Science and Engineering 181.

3 units, Aut (Bates)


3 units, Spr (Spicer)

335. Seminar in Quantum Electronics and Optics—Discussion by staff and students of topics in lasers, optics, quantum electronics, and optical parametric devices.

1 unit, Aut, Win, Spr (Siegman, Byer, Harris)

338A. Quantum Theory of Energy States in Solids—(Enroll in Materials Science and Engineering 233.)

338B. Electronic Transport in Solids—(Enroll in Materials Science and Engineering 234.)

338C. Photoelectronic Properties of Solids —(Enroll in Materials Science and Engineering 235.)

342. Radiation — Spectra; wave packets; mode density; Maxwell stresses; radiation pressure. Green’s function; delta-function; retarded potentials; relativity; multipole fields; bremsstrahlung. Huygen’s principle; Fresnel diffraction; computational methods
for field problems. Prerequisite: 243 or equivalent.

3 units, Spr (Buneman) alternate years, given 1976–77

346. Principles of Nonlinear Optical Devices — Wave propagation in anisotropic, nonlinear, and time-varying media. Tensor description of nonlinear susceptibilities; coupled wave equations; harmonic generation; parametric amplification and oscillation; Manley-Rowe relations; interaction with vibrational waves, Brillouin and Raman scattering; electro-optic and acoustic frequency translation; light modulation; optical scanning, and filtering. Prerequisite: 232, or 243, or 241N or equivalent.

3 units, Spr (Harris)

347. Introduction to Fourier Optics — Application of Fourier theory to the analysis and synthesis of optical imaging and data-processing systems. Diffraction, lenses, coherent and incoherent imaging, optical data processing, and holography. Prerequisite: familiarity with Fourier analysis.

3 units, Win (Macovski)

348. Ionospheric Processes — The neutral atmosphere; the solar ionizing radiation; the role of production, loss and diffusion processes in establishing the ionosphere; thermal behavior of the ionospheric plasma; coupling to the protonosphere. Transionospheric propagation and its practical applications. Prerequisite: 243 or equivalent.

3 units, Spr (daRosa) alternate years, given 1975–76

349. Statistical Optics — Applications of statistical tools to problems in optics: theory of partial coherence, image formation with partially coherent light, imaging through randomly inhomogeneous media, photon counting statistics, noise in photographic detection, and statistical problems in holography. Prerequisite: 275.

3 units, Spr (Goodman)

350. Radioscience Seminar — Student-faculty discussion of research problems in the fields of ionospheric and magnetospheric physics; radio propagation in, and radio emission by, ionized media; solar terrestrial relations; and radio and radar astronomy, and plasma physics.

1 unit, Aut, Win, Spr (Staff)

351. Plasma Wave Theory — Introduction to plasma wave propagation in cold and warm plasmas; equivalent permittivity concept; energy and group velocity; pulse response; dispersion relations for transverse and longitudinal wave propagation; effects of boundaries and inhomogeneities; origins of instabilities and criteria for their classification as absolute or convective; special cases of velocity-space and macroscopic instabilities; wave/wave interaction and parametric amplification. Courses 351 and 352 are complementary, and may be taken in either order. Prerequisite: 243 or consent of instructor; recommended: 261.

3 units, Spr (Crawford) alternate years, given 1975–76

352. Wave Propagation in the Ionosphere and Magnetosphere — Magnetionic theory in multi-component media; signal dispersion; group ray velocity; wave polarization; refractive index surfaces; absorption; boundary effects; interpretation of natural phenomena (e.g., whistlers and VLF emissions); remote sensing in plasmas; communication; theory of wave-particle interactions in the magnetosphere. Prerequisite: 243 or equivalent.

3 units, Spr (Helliwell) alternate years, given 1976–77

353. Image Formation and Interferometry — Image reconstruction from X-ray scans, image filtering, image resolution loss due to scanning with sensor, restoration in the presence of noise. Diffraction theory of antennas and other sensors, interferometry, arrays of sensors. Coherence properties of random radiation fields, image-forming techniques, aperture synthesis, rotation synthesis. Prerequisite: 261 or equivalent.

3 units, Aut (Bracewell)

354. Theory and Application of Radio Wave Scattering — Theory of radio wave scattering from metallic and dielectric spheres, cylinders, and laminas of small and large size. Scattering from electron ensembles, and from turbulent media. Scattering from rough surfaces, with large and small scale roughness, planetary surfaces and the sea; Rice's solution. Emphasis on physical descriptions. Applications to radar, radar astronomy, and remote sensing. Prerequisite: 243 or consent of instructor.

3 units, Aut (Tyler) alternate years, given 1975–76
356. Introduction to Plasma Physics—Plasma as a new medium; its significance in space and fusion research, individual and collective phenomena; ionization, charged particle orbits, collisions, plasma oscillations; Maxwell-Boltzmann distributions, Debye length, Landau damping, magnetoionic propagation and dispersion. Sheath and probe theory, magnetic confinement, pinches, adiabatic motion, mirrors, pressures, stresses, magnetogasdynamics. Prerequisite: 243 or equivalent.

3 units, Aut (Buneman) alternate years, given 1975-76

358A,B. Quantum Electronics Laboratory—(Enroll in Applied Physics 358A,B.)

358C. Solid State Physics Laboratory—(Enroll in Applied Physics 354.)

360. Seminar on the Theory of Systems — Discussion of research problems and current literature in control, communication, and system theory by faculty, students, and outside specialists.

1 unit, Aut, Win, Spr (Bryson, Morf)

363. Introduction to Linear System Theory — Analysis of finite-dimensional single input-single output linear systems. Analog computer realizations, state variables, canonical forms. Controllability, observability, and minimality. Relations to transfer function descriptions. Time- and frequency-domain design of controllers and observers. State-variable realizations from input-output data. Prerequisite: 102 or Engr. 104.

4 units, Aut (Bryson, Kailath) Spr (Staff)

364. Multivariable System Theory—Structural properties—controllability, observability, canonical forms. Applications to pole-shifting, decoupling, system realization and identification. A sequel to E.E.363 where similar problems are studied for scalar systems. Student presentations based on current research literature.

3 units, Win (Morf)

366. Optimal Control of Dynamic Systems — (Enroll in Aeronautics and Astronautics 278A.)

367. Optimal Estimation and Control Logic in the Presence of Noise—(Enroll in Aeronautics and Astronautics 278B.)


3 units, Spr (Widrow)

375. Information Systems Seminar — Lectures and discussion of topics and research areas in information systems: selected topics such as computational and statistical complexity, rate distortion theory, algebraic systems theory, simultaneous communications, and telecommunications policy.

1 unit, Aut, Win, Spr (Staff)

376. Information Theory — Information sources. The measure of entropy, information, and mutual information properties of codes; coding information sources; Huffman coding. Kolmogorov complexity. Information channels; reliable messages through unreliable channels; Shannon’s noiseless and noisy coding theorems; channel capacity; restricted primarily to discrete channels. Prerequisite: Statistics 116 or Engineering-Economic Systems 221 or equivalent.

3 units, Win (Cover)


3 units, Win (Cover) alternate years, given 1976-77

378A. Linear Estimation and Detection Theory—Linear least-squares estimation. Wiener filtering. Canonical representations and
innovations. Recursive estimation for state and covariance models. Statistical decision theory and signal detection. Detection of known and random signals in additive Gaussian noise; receiver structures and error probabilities. Prerequisite: 278 or equivalent and 363.

3 units, Win (Kailath)

378B. Statistical Detection and Nonlinear Estimation—Filtering, smoothing and detection of general signals in Gaussian and/or non-Gaussian noise. Martingales and innovations as basic processes in estimation and detection; properties and applications. Recursive non-linear estimation and detection. The separation theorems of stochastic control and of the detection of random signals. Prerequisite: 378A or consent of the instructor.

3 units, Spr (Kailath)

379. Communication Channels — Fundamental principles of digital communications; detection of signals in Gaussian noise; channel capacity and channel reliability functions; applications to signal selection, input and output quantization, error-correcting codes. Primary emphasis on continuous channels. Prerequisite: 278 or equivalent.

3 units, Spr (Hellman)

380. Seminar on Digital Systems — Discussion of current research in the area of digital systems including logic design, switching theory, and machine organization.

1 unit, Aut, Win, Spr (McCluskey)
W 4:15

381A,B. Switching Theory and Logic Design—Analysis and synthesis of digital circuits with emphasis on basic design techniques and general concepts. Boolean algebra; simplification of switching functions; sequential circuits; simplification of sequential machines. Characteristics of switching, memory, and input/output devices. Comparison of digital integrated-circuit families. Introduction to large-scale integration. Logic design of a system such as a stored program computer, digital differential analyzer, desk calculator, or radar signal processor. Prerequisite: Basic knowledge of Boolean algebra and number systems.

381A. 3 units, Aut (Peterson) MWF 9 and (McCluskey) MWF 11
Win (Staff) MWF 11
Sum (Staff) MTWTh 11

381B. 3 units, Win (McCluskey) MWF 11 and (Peterson) MWF 1:15
Spr (Staff) MWF 1:15

385A. Digital Reliability Seminar — Student-faculty discussions of research problems in areas of reliability, testing, diagnosis, and redundancy in digital systems. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr (McCluskey and Wakerly) M 3:15–5:05

385B. Parallel Systems Seminar—Student-faculty discussions of research problems in areas of hardware and software system design. Design methodologies for operating systems; system reliability including program verification, program testing, error detection, and error recovery; machine-independent system design; languages for systems implementation; models for parallel systems. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr (Bredt) M 4:15 and by arrangement

385C. Computer Systems Analysis Seminar—(Enroll in Computer Science 319C.)

385D. Communications Network Seminar—Student-faculty discussions on computer communication networks, including study of packet switching, loop systems, topology and capacity assignment, reliability, and performance measurement. Major focus on inter-process communication methods and operating system design for distributed resource networks.

1 to 4 units, Aut, Win, Spr (Cerf)

385E. Microprogramming and Emulation Seminar—Student/Faculty discussions of research problems in microprogramming, microprogram representation, machine representation, and the emulation of both conventional and abstract machines. Students will use the Emulation Laboratory facilities and will write interpreters for specific machines.

1 to 4 units, Aut, Win, Spr (Flynn)

386. Operating Systems — Multi-programming and time-sharing system design. Topics covered include processes and process communication, control of input-output, memory management, scheduling, file systems, protection, resource allocation, design methodologies. (Same as Computer Science 246.) Prerequisites: Statistics 116 or equivalent; 286B or systems programming experience.
3 units, Aut (Enroll in Computer Science 246)  
Spr (Bredt) TTh 1:15-2:30

387. Algebraic Coding Theory — Theory and implementation of codes for detection and correction of independent and burst errors. Hamming codes; BCH codes; Berlekamp decoding algorithm. Convolutional encoding and sequential decoding. Optional: synchronization; comma-free codes, codes with special correlation properties. Prerequisite: 284.

3 units, Spr (Gill) alternate years, given 1976-77

388. Computer System Evaluation—Performance criteria in computer systems, queueing theory; queueing models of multi-programming; analysis of bottlenecks, measurements via hardware and software; simulation; models of program behavior, storage devices, memory hierarchies, and file structures; allocation and scheduling of jobs and computer systems resources. Recommended prerequisite: 386.

3 units, Spr (Staff) alternate years, given 1975-76

390. Special Studies or Projects in Electrical Engineering—Independent work under the direction of a faculty member for which no letter grade is given. Individual or team activities involving laboratory experimentation, design of devices or systems, or directed reading.

By arrangement

391. Special Studies and Reports in Electrical Engineering—Independent work under the direction of a faculty member; a written report or a written examination is required and a letter grade is given. If a letter grade based on written work is not appropriate, student should enroll in 390.

By arrangement

392. Special Seminars — Each year special seminars are given on topics of current interest. These seminars are usually announced one or two quarters prior to their presentation and are given by specialists in the field. See the Time Schedule for details.

395. Electrical Engineering Instruction: Practice Teaching—Open to a limited number of Electrical Engineering students who plan to make teaching their career. Qualified students conduct a small section of an established course taught in parallel by an experienced instructor.

(Smith) by arrangement

397. Faculty Seminar—Discussion meetings arranged by a faculty member or initiated by interested students and sponsored by a faculty member.

1 unit, by invitation

400. Thesis and Thesis Research—Limited to students who have established candidacy for the degree of Engineer or Ph.D. A grade of P indicates satisfactory work; no letter grade is assigned.

By arrangement

412. Advanced Integrated Circuit Laboratory — Experimental projects and seminars on integrated circuit fabrication using epitaxial, oxidation, diffusion, evaporation, sputtering, and photolithographic processes with emphasis on techniques for achieving advanced device performance. May be repeated for additional credit. Prerequisite: 312 and consent of instructor.

3 units, Win (Meindl)

413. Ion Implantation Techniques—Theory of ion implantation and related processes, with applications to the study of solid-state materials and the fabrication of solid-state devices. Prerequisite: consent of instructor.

1-3 units, Spr (Gibbons)

415. Solid State Laboratory—Experimental and theoretical problems related to the understanding, control, and use of the electronic, magnetic, and optical properties of solid-state materials and devices. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr, Sum

Section 1 Gibbons  
Section 2 Pearson  
Section 3 Spicer  
Section 4 White

417. Integrated Circuit Applications—Computer assisted analysis, and design, fabrication, and application of integrated circuits and transducers in electronic systems such as optical-to-tactile reading aid for the blind, implantable ultrasonic blood flow-meter, microprobe for biopotential sensing, gas chromatograph, and ultrasonic imaging systems. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr, Sum

Section 1 Angell

425. Microwave Solid State Devices—Theory and laboratory techniques for microwave acoustics, Gunn effect, and other microwave semiconductor devices, and for biological applications of acoustics. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr, Sum

430. Electron Spectroscopy Seminar—Electronic structure, photoemission, and surface physics. Topics of current research interest selected from the literature. The more advanced students present the material for discussion.

1 unit, Aut, Win, Spr (Spicer, Herman)

431. Quantum Electronics—Quantum theory of lasers and related quantum electronic devices. Interaction of radiation and atoms; stimulated transitions; the density matrix; inhomogeneous broadening; quantum noise. Provides the quantum theory underlying the semiclassical approach of 231–232. Prerequisites: quantum theory to the level of 322B or Physics 231. 231–232 is not a prerequisite, but background reading from this course material may be necessary.

3 units, Spr (Siegman) alternate years, given 1976–77

435. Advanced Quantum Electronics—Advanced topics in lasers, quantum electronics, and nonlinear optics. May include experimental work on the generation and measurement of tunable optical and ultraviolet radiation. Prerequisite: consent of instructor.

3 to 4 units, Aut, Win, Spr, Sum

438A. Group Theory and Symmetry—(Enroll in Applied Physics 270.)

438B. Solid-State Theory—(Enroll in Applied Physics 339.)

438C. Solid-State Theory—(Enroll in Applied Physics 340.)

445. Plasma Waves and Instabilities—Special topics in plasma wave propagation and instabilities in laboratory and space plasmas. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Crawford)

449. Medical Imaging Systems—Basic modalities used for imaging internal structures within the volume of the body from a systems viewpoint: X-ray radiography, computerized tomography, nuclear medicine, and ultrasound. Analysis of existing and proposed systems in terms of resolution, modulation transfer function, detection sensitivity, and ability to visualize disease processes, and potential for improving diagnosis. Prerequisites: Fourier transforms. 347 recommended.

3 units, Spr (Macovski)

450. Radioscience Laboratory—Experimental, observational, and theoretical problems of the ionosphere, magnetosphere, thermosphere, and radio and radar astronomy. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr, Sum

451. The Laboratory Plasma—(Enroll in Engineering 211.)


3 units, Aut (Buneman) alternate years, given 1976–77

456A. Solar Terrestrial Relations—(Enroll in Applied Physics 360.)

457. Computer Simulation of Continuous
Media—A survey of the algorithms, tricks, approximations, economies, and data management used in simulating media such as plasmas, gases, the atmosphere, electron and/or hole distributions, etc. on a large computer; introduction to low level languages. For doctoral candidates in Electrical Engineering, Mechanical Engineering, Aeronautics and Astronautics, Applied Physics, or Computer Science.

1 to 3 units, Aut, Win, Spr (Buneman)

by arrangement

465. Modeling and Optimization of Environmental Systems—Application of the techniques and methodology of engineering and scientific mathematics to problems of the environment. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr, Sum (Pantell)


475. Special Studies in Information Systems—Advanced topics in information and communication theory, control theory, and related areas, including applications. May be repeated for credit. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr, Sum by arrangement

Section 1 Cover
Section 2 Franklin
Section 3 Gill
Section 4 Goodman
Section 5 Gray
Section 6 Hellman
Section 7 Kailath
Section 8 Luenberger
Section 9 Macovski
Section 10 Tuttle
Section 11 Widrow

477. Statistical Complexity — (Enroll in Statistics 363.)

478. Topics in Statistical Signal Processing—Problems selected from recent research of the faculty in areas that have reached a level of development suitable for course presentation. Topics to be covered 1975–76: Information theoretic and computational complexity approaches to cryptography; connections to computer security, coding and complexity theory. Prerequisites: 376 or 379.

3 units, Aut (Hellman)

479. Topics in Statistical System Theory—

Selected problems in statistical communication, stochastic control, statistical data processing, network and system realization and identification, stability theory. (May be repeated for credit.) For 1976, emphasis is on complexity of computer computations. Prerequisite: some computer programming experience.

3 units, Spr (Morf)

482. Advanced Computer Organization — Machine algorithms for high-speed arithmetic. Analysis of hierarchical memory systems and their management. Data formats, instruction sets, addressing, and control. Comparison of advanced systems including multi-processors, stack-organized computers, and pipeline computers. (Same as Computer Science 311.) Prerequisites: 181, 182 or 381B or equivalents.

3 units, Spr (Flynn)

483. Advanced Topics in Switching Theory and Logic Design — Functional decomposition theory, iterative networks, threshold logic, NAND networks, reliability, diagnosis, and related topics. Prerequisites: 284 and 381B or equivalent.

3 units, Spr (Staff) alternate years, given 1975–76

484. Advanced Automata Theory—Realization of digital behavior by finite-state machines. Machine recognition experiments, reduction and decomposition, regular expressions, lossless machines, iterative systems, space-time transformations, linear machines, concepts of pipelining and parallelism. Prerequisites: 284 and one of 381B, Philosophy 162, or Computer Science 156.

3 units, Spr (Staff) alternate years, given 1976–77

485. Advanced Computer Systems—Individual student-faculty discussions of advanced topics in logic design, computer architecture, operating systems, reliability, and performance evaluation. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr, Sum by arrangement

Section 1 Bredt
Section 2 Cerf
Section 3 Flynn
Section 4 McCluskey
Section 5 Peterson
Section 6 Wakerly
ENGINEERING-
ECONOMIC SYSTEMS

Chairman: William K. Linvill
Associate Chairman: Donald A. Dunn

Associate Professors (Consulting): Nicolaos V. Arvanitidis, Robert E. Larson, James E. Matheson, Peter A. Morris
Adjunct Professor: John T. McAlister, Jr.

OFFERINGS AND FACILITIES

The Department of Engineering-Economic Systems is dedicated to preparing individuals for careers dealing with the phenomena characteristic of planning, operation, and control of large-scale technological-economic systems through programs of study, internship, and research on the graduate level.

The formal coursework provides the basic framework of professional training and emphasizes the system analysis techniques that are sufficiently powerful to have important application in the planning and operation of the complex systems required by modern society.

A unique feature of the doctoral program is the internship, a period of experience in the real world that allows a student to test theory in the face of reality and thereby gain first hand experience in the limitation of existing methodology. The internship experience will often provide the basis for formulating meaningful research problems.

The research programs of faculty and students are designed to abstract from experience and, thus, extend the frontiers of knowledge in the systems area. The research program is the source of new methodology that sustains the course program.

BACKGROUND REQUIRED

Students admitted for graduate study in Engineering-Economic Systems must have a background of undergraduate work that indicates a level of mathematical maturity customarily found in an intensive undergraduate engineering or physical science program. Undergraduate course work in economics is not required, but will prove helpful in graduate study in this field.

PROGRAMS OF STUDY

There are three programs of study, all at the graduate level, leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy in Engineering-Economic Systems.

MASTER OF SCIENCE

The degree of Master of Science requires a minimum of one academic year of study beyond the B.S. degree. University regulations governing the degree of Master of Science are described in the “Degrees” section of this bulletin. The Department does not have a thesis requirement for the Master's degree. Department requirements provide great flexibility for meeting individual objectives. The Master's degree may be viewed as a terminal degree program to provide a professional focus, or it may be used as an exploratory vehicle to formulate and select a more advanced graduate school program. Course programs are approved individually by Engineering-Economic Systems faculty. In addition to meeting University requirements, M.S. programs must involve at least 21 units of courses in Engineering-Economic Systems with letter grades and a total of 42 units of course work.

ENGINEER

The degree of Engineer requires a minimum of two academic years of study beyond the B.S. degree (three academic quarters beyond the M.S.). University regulations governing the degree of Engineer are described in the “Degrees” section of this bulletin.

The applicant has almost complete freedom of selection of courses beyond the requirements for the M.S. degree. The equivalent of approximately one quarter is devoted to independent study and thesis work with faculty guidance.

Permission to study beyond the Master of Science degree must be obtained from the appropriate Department committee. The decision of the committee is based on its eval-
uation of the applicant's academic record, performance in independent work, and potential for advanced study, and on the ability of the faculty to support and supervise such study.

**Doctor of Philosophy**

The degree of Doctor of Philosophy requires a minimum of three academic years of study beyond the B.S. degree. A complete statement regarding University regulations governing the degree of Doctor of Philosophy will be found in the "Degrees" section of this bulletin. The requirements are administered by the University Committee on Graduate Studies.

Admission to the graduate school does not imply that the student is a candidate for the Doctor of Philosophy degree. Only after the Application for Doctoral Candidacy has received official Departmental and University approval does the student become a candidate for the degree.

All students who have not already earned a Master's degree must receive the Master of Science degree in Engineering-Economic Systems as a prerequisite to candidacy for the PhD. Not later than the first Autumn quarter after receiving the Master of Science degree the student should submit an application to participate in the Department qualifying procedure.

Requirements may be summarized as follows: The student is to complete successfully (1) a minimum of three years of residence with graduate standing, (2) Department qualifying procedure, (3) an approved program of courses, (4) a 3.5 average letter grade indicator on the core courses (see p. 157), (5) an oral examination near the completion of the doctoral program, (6) a dissertation, based on research, which must be a contribution to knowledge. The Department does not have a foreign language requirement.

**Ph.D. Minor**—Doctoral students throughout the University may complete a minor in Engineering-Economic Systems by taking 21 units of courses selected from the list below. The selection must be approved by the student's Department adviser and by the Engineering-Economic Systems faculty. The primary aim of this minor is to develop system analysis and decision-analysis capabilities for graduate students who anticipate careers associated with system problems.

**System Internships**

Since most large-scale system problems cannot be made available within a university, internships are offered to help the student develop the ability to solve system problems by working on real problems in the field environment.

Problems of broad scope requiring a system viewpoint and thus suitable for the internship experience are found in large industrial firms, in companies and research groups concerned with the design and operation of large-scale systems, and in government agencies. Opportunities also exist to participate in economic and industrial planning in developing countries.

The duration of an internship ranges from 6 to 24 months, depending on the time required to complete the project successfully. While interning, the student lives on location and works as an employee responsible to the company or agency concerned. The Engineering-Economic Systems faculty locates and screens suitable internship opportunities in a variety of areas, and reviews each proposed project to verify its educational value.

With the support of the Ford Foundation and the Sea Grant Program of the National Oceanic and Atmospheric Administration (NOAA), a unique internship has recently been established on Capitol Hill in conjunction with the Technology Assessment Board of the U.S. Congress. For the first time in the experience of the Congress, advanced graduate students having special training in technology assessment and public policy have been assigned to legislative offices to work on questions arising from applications of technology to achieve national goals. In a program closely supervised by faculty, students chosen as Congressional Fellows in Technology Assessment or as Sea Grant Fellows become legislative staff aids responsible for drafting legislation, organizing public hearings, providing analyses of proposed legislation or conducting technology assessments. Additionally, some students are assigned to the staff of NOAA where they coordinate with their EES colleagues on Capitol Hill while working on such problem areas as coastal zone management, outer continental shelf development, and oceans resource management.

The student's internship work in the field is mainly directed toward the successful so-
solution of a real-world problem. Consequently, the student will gain an appreciation for the approximations and compromises with rigor that characterize applied work in the field. After returning to the University, the student will complete this phase of the program by reexamining the field work in the light of the fundamental principles of system analysis, pointing out the shortcomings of the existing theory in this application, and abstracting from the experience the general insight that he or she expects to be useful in future studies.

One internship project or equivalent practical experience is standard in both Engineer's degree and Ph.D. programs, but is not a requirement. There is wide flexibility in the Ph.D. program to accommodate the particular interest of the student. Over 80 EES students have been on internships to date.

The variety of internships available will vary in time as new problem areas become of interest. The aim is to undertake projects that are technically challenging, practically significant, and theoretically enlightening.

**RESEARCH AND APPLICATIONS**

Although system concepts are portable and their generality must be emphasized, it is important for a student to receive experience in the application of these concepts in depth to at least one specific problem area. A practitioner, to be responsible and effective, must combine general system knowledge with the important specific factors relevant to the problem at hand. The opportunity for students to receive this important aspect of a systems education exists primarily in the internship program, in various applied research projects that may be in progress within the Department, and in special courses that concentrate on the application of system concepts to specific areas.

The major research programs of the department are listed below. Regular and acting faculty and lecturers who are active in these programs are indicated.

**Mathematical System Analysis** (Luenberger, Sweeney, Morris, Oren, Tse)

Mathematical system analysis is the development and application of those mathematical principles and techniques that form the basis for problem formulation and solution in the system area. The field is one of great multiformity, both with respect to the types of mathematics employed and in the areas of application. The Stanford program emphasizes the development of new techniques through an involvement in a variety of practical problems ranging from system design to policy analysis. Faculty and students in the program have developed effective analytical approaches to problems such as: the design of a national housing allowance experiment; planning of electric power expansion; analysis of U.S. agricultural policy; the theory of instruction; the control of various physical, economic, and social systems; land-use planning; housing policy planning; word processing system evaluation; and water resource planning. Students have often been employed by various local consulting firms while working on these problems. In parallel with this practical involvement, members of the program have made several fundamental contributions to theory in dynamic systems, optimization, policy theory, and economics. Current projects in the program include the application of dynamic system concepts to organizational structure, land-use analysis, housing dynamics, and the development of control theory.

**Decision Analysis** (Howard, Matheson)

Decision analysis is a logical procedure for balancing the many factors that influence a decision, including economic, technical, and social factors. It simultaneously considers the uncertain, dynamic, and complex consequences of a decision as well as the assignment of value to those consequences. Business applications in such areas as new product introduction, plant expansion, and merger decisions have been successfully treated. Government applications have included optimal expansion through nuclear plants of the electrical power system of Mexico, evaluating social policies for the control of sulfur emissions, and determining whether hurricanes threatening the United States should be seeded with silver iodide crystals. All of these applications have been made possible by the close liaison between the university program and the Decision Analysis Group of the Stanford Research Institute, both at the internship and post-doctoral levels. Current doctoral research areas are establishment of preference structures, development of decision systems for decentralized use, expert resolution, approximate methods, Markovian decision
models, determining the sensitivity to modeling assumptions, and the application of decision analysis to multi-party social decisions.

Public Policy Analysis (Dunn, Harman, Linvill, McAlister)

The policy analyst is concerned with exploring and mapping alternative approaches to large-scale problems of the society and with evaluating relative costs, benefits, and long-term intentions implied by various approaches. Agreement is widespread that policies in the public and private sectors need to be made in the context of (1) understanding of second- and higher-order consequences, (2) a long-term strategic perspective, and (3) coordinated actions among diverse agencies and institutions. The analysis of public policy alternatives requires a synthesis of several disciplines, including decision analysis, economics, quantitative systems analysis, and law.

A policy analysis program emphasizing future research is centered at SRI, involving EES faculty and students working with social scientists and systems analysts under the direction of Professor Harman.

A policy research program in national growth policy is being conducted by Professors Harman, Linvill, and McAlister. The focus of this project is on the definition of national objectives for a wide range of growth-connected quantities such as environmental quality and on the ways that a national consensus in this area can be developed.

University-wide policy research programs in telecommunications involve faculty and students from a number of departments and schools. Professor Dunn and several EES students have been active in these programs which have dealt with policy issues in such areas as cable television, broadcast television, and the regulation of the telephone industry.

Technology Assessment (Dunn, Linvill, Luenberger, McAlister, Stiglitz, Sweeney)

Technology assessment is a form of policy analysis which attempts to account for the secondary and tertiary impacts on society from the applications of technology. A relatively new concept, technology assessment is still without a precise methodology of scientific inquiry. Yet, the interdependent effects of past and anticipated future applications of technology have created pressures on policy-making institutions which have resulted in a steadily increasing demand for a more detailed evaluation of technological impacts and/or alternatives. To meet this demand, technological assessments have been conducted which apply a variety of analytical methods to four basic procedures in the inquiry: (1) problem definition, (2) identification of technological alternatives to meet societal needs, (3) evaluation of impacts of alternative technologies, and (4) determining policy options.

Because of its deep concern over the impacts of technology on American society and its constitutional responsibility to appropriate funds for public technologies and to legislate regulation of private technologies, the Congress of the U.S. has taken the lead in technology assessment. In 1972, Congress passed the Technology Assessment Act which established a Joint Board composed of members of the two houses of Congress, an Advisory Council composed of academic, business, and public interest representatives, and an Office of Technology Assessment (OTA) under the direction of former Congressman Emilio Q. Daddario, the original proponent of the Act. The OTA, established in late 1973, is now the principal focus for technology assessment in America, although for a number of years assessments have been conducted and are continuing under the sponsorship of the National Science Foundation. Assessments are being conducted in other countries under a variety of sponsorships, but few of them have been directly incorporated into the policy-making process as in the United States.

Within EES, a "Workshop on Technology Assessment" has been established to prepare advanced graduate students having a career commitment to policy analysis for practical assignments in the technology assessment field. Analysis of emergent technology assessment methodologies, of the applicability of EES core disciplines to the technology assessment process, and of priority issues for technology assessments are items on the workshop agenda. Students chosen as Congressional Fellows in Technology Assessment or as Sea Grant Fellows for assignment in Washington (see Systems Internships) are able to prepare themselves for their assignments in the workshop.

Because technology assessment is still in
its formative stages there are unusual opportunities for students who seek to relate rigorous analytic techniques to practical questions of technological applications which are actually being considered by policy-making institutions.

**Health Systems** (Smallwood, Sondik)

EES health systems research is directed toward the development of an integrated methodology for the analysis of health care systems. Our previous research has developed methodologies and analysis tools to aid in program or policy planning and evaluation in several health care problem areas. Currently we are collaborating in health planning research with the local regional health planning authority, the Bay Area Comprehensive Health Planning Council. Other current research projects include a joint study with the Stanford University School of Medicine on the formulation, evaluation, and testing of alternative heart disease prevention programs, a developmental study toward improved health care quality assessment strategies, and collaboration with Xerox Palo Alto Research Center on research in medical decision-making.

**Telecommunications Systems** (Dunn, Linvill)

Developments in computers and communication technology over the last decade and the synthesis of these two technologies have created a wide range of opportunities for society. A long-term interdisciplinary study of the technology, costs, markets, and social effects of computer communication systems is being carried out under Professor Dunn. The study is centered in EES, but it brings together faculty and students from the economics, communication, and electrical engineering departments as well as EES. The research utilizes decision analysis and economics in the analysis of public policy issues, as well as legal and social science research methodologies. Specific topics being studied include: (1) economic models of computer communication networks; (2) the effects of pricing policy on congestion in such networks; and (3) international standards and agreements and their effects on domestic systems.

Professor Linvill is working at the interface between telecommunications and the society. He is developing a system to integrate the delivery of public services which would utilize a public information system, a credit card system for accounting for public service deliveries, and a process for planning public service delivery systems.

**National Resource Management** (Linvill, Luenberger, McAllister, Stiglitz, Sweeney)

The Department has several research and project activities that relate to the policy issues associated with the use of limited national resources. Present activities include studies of energy problems, agricultural policy, mineral resource planning, land use planning, and efficient use of coastal and marine resources. Project work is centered in the Congressional Fellows program, the Sea Grant Fellows program, various government agencies, and local consulting firms. The on-campus research program, which complements these project activities, is aimed at developing the methodology of analysis that is common to these various resource management problems.

**FINANCIAL ASSISTANCE AND ADMISSION**

Most students in the EES Ph.D. program have found that, after completing the qualifying procedure, they are able to obtain financial support through a combination of research assistantships, teaching assistantships, and their internships, all of which contribute directly to their educational programs as well as providing financial support. In the recent past students have typically received $1000 per month during the period of their internships. The critical period financially for most students has been the first year to year-and-a-half of graduate work. A financial commitment of about $6000 per year is required to cover tuition and expenses.

A limited number of fellowships for first-year students are available through the department. These pay tuition plus an allowance of approximately $200–$250 per month during the academic year. Two other potential sources of first-year support are research assistantships and loans. However, research assistantships are, in most cases, awarded to students who have completed the qualifying procedure.

For all students who are U.S. citizens and who wish to obtain loans, the department can provide the means of obtaining loans up
to $5000. Loans may be repaid from the salary that the student earns during the internship, but repayment need not begin until graduation.

Applicants for all forms of assistance may obtain the necessary application forms from the University Admissions Office. Applications for fellowships must be made by the 15th of January preceding the Autumn quarter that admission is desired and must be accompanied by application for admission. Research assistantships, however, are awarded by the individual faculty research supervisors, not by the Department, and have no such deadline. Applicants, because of the individual nature of these awards, are advised to contact directly the faculty member under whom they wish to work. Formal applications to the Department for research assistantships will be referred to the individual faculty research supervisors.

Except in unusual circumstances, admission to the Department of newly entering graduate students is confined to the Autumn quarter because the course offerings are arranged sequentially with basic courses and prerequisites falling early in the academic year.

COURSES OF STUDY

Study programs should be selected to give a broad coverage as well as work in depth in one or more specific areas. System analysis is a young discipline that draws many of its models and methods from mathematics, physical science, and social science. Future developments in system analysis will often be an outgrowth of concepts born in these foundation fields. The student's course program should include a selection of foundation material from the offerings of other departments so that the student will have the breadth to contribute to the growth of his or her profession both now and for the years to come.

Up to half of the student's courses for the M.S. degree may be taken outside the department. However, a typical M.S. program would include 30 units of EES courses including 3 units of EES 293, Math 113 and 115, and two additional out-of-department courses.

Examples of student programs for the Ph.D. which emphasize different foundation disciplines are as follows:

1. A quantitative system analysis program which emphasized mathematics might include the following mathematics courses: 113, 114, 115, 116, 117, 205A, B, C, 261A, B, C.

2. A program which emphasized economics might include the following economics courses: 202, 203, 204, 249, 250, 254, 256.

Similar programs with an emphasis in other specific areas such as political science or sociology can be developed with the aid of an adviser. In most such cases it is possible to obtain a minor in the student's additional area of special interest.

In some cases a student may wish to emphasize an interdisciplinary area such as communications which might involve taking courses in a number of other departments. Individual programs can be developed with the aid of an adviser to meet particular student interests, but an attempt should be made to develop substantial depth in at least one area outside the EES department during the course of the Ph.D. program.

The courses in this Department are divided into the following categories:

1. System Analysis
   a) Modeling
      1) Dynamic Systems: 201A*, B*
      2) Probabilistic Models for Problems of Uncertainty: 221*, 251*, 252
   b) Optimization: 242*, 243*, 248, 263A, B
2. Economics: 110, 211, 212A*, B*
3. Decision Analysis: 231*, 232, 236
4. Applications and Research
   a) Health Systems: 264
   b) Telecommunication Systems: 280
   c) Urban Systems: 249
   d) Research Seminars: 291, 292, 293, 300

* The courses identified by asterisks above are core courses. A 3.5 average letter grade indicator is required on these core courses for doctoral candidates.

COURSES

SYSTEM ANALYSIS: MODELING

201A. Dynamic Systems — An introduction with about equal emphasis given to development of general dynamic system theory and to exploration of classical models from social, physical, and life systems. Goal is to develop ability to recognize and analyze dynamic phenomena in diverse situations. Concepts covered include: formulation and analysis of difference and differential equa-
tions; state-space formulation; linear systems, fundamental solution sets, equilibria, flow graphs; eigenvector analysis of linear systems, the concept of stability; transform analysis. Applications that are discussed in some detail include: cohort population models, social structures, migration models, national economics, price cycles, cultural media dynamics, housing dynamics.

3 units, Aut (Luenberger) TTh 9:30-10:45


3 units, Win (Luenberger) TTh 9:30-10:45

221. Probabilistic Analysis — A self-contained development of probability theory that is both theoretically sound and suited to application. Appropriate either as a terminal course or as a foundation for further graduate work in applied areas. Theory presented axiomatically with emphasis on sample space representation for both discrete and continuous random variables. Discussion of basic concepts, description of random variables, changes of variable, transform techniques, named distributions, and computer simulation. Goal is to provide student with same understanding and competence in analysis of probabilistic problems that he already possesses in dealing with deterministic problems. Prerequisite: working knowledge of calculus.

3 units, Aut (Howard) TTh 11:00-12:15

251. Dynamic Probabilistic Models—Emphasizes the extension and further application of basic systems concepts to modeling of processes exhibiting both dynamic and uncertain behavior. Linear systems under uncertainty. Application of linear system theory to the study of Markov and semi-Markov processes over finite and countable state spaces and discrete and continuous time. Examples in the areas of system reliability, marketing, health systems. Prerequisites: 201A and 221 or equivalents.

3 units, Spr (Sondik) TTh 1:15-2:30

252. Discrete State Systems and Optimization — Analysis and optimization of finite and infinite state systems. Topics include but are not limited to Markov and semi-Markov decision processes, population processes, and systems under partial observation. Techniques such as policy iteration and dynamic and linear programming are discussed with applications drawn from various fields including marketing, maintenance and reliability, and medicine. Prerequisite: 251 or equivalent.

3 units, Aut (Sondik) TTh 1:15-2:30

SYSTEM ANALYSIS: OPTIMIZATION

242. Introduction to Optimization — Overview of optimization field. Basic notions related to convexity. An introduction to linear programming including: problem formulation, basic properties, simplex method, duality, dual simplex method, reduction of linear programs to minimal form. Special computing techniques and their economic interpretations. Applications. Recommended: Mathematics 113 or equivalent.

3 units, Win (Oren) MW 3:15-4:30


3 units, Spr (Oren) MW 3:15-4:30

248. Dynamic Programming—The discrete-time dynamic optimization problem. Bellman's principle of optimality. The basic computational procedure. Advanced computational procedures, including successive approximations, approximations in policy space, dynamic programming with shift vectors, and state increment dynamic program-
ming. Dynamic programming for continuous time systems and the calculus of variations. Linear systems. Dynamic programming for stochastic and adaptive systems. Applications in system expansion planning, operations research, process control, power systems, environmental systems, and trajectory optimization.

3 units, Aut (Larson) TTh 2:45-4:00

263A. System Optimization — Introduction to functional analysis; linear vector spaces, normed spaces, Hilbert space. The projection theorem in Hilbert space with applications to approximation, control and estimation theory. Dual spaces and linear functionals, the Hahn-Banach theorem. Prerequisite: 201B or Mathematics 113. Recommended: Mathematics 115.

3 units, Aut (Tse) TTh 11:00-12:15

263B. System Optimization — Linear operators; inverses; adjoints, pseudo-inverses. Minimization of functionals; calculus of variations. Constrained optimization; Lagrange multipliers, Kuhn-Tucker theorem, duality, optimal control theory. Iterative techniques of optimization. Prerequisite: 263A.

3 units, Win (Tse) TTh 11:00-12:15

ECONOMICS

110. Introduction to Microeconomics — A self-contained presentation of the basic tools of microeconomics for students having an analytical background typical of senior or first year graduate students in engineering, but having no previous economics background. Topics presented include: theories of the consumer and of the firm, theories of competitive and monopolistic markets, conditions for economic efficiency, theories of efficient and non-efficient markets, and planning rules for the improvement of resource allocation. Particular emphasis is placed on phenomena characteristic of decentralized economies.

3 units, Aut (Stiglitz) MW 11:00-12:15


3 units, Win (Dunn) MW 11:00-12:15

212A,B. Economic Analysis—Analytic modeling of economic phenomena: methodologies for modeling choices of individual agents, for modeling the interactions among choice-making agents, and for analyzing normative economic models. Models of individual agents include theories of consumers and of firms. Models of interactions include theories of competitive and noncompetitive markets, general equilibrium theories, aggregate models of employment, national income, and inflation, and models of economic growth. Normative economic models include those which focus on the conditions for economic efficiency, the mechanisms by which markets may fail to be efficient, the planning rules for improving resource allocation, and the conditions for optimal economic growth.

212A: 3 units, Win (Stiglitz) TTh 2:45-4:00

212B: 3 units, Spr (Stiglitz) TTh 9:30-10:45

DECISION ANALYSIS

231. Decision Analysis — Development of a normative rationale for individual and group action in the face of uncertainty, complexity, and dynamism. Presentation of the procedures necessary to reduce the rationale to practice. Encoding of information and preferences. Discussion of utility measures of risk preference and discounting measures of time preference. Analysis of problems using decision trees that include risk and time preference. Determination of the economic value of perfect and imperfect information on one or several variables in a decision problem. Design of economic information-gathering experiments. Presentation of examples that range over the fields of business, engineering, law, and medicine. Applications drawn from private and public sectors of the economy. Prerequisite: 221 or equivalent.

3 units, Win (Howard) TTh 11:00-12:15

232. Advanced Decision Analysis—Extension of decision analysis beyond the basic paradigm. Emphasis on determining and extending the boundaries of logical analysis of decisions. Discussion of such representative topics as creation of alternatives; the encod-
ing of subjective information without bias; foundations of inference; invariance and exchangeability principles; relationship of decision analysis to classical inference and data analysis procedures; analysis of complex preference structures; normative preference principles; repetitive, iterative, and decentralized decision systems; value of information in special contexts; use of experts; competitive and social decision analysis; sensitivity and approximation; and decision analysis in dynamic processes. Content will vary with current research interests. Prerequisite: 231.

3 units, Spr (Howard) Th 2:45-5:15

236. Decision Analysis Practice — Provides an opportunity for students trained in the theory of decision analysis to apply that knowledge in practice, and also to extend the domain of rational analysis. Teams of students each analyze a current decision problem faced by an actual decision maker. They must carry out the technical procedures of modeling, information assessment, and value encoding by communicating with individuals who are usually not trained in logical analysis. Problems chosen by students have covered every level of decision-making from the university to the community of nations, and many fields of human endeavor. Project evaluations are based solely on the professional quality of analysis and presentation. Prerequisite: 231.

4 units, Spr (Howard) TTh 11:00–12:15

APPLICATIONS AND RESEARCH

249. Urban Economic Analysis — (Enroll in Economics 249.)

264. Health System Analysis—Quantitative approaches to health systems problems including regional health planning, medical decision-making, health care quality measurement and assurance and large-scale trial design. Emphasis on modeling and decision-making.

3 units, Win (Sondik) TTh 1:15–2:30

280. Telecommunications Systems and Public Policy—(Same as Communication 280.) Structure of the U.S. and international communications industry. Regulation of common carriers, TV and radio broadcasters, and users of the frequency spectrum, analysis of social consequences and public policy issues arising out of the rapidly changing technology in this field. Emphasis on economic analysis. Case studies of pay television, telephone interconnection, and computer-based teleprocessing systems.

3 units, Spr (Dunn) MW 11:00–12:15

291. System Research Seminar — Group study of an area of current system research. Topics may include areas of theory as well as areas of applications. Topics will be announced on a quarterly basis. In 1974–75 the following 3-unit seminars were held: Social Systems Analysis (Luenberger); Technology and Public Policy (McAlister), Stochastic Finite State Systems (Sondik), and The Art of Mathematical Modeling (Smallwood).

1 or more units, Aut, Win, Spr (Staff)

292. Directed Reading and Research in Engineering-Economic Systems — Directed study and research on subject of mutual interest to student and staff member.

1 or more units, any quarter (Staff) by arrangement

293. Seminar in Engineering-Economic Systems—Lectures on research problems and recent results in engineering-economic systems by faculty, students, and visiting specialists.

1 unit, Aut, Win, Spr (Staff) T 4:15


300. Thesis and Thesis Research—Limited to students who have established candidacy for the degree of Engineer or Ph.D. A grade of + indicates satisfactory work; no letter grade is assigned.

Any quarter (Staff) by arrangement

INDUSTRIAL ENGINEERING

Emeritus: Eugene L. Grant (Professor)

Chairman: James L. Adams


PROGRAMS OF STUDY

Industrial Engineering is concerned with the organization of people, information, and equipment in order to produce and distribute a service or product in an economic way, consistent with prevailing social values and the preservation of natural resources and environment. Depending on the degree level, students are prepared to design, manage, and perform research or teach about these productive systems which may be in federal, state or local government, public or quasi-public hospitals or schools, or in private industry. The curriculum is especially concerned with planning, designing and implementing organizations and programs for the application of technology to societal problems.

BACHELOR OF SCIENCE

The program leading to the degree of Bachelor of Science in Industrial Engineering is given earlier under School of Engineering. This curriculum is planned to serve those students whose long-run objective is the planning, designing, and implementing of complex economic and technological management systems where a scientific and engineering background is necessary or desirable. The fundamentals of engineering are stressed. The Industrial Engineering program is designed to introduce the student to measurement and control theory, organization theory and behavior, management, economic analysis and modeling, facilities planning and design, and utilization of computers and information systems. The objective is to provide the student with systems concepts, the role and function of management, methods of analysis, and the human and economic factors that bridge the gap between pure engineering design and pure management. To achieve this objective, the student will take several courses in which group projects comprise an important part of the course. In these projects, the student has the opportunity to formulate and solve problems and implement solutions for firms and organizations in the surrounding community.

Many students completing the Bachelor's program will wish to pursue graduate study in Industrial Engineering, in other professional schools—law, medicine, or business—or in fields related to Industrial Engineering such as economics, statistics, or operations research.

ADVANCED DEGREES

The Industrial Engineering Department, in collaboration with other departments of the University, offers programs leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy in Industrial Engineering. Options at the Master's degree level are available in

1. Management Systems Design
2. Economic Systems Planning
3. Systems Analysis and Synthesis
4. Computer Utilization
5. Transportation Systems

Opportunities for special study are available under the first three of these options. The Management Systems Design option incorporates production systems and man-machine systems. The Economic Systems Planning option presents special work in planning, programming, and budgeting for economic development, and engineering economy. Systems Analysis and Synthesis concentrates on analytical methods, systems synthesis, and control methods. Computer utilization incorporates computation, data processing, and information systems design and operation. The Transportation Systems option emphasizes methods of analysis and planning; students interested in this field should consult the bulletin of the Stanford Transportation Research Program (STRP) for other courses dealing with transportation.

Applicants for admission as graduate students in Industrial Engineering must submit the results of the verbal and quantitative aptitude parts of the Graduate Record Examination.

MASTER OF SCIENCE

The Master of Science program is designed to provide sufficient additional skills over the B.S. course in Industrial Engineering to prepare students for the careers described above. It is also designed to prepare students with Bachelor's degrees in other engineering disciplines to learn more about application of their technology to societal problems or for using the technology as a basis for a productive system. An additional use of the Master's degree is as a step toward a second advanced degree.

The Master of Science degree programs
require a minimum of 45 units beyond the equivalent of a Bachelor of Science degree at Stanford. All programs represent substantial progress in the major field beyond the equivalent of a Bachelor's degree. Suggested or sample programs leading to the degree of Master of Science in Industrial Engineering without specialization or with specialization in one of the five option areas previously listed are available. These sample programs and the requirements for the Master of Science degree may be obtained from the Department of Industrial Engineering.

All Master of Science degree programs must contain certain core courses unless the student has already had equivalent courses before entering the Industrial Engineering graduate program. Only 15 units of these core courses may be applied toward the 45 units required for the M.S. degree.

Any student admitted to graduate standing on the basis of a Bachelor's degree in a field other than engineering must complete 45 units of work as outlined above, but must also have successfully completed or must complete the equivalent of 45 units of mathematics and science. In addition, the student must be sure that he or she has complied with the prerequisites for the courses listed on the program for the M.S. degree.

ENGINEER

The Engineer degree is designed for students desiring the maximum academic preparation for a career of professional practice in the activities and areas described previously.

The Engineer degree requires two years of academic work beyond the Bachelor's degree. Normally a program of study for the Engineer degree will include the courses required for the M.S. plus approximately 30 units of additional courses of a more advanced level and a thesis. Up to 15 units may be allowed for the thesis. The purpose of the thesis is to prove the professional competence of the candidate and not necessarily to make an original contribution to knowledge.

DOCTOR OF PHILOSOPHY

The Doctor of Philosophy degree is for students desiring careers in teaching or research as opposed to professional practice.

The degree of Doctor of Philosophy is offered under the general regulations of the University. The program requires a minimum of three years (nine quarters) of graduate study, at least one year of which must be at Stanford. The first year is usually represented by the M.S. program. The completion of an acceptable dissertation may occupy most of the third year of study.

The program of study will be arranged by the candidate with the advice of a Faculty Committee of three appointed by the Department head and having as chairman the faculty member who will direct the thesis work. The final program must be approved by the Department.

ASSISTANTSHIPS AND SCHOLARSHIPS

A limited number of fellowships and assistantships with stipends of $750 to $6,120 a year are awarded each year. Application forms and detailed information may be obtained by writing the Department of Industrial Engineering. Applications should be made by March 1 preceding the start of the academic year for which the award is to be made.

The University's Information Bulletin should be consulted for a description of the procedure for making application.

UNDERGRADUATE COURSES

10. The Practice of Industrial Engineering  
—A project course in which the students will work in groups of 3 or 4. Each group will select a problem from a list of problems defined in advance by the I.E. faculty. Each group will have a senior I.E. undergraduate, an I.E. graduate student, or an I.E. professor acting as a guide, a coordinator, a consultant, and a reviewer. This resource person will not be a project leader; that role must be assumed by one or more of the students. Each group will be supervised by a professor, but the resource person will be the primary contact for the group. The purpose of the course is to provide (1) project experience in practical systems analysis and design work and (2) some insight into the methodology of group problem solving.

3 units, Spring (Staff) F 1:15 and 2 hrs. by arrangement

50. Human Values in a Technological Society — The ways in which technology is
changing our physical lives is obvious: we have better health and longer more comfortable lives, greater mobility, more opportunities and more information about these opportunities, etc. But less obvious and at least as important is the effect of technology on our beliefs and our value system, particularly as it affects ourselves and others. The class will explore some of these effects in an attempt to understand them a bit better and in the conviction that the thrust of technology can be shaped and redirected by society.

3 units, Aut (Thompson) M 2:15-4:05

100. Organizations: Theory and Management—A survey of classical and modern organization theory; concepts and functions of management; and the behavior of the individual, the work group, and the organization.

4 units, Aut (Jucker) TTh 8-9:50
Win (Jucker) TTh 8-9:50

108. Work Systems Design and Measurement—Concepts and techniques of designing and improving work performance and productivity of men and man-machine systems. Work flow sequences, human physiological information processing capabilities and resultant principles of job design. Measurement and evaluation of work with respect to time and wages. Prerequisite: 120 (or concurrent registration), or a course in statistical methods.

3 units, Spr (Thompson) MWF 11

120. Quality Assurance — This course will examine the various aspects of modern quality assurance, for products, services, and public goods (e.g., air and water). The setting of standards, the determination of performance, and the methods for achieving standards will be discussed. Major emphasis will be on quality assurance for industrial processes and products. Quality Control charts and Acceptance Sampling Plans will be covered. Opportunities for visits to local industries will be provided. Prerequisite: Statistics 40 or 116.

3 units, Win (Daetz) MWF 11

133. Industrial Accounting — Introduction to basic accounting concepts and operating characteristics of accounting systems. Principles of financial and cost accounting, design of accounting systems, techniques of analysis and cost control. Course is designed for the user of accounting information and not as a first course for those preparing for careers as professional accountants. Interpretation and use of accounting information for decision making is stressed through case discussions. An understanding is developed of the usefulness and benefits of accounting data as well as of the limitations of that data. Students who have taken or are taking another University course in elementary accounting should not enroll.

4 units, Aut (Riggs) MWF 1:15 and one hour by arrangement
Win (Riggs) MWF 11 and one hour by arrangement
Sum (——) MTWThF 8

140. Introduction to Computers and Programming—An introduction to computers and their application in engineering and business. FORTRAN taught through programming problem approach. Extensive use of the Stanford Center for Information Processing (SCIP) will be made. The student will learn the concepts of text-editing (WYLBUR) and time-sharing (ORVYL) through the use of terminal interaction with the computer. Daily quizzes and exercises. Intended for non I.E. undergraduates and I.E. graduates with no prior computer programming experience. I.E. 242 or 243 may follow this course.

4 units, Aut (Ludwig) MWF 2:15

141. Computer Applications and Techniques—Exposure to various industrial engineering problems through the use of computerized exercises and examples. FORTRAN is utilized in conjunction with the text-editing and time-sharing capabilities of the Stanford Center for Information Processing (SCIP). References made to other computer languages to determine programming efficiency and effectiveness. Prerequisite: CS 106 or equivalent. (Must have programmed in a Macro Language such as FORTRAN or ALGOL.) Not for students who have taken I.E. 140 for credit.

3 units, Win (Ludwig) MWF 2:15

144. Information Systems & Simulation—Exposure to the fundamental concepts and applications of management information systems and simulation. Topics include: indexing, data structures, lists, arrays, pointers, clocks, random number generation, report generation. A project oriented course. Prerequisite: I.E. 141.

3 units, Spr (Ludwig) TTh 9:30-10:45
149. Computation Laboratory—Application of digital computers to problems relating to industrial engineering. Student will choose a problem, program and test the solution, prepare the input data and analyze the output. Prerequisite: consent of instructor.

1 or more units, Aut, Win, Spr (Staff) by arrangement

152. Introduction to Operations Research I—(Enroll in Operations Research 152.)


160. Analysis of Production Systems I—Introduction to the design, scheduling, and control of production systems using mathematical, computational, and other modern analytical techniques. Areas investigated will include capabilities and costs of production systems, determination of optimal facility location, line balancing for continuous production processes, and optimal timing and sizing of production capacity expansion. Graduate students enroll in 260. Prerequisites: 153, Engineering 161, and Statistics 116.

3 units, Aut (Carlson) MWF 8
Win (Carlson) MWF 9

164. Production Engineering Problems—Each student will participate in a major term project. Special attention will be given to problem identification and definition. Students may work individually or in groups of from two to four. Students will be expected to apply analytic methodology obtained from previous course work, but the emphasis will be on the creativity exhibited in the synthesis of feasible solutions to real problems. Not open to graduate students. Prerequisite: 160.

3 units, Win (Carlson, Staff) MWF 1:15

191. Directed Study—Directed study on subject of mutual interest to student and staff member. Student must find a sponsor and submit a one-page description of plan.

1 or more units (Staff) by arrangement

199. Senior Seminar—Class discussions of current problems and methodologies. Emphasis given to reading current literature. Students will be encouraged to critically evaluate recent work. Concentration on broad problems requiring initiative, ingenuity, and the judicious selection and integration of analytical techniques from all previous course work. Prerequisite: 164.

3 units, Spr (Jucker) MWF 10

COURSES PRIMARILY FOR GRADUATE STUDENTS

208. Man-Machine Systems—Design and analysis of human and man-machine information processing systems with emphasis on man-machine interface. Physiological considerations, such as effort and skill, and intellectual considerations, such as subjective decision-making. Special topics include interactive information systems, including computer graphics; keyboard design; and public information display (for passengers, patients, etc.).

3 units, Aut (Thompson) MWF 10

210. Systems Analysis and Synthesis I—A first year course in mathematical methods of systems analysis. The emphasis in the lectures is on deterministic optimization tools, including linear programming, integer programming, network flow models, discrete and continuous dynamic programming, branch and bound methods. The theory is developed in an effort to provide the student with the ability to make rational choices from the set of candidate models available for a particular application. The exploitation of special structure in formulating and solving problems is emphasized. Assigned readings will include papers discussing specific applications of the models discussed in class. Prerequisites: calculus; linear algebra suggested.

3 units, Aut (Brastow) MWF 9

211. Systems Analysis and Synthesis II—Continuation of 210. Topics include deterministic and stochastic models. Lectures cover non-linear programming, Kuhn-Tucker conditions and special structure, geometric programming, optimal control, non-linear transportation models, decomposition of large mathematical programs, probabilistic programming, probabilistic dynamic programming, markovian decision theory, the application of z-transforms. Emphasis is on the understanding necessary to make rational choices among candidate models for specific applications. Readings include papers discussing specific applications. Prerequisites: 210, Statistics 116, or equivalents.

3 units, Aut (Brastow) MWF 9

212. Systems Analysis and Synthesis III—Continuation of 211. Topics include deterministic and stochastic models. Lectures cover non-linear programming, Kuhn-Tucker conditions and special structure, geometric programming, optimal control, non-linear transportation models, decomposition of large mathematical programs, probabilistic programming, probabilistic dynamic programming, markovian decision theory, the application of z-transforms. Emphasis is on the understanding necessary to make rational choices among candidate models for specific applications. Readings include papers discussing specific applications. Prerequisites: 210, Statistics 116, or equivalents.

3 units, Aut (Brastow) MWF 9
212. Systems Analysis and Synthesis III—Continuation of 211. Lecture topics include surveys of semi-markov decision processes, queuing theory, simulation models and experimental design, Bayes estimation, and data analysis. Since the techniques discussed in 210, 211, and 212 can only be applied once a problem has been clearly defined, students in 212 are required to work in small groups on a project, of their choosing, involving the synthesis of a tractable problem definition from an otherwise nebulous real-world problem. Prerequisites: 211, Statistics 219, or equivalents.

3 units, Spr (Brastow) MWF 10

215. Urban Public Transportation Systems—Current and emerging urban public transportation systems will be surveyed from technical, social and economic viewpoints. The needs of travelers and community groups will be examined. Emphasis will be given to innovations in services, equipment, facilities, institutions and financing. Planning and evaluation techniques will be outlined.

3 units, Aut (Henderson) F 3:15-5:05

216. Airline Management—This course will be limited to 25 students who have a strong interest in airline management. It is designed to be an action-oriented curriculum studying functional airline management in three basic fields: Finance, Operations, and Marketing. Airline management problems and techniques will be studied both academically and in the field.

4 units, Spr (Banfe) MF 3:15-5:05

217. Transportation Modeling — Methods and techniques useful in modeling components of transportation systems will be studied and discussed. Current literature will be emphasized, and experienced modeling practitioners will make presentations relating real-world problems to the literature. Topics discussed will include demand modeling, traffic assignment, constrained optimal routing, and network investment.

3 units, Spr (Carlson) W 4:15-6:05

220. Advanced Quality Assurance—Current practices in program planning and control of quality and reliability in both industry and government. Design, production, testing and economic considerations. Plant visits to local industry. Prerequisite: 120.

3 units, Spr (Ireson) TTh 11;

229. Engineering Economy—The logic of engineering economy and capital budgeting decisions is developed. Measures of worth commonly used in the literature are defined rigorously and compared. Income taxes are introduced. Satisfies prerequisite for 230, 231, and 232.

3 units, Aut (Oakford) TTh 2:45-4:00

230. Capital Budgeting — Development of the logic of the capital budgeting decision is continued from 229. Topics treated include borrowing, retirement and replacement, sensitivity analysis, the probabilistic treatment of uncertainty, and the role of capital budgeting in financial management. Prerequisite: 229 or Engineering 161 and Statistics 116.

3 units, Win, Spr (Oakford) TTh 2:45-4:00

231. Problems in Engineering Economy—Independent study of selected problem in engineering economy. Prerequisites: 229 or Engineering 161 and consent of instructor.

1 or more units (Staff) by arrangement

232. Engineering Economy Cases—A series of case studies dealing with special problems in engineering economy. Emphasis will be on application of fundamental principles of engineering economy to regulated publicly and privately owned utilities, transportation, benefit/cost studies, income tax, leases vs. ownerships, and replacement. Prerequisite: 229 or Engineering 161.

3 units, Win (——) TTh 10

233. Industrial Financial Controls — Following on the basic courses in accounting, cost accounting, and engineering economy, this course seeks to develop further sophistication in cost analysis and financial decision-making within an industrial environment. The importance of management judgment and effective written and oral expression is stressed. Seminar format is used, with emphasis on case analysis and discussion. Prerequisites: I.E. 133 and Engineering 161, or consent of the instructor.

3 units, Spr (Riggs) TTh 8:00-9:15

234. Research and Development Management—The function of research and development in the business enterprise. The practical problems of project selection, integration of R&D with marketing, production, and financial management; selection and reten-
tion of scientists and engineers; establishment of research priorities; financial controls of R&D operations; R&D evaluation. An examination of the current state of the art in technological forecasting. Prerequisite: graduate standing or consent of instructor.

3 units, Win (Blake) MW 4:15–5:30

236. Project Management Systems — Study of project formulation, definition, and organization. Types of projects; documenting ideas; research and development; proposal preparation; contract provisions; cost estimates; contract negotiations; performance; administration; evaluation. Involves actual field work.

3 units, Spr (Blake) W 1:15–3:05

240. Introduction to Computers and Programming—For graduate students. Lectures same as 140. Prerequisites: same as 140.

4 units, Aut (Ludwig) MWF 2:15

242. Utilization of Computers—An in-depth study of various computer topics. Programming language considerations, discussion of job control language, data structures, text editing, and time-sharing. Overview of differences between programming language structure. Guest lecturers presenting developed and implemented systems operating at Stanford and in industry. Prerequisite: I.E. 140/240 or equivalent.

3 units, Aut (Brastow) MWF 11

243. Computing Techniques for Information Systems—The basic building blocks of information systems are presented along with the concepts of logical records, physical records, data structures, indexes, hierarchical decision trees, etc. Examples of Management and Medical Information Systems are presented. Extensive research into recognizers, generators, filing systems. A substantial term project is required. Prerequisite: I.E. 240 or consent of instructor.

3 units, Win (Ludwig) TTh 9:30–10:45

244. Computer Modeling and Simulation—Topics covered include simulation and business gaming, with an in-depth presentation of modeling techniques. Random number generators, report generators, simulation clocks, as well as list philosophies are covered. Simulation languages such as GPSS, SIMSCRIPT, and DYNAMO are presented usually by guest speakers. A substantial term project and presentation is expected of every student. Prerequisite: I.E. 243 or consent of instructor.

3 units, Spr (Brastow) TTh 4:00–5:30


249. Computation Laboratory—For Graduate Students. See I.E. 149.

1 or more units, Aut, Win, Spr (Staff) by arrangement


260. Analysis of Production Systems I—For graduate students. Lectures same as 160. Prerequisites: same as 160.

3 units, Aut (Carlson) MWF 8
Win (Carlson) MWF 9

261. Analysis of Production Systems II — Topics in the scheduling and control of production and inventory systems. The functions of inventory, the control of purchased material inventories, scheduling single-facility production-inventory systems, scheduling multi-stage production, planning aggregate production, materials requirements planning, and forecasting systems. Prerequisite: I.E. 260.

3 units, Spr (Jucker) MWF 9
alternate years, given 1976–77

262. Analysis of Production Systems III — Advanced topics in production planning and control, inventory accumulation, assembly line balancing, facility location, and industrial growth. Not open to undergraduates. Prerequisite: 260 or equivalent.

3 units, Spr (Hillier) MWF 9
alternate years, given 1975–76

263. The Engineering and Organization of Small Businesses—A laboratory for the development of a technical idea, embodied in a specific product, into an economic enterprise. Includes product selection, market analysis, pricing, engineering design, pro-
duction design, economic analysis, establishment of marketing plan, financing and financial planning, design of management organization. Students, including qualified undergraduates, from all appropriate disciplines are encouraged to enroll. Special emphasis on planning small industries in developing nations. Prerequisite: consent of instructor.

3 units, Spr (——) TTh 11; lab.  
T 2:15–5:05

280. Health Systems Analysis — A projects course emphasizing the systematic development and application of Systems Analysis techniques to the design and improvement of various areas of health care delivery. Specific problems will be studied in hospitals and health maintenance organizations by student teams acting as consultants to the appropriate hospital supervisors and professional staff. Studies will include hospital information systems, and service delivery.

3 units, Win (Thompson) TTh 11–12:15

281. Individual Study in Man-Machine Systems — Directed reading and research in man-machine systems. Prerequisite: consent of instructor.

1 or more units, any quarter (Thompson) by arrangement

291. Industrial Engineering Problems — Directed study on subject of mutual interest to student and staff member. Student must find a faculty sponsor.

1 or more units (Staff) by arrangement

293A. Development Planning I — This course provides a systems analysis introduction to development planning. The concept of development, important development issues, indicators of development, and the instruments of development (the means) are discussed. The construction of models for assessing the expected consequences of various development proposals is studied. Each student defines and researches a development problem of his or her own choosing. This research provides the groundwork for quantitative study that may be pursued in I.E. 293B. However, I.E. 293A may be taken as a self-contained course. Prerequisites: Graduate standing and at least one prior course in, economics or engineering economy.

3 units, Win (Daetz) TTh 1:15–2:30

293B. Development Planning II — Continuation of 293A for the purpose of preparing and utilizing mathematical models of development problems of interest to the students. Emphasis will be on inclusion of feedback effects. Students will have an opportunity to present their models for class discussion. Prerequisite: 293A or consent of instructor.

3 units, Spr (Daetz) TTh 1:15–2:30


Aut, Win, Spr (Staff) by arrangement


Aut, Win, Spr (Staff) by arrangement

341. Interactive Computer Graphics — An introduction to current hardware and software techniques applicable to interactive computing using CRT graphics for input/output. The course is designed to stimulate the use of this tool for problem solving in various disciplines. Examples of the use of computer graphics in a number of fields will be shown and discussed. Lecture material will cover software appropriate to the design of interactive programs, and the mathematics of linear transformations, as well as the more common algorithms peculiar to graphic displays. Each student will design and implement an interactive graphics program for the solution of a problem of his own choosing using the AGT-30 three-dimensional graphics system. Prerequisite: FORTRAN (or comparable) programming experience.

3 units, Win (Brastow) TTh 9, and one hour by arrangement

351. Dynamic Programming and Stochastic Control — (Enroll in Operations Research 351.)

355. Reliability Theory — (Enroll in Operations Research 355.)

358. Queuing Theory — (Enroll in Operations Research 358.)

MATERIALS SCIENCE AND ENGINEERING

Emeriti: Welton J. Crook, O. Cutler Shepard (Professors)

Chairman: Richard H. Bube
Associate Chairman: William D. Nix
Professors: Arthur I. Bienenstock, Richard H. Bube, Theodore H. Geballe, Robert A.
Huggins, William D. Nix, G. Marshall
Pound, Oleg D. Sherry, John C. Shyne,
William E. Spicer, David A. Stevenson,
William A. Tiller, Robert L. White

Associate Professors: Craig R. Barrett, Clay-
ton W. Bates, Jr., David M. Barnett. Con-
sulting: Farid Abraham, Robert I. Jaffee,
Helmut R. Poppa

Lecturers: Claus G. Goetzelt, Egon Loebner
(on leave), Rosemarie Koch, Glen B. Hay-
don

Members of the faculties of other divisions of the University giving courses or cooperating in the offerings of the Department of Materials Science and Engineering are Robert N. Anderson, Norman A. Parlee, and George A. Parks.

OFFERINGS AND FACILITIES

Materials Science and Engineering is concerned with the relation between the structure and properties of materials, factors which control the internal structure of solids, and processes for altering the structure and properties of solids. It brings together in a unified discipline the developments in physical metallurgy, ceramics, and the physics and chemistry of solids. The undergraduate program of the Department, described under School of Engineering, provides training for the physical metallurgist or materials engineer and also preparatory training for graduate work in materials science. Able students are encouraged to take at least one year of graduate study to extend their course work and to obtain training in research. Graduate programs lead to the degrees of Master of Science, Engineer, and Doctor of Philosophy.

FACILITIES FOR INSTRUCTION AND RESEARCH

The Materials Science and Engineering Department occupies an area of 30,000 square feet in the Thomas F. Peterson Engineering Laboratory building. The laboratory includes modern facilities for teaching and research in physical metallurgy and materials science. Ordinary melting and heat treating furnaces are included as well as furnaces for vacuum melting, zone refining, and crystal growing. Mechanical testing equipment includes hardness measuring devices, variable strain rate machines for mechanical deformation studies, creep machines and equipment for dynamic elastic modulus and internal friction measurements. For studying the structure of solids, there are optical and electron microscopes as well as X-ray and electron diffraction machines, X-ray fluorescent equipment, gamma ray spectrometer, electron probe microanalyzer, nuclear magnetic resonance spectrometer, and equipment for standard electrical, magnetic, and optical measurements.

The Department, together with Physics, Chemistry, and Solid State Electronics, participates in an interdisciplinary Center for Materials Research. The Center provides equipment, service facilities, and funds for faculty and student research. In addition the Center provides 35,000 square feet of space for materials research in the McCullough Building.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The undergraduate Materials Science and Engineering program provides training in solid state fundamentals and in physical metallurgy. Students desiring to specialize in this field during their undergraduate period may do so by following the curriculum outlined earlier under School of Engineering. The University's basic requirements for the Bachelor's degree are discussed in the section "Degrees" in this bulletin. Electives are available so that students with broad interests can combine Materials Science and Engineering with work in another science or engineering department.

ADVANCED DEGREES

Graduate students can specialize in any of the areas of Materials Science and Engineering. In collaboration with other departments of the University, additional special programs are available. For example:

- Materials Science and Engineering—Electronic Materials
- Materials Science and Engineering—Applied Mechanics and Structures
- Extractive and Process Metallurgy (in cooperation with the Applied Earth Sciences Department).

MASTER OF SCIENCE

The University's basic requirements for the Master of Science degree are discussed
in the section "Degrees" in this bulletin. The following are general Departmental requirements:

1. Completion of the equivalent of the requirements for the B.S. degree in Materials Science and Engineering. Deficiencies in previous training should be made up.

2. Completion of 45 units of an approved program with a minimum grade point average of 2.75 for course work.

The Department offers several different programs of study leading to the Master of Science degree. The majority of students take a general program in Materials Science, however programs are available that specialize in various technological areas of Materials Engineering. The requirements for the M.S. degree programs are itemized below:

1. Materials Science
   This program should be taken by those who wish to pursue a Ph.D. degree in Materials Science and Engineering.
   a) All courses in the 180 series (17 units) except for students who have had equivalent courses at other universities.
   b) Completion of 6 units of Materials Science and Engineering 202A,B, and C, Materials Science Laboratory, except for students who have had equivalent previous experience at other universities.
   c) A minimum of 12 units of advanced course work (beyond the 180 and 202 series) in the Department (excluding attendance-only seminars and research special problems).
   d) The entire 45-unit Master's program should represent an integrated technical program. Approval of the program by the student's adviser is reviewed by the Advanced Degree Committee prior to admission to candidacy.
   e) A minimum of 6 units and not more than 12 units of Materials Science and Engineering 200 (Special Problems) with a Master's Research Report approved by two faculty members. This requirement is optional at the discretion of candidate's adviser. Zero units of Materials Science and Engineering 200 are allowed if no Master's Report is required.

2. Materials Engineering
   Three programs are designed for those students who wish to obtain a working knowledge of Materials Science and Engineering applied to materials technology. These programs are normally viewed as terminal M.S. programs although transfer into the Ph.D. program may be possible in some cases. Course requirements are listed below. Other programs are possible to meet other special needs.

Mechanics of Materials

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>MS&amp;E 151</td>
<td>Materials Technology for Structural Applications</td>
<td>3</td>
</tr>
<tr>
<td>MS&amp;E 179</td>
<td>Intermediate Materials Science</td>
<td>4</td>
</tr>
<tr>
<td>MS&amp;E 185</td>
<td>Mechanical Behavior of Solids</td>
<td>3</td>
</tr>
<tr>
<td>MS&amp;E 202A,B,C</td>
<td>Experimental Methods in Materials Science</td>
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<tr>
<td>MS&amp;E 238</td>
<td>Fracture of Solids</td>
<td>3</td>
</tr>
<tr>
<td>MS&amp;E 244</td>
<td>Failure Analysis</td>
<td>3</td>
</tr>
<tr>
<td>A.M. 202A,B</td>
<td>Theory of Elasticity</td>
<td>6</td>
</tr>
<tr>
<td>A.M. 250</td>
<td>Math. Methods (or equivalent)</td>
<td>3</td>
</tr>
<tr>
<td>A.M. 251</td>
<td>Math. Methods (or equivalent)</td>
<td>3</td>
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<tr>
<td>Electives</td>
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<td>11</td>
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<td>45</td>
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Electrical, Optical, and Magnetic Properties of Materials

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<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>MS&amp;E 179</td>
<td>Intermediate Materials Science</td>
<td>4</td>
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<tr>
<td>MS&amp;E 188</td>
<td>Electrical, Optical, and Magnetic Properties of Materials</td>
<td>3</td>
</tr>
<tr>
<td>MS&amp;E 202A,B,C</td>
<td>Experimental Methods in Materials Science</td>
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<tr>
<td>MS&amp;E 209</td>
<td>Mathematical Methods in Materials Science</td>
<td>3</td>
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<tr>
<td>MS&amp;E 222</td>
<td>Statistical Thermodynamics</td>
<td>3</td>
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<tr>
<td>E.E. 322A,B</td>
<td>Quantum Mechanics</td>
<td>6</td>
</tr>
<tr>
<td>MS&amp;E 233</td>
<td>Quantum Theory of Energy States in Solids</td>
<td>3</td>
</tr>
<tr>
<td>MS&amp;E 234</td>
<td>Electronic Transport in Solids</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 332</td>
<td>Optical Properties of Solids</td>
<td>3</td>
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<tr>
<td>Electives</td>
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Materials Processing–Extractive Metallurgy

This program is designed for students who wish to obtain a basic knowledge of Materials Science and Applied Earth Sciences, with particular focus on the Materials Processing–Extractive Metallurgy industry. The program has a concise central core of required courses combined with a liberal number of electives, so that the student may
choose any of a number of possible facets of this broad field including research units. Students may elect to obtain their degree in either the Department of Materials Science and Engineering or the Department of Applied Earth Sciences.

Course No. Subject Units
MS&E 181. Thermodynamics and Phase Equilibria 4
MS&E 182. Rate Processes in Materials 3
MS&E 185. Mechanical Behavior of Solids 3
MS&E 105 (AES 105). Extractive Process Metallurgy 2
MS&E 214 (AES 214). Metallurgical Reaction Engineering 3
MS&E 203 (AES 203). Mineral Processing 3
MS&E 207 (AES 207). Metal Refining and the Nature of Liquid Metals 3
Electives 24

45

ENGINEER

The University's basic requirements for the degree of Engineer are outlined in the section "Degrees" in this bulletin.

The following are Departmental requirements:

1. Completion of the substantial equivalent of the requirements for the Master of Science degree in Materials Science and Engineering.

2. Completion of an acceptable thesis and 15 units of approved advanced course work beyond the requirements of the Master of Science degree.

3. A program of study should be submitted to the Department for approval prior to the end of the third quarter at Stanford.

DOCTOR OF PHILOSOPHY

The University's basic requirements for the Ph.D. degree are outlined in the section "Degrees" in this bulletin.

The following are Departmental requirements:

1. Complete the substantial equivalent of the requirements for the Master of Science degree in Materials Science and Engineering.

2. Pass a Departmental oral qualifying examination.

3. Graduate students working toward the Ph.D. degree must submit a program of study to the Department prior to the end of the student's third quarter at Stanford.

The program should contain at least 72 course units beyond the B.S. degree and should include the following:

a) All courses in the 180 series or their equivalent. These must be taken on a letter grade basis.

b) A minimum of 36 units of advanced course work which, when taken as a group, comprise a coherent and well-designed program leading to proficiency in a certain area of Materials Science and Engineering. These courses are to be taken for a letter grade and must include a minimum of 21 units of graduate courses within the Materials Science and Engineering Department. A minimum of 15 of the 36 units should be advanced specialty courses. Courses which are graduate courses within the department but not considered specialty courses include 204, 206, 209, 222, 233, 240, 246.

4. Maintain a grade point average of 3.0 for all course work taken as a graduate student at Stanford.

5. A candidate must present the results of his or her dissertation at a Departmental Seminar prior to his University Oral Examination.

COURSES

50. Introductory Science of Materials — (Enroll in Engineering 50.)

100. Undergraduate Special Problems—Independent study in Materials Science under supervision of a faculty member.

1 to 3 units, any quarter (Staff) and by arrangement


151. Materials Technology for Structural Applications—Metals, alloys, ceramics, glass, materials used primarily for their mechanical properties. Description of materials processing techniques, e.g., heat treatment, used to develop optimum properties. This course provides information necessary for materials selection and processing for engineering applications. Prerequisite: Engineering 50.

3 units, Spr (Nix) MWF 9

179. Intermediate Materials Science — An intermediate level course on the structure,
thermodynamics and kinetics of solids. Topics include atom arrangements, defects in crystalline and amorphous solids, application of thermodynamics and kinetics to the control of microstructure. Prerequisite: Engineering 50.

4 units, Aut (Staff) dhr, not given 1975-76

180. Atomic Arrangements in Solids—Description and determination of atomic arrangements in perfect and imperfect crystals and in amorphous materials. Among topics to be treated are formal crystallography, crystalline defects, and diffraction phenomena.

4 units, Aut (Barrett) MTWTh 10

181. Thermodynamics and Phase Equilibria — Application of thermodynamics to the control of the properties of materials. Heterogeneous equilibria with emphasis on solids. Prerequisite: elementary thermodynamics. Recommended: elementary computer programming.

4 units, Aut (Stevenson) TTh 2:15-4:05

182. Rate Processes in Materials—Diffusion in solids, structural transitions including recrystallization and liquid-solid and solid-solid phase transformations, property control by microstructural control. Prerequisites: 180 and 181.

3 units, Win (Pound) MWF 10

185. Mechanical Behavior of Solids — Mechanics and mechanisms of mechanical properties of solids. Introductory treatments of continuum mechanics, elasticity, anelasticity and damping, and continuum plasticity are given. Phenomenological aspects of plastic deformation including strain hardening, strain rate sensitivity, plastic instability and ductility are also presented. Mechanisms of plastic deformation in crystalline solids based on the properties of dislocations are discussed. The relationship between strength and microstructure is also developed.

3 units, Win (Nix) MWF 9

188. Electrical, Optical and Magnetic Properties of Materials—An introduction to materials’ properties. Includes properties of waves, free electron model, energy bands, optical refraction and absorption, electrical conductivity, scattering processes, Hall and thermoelectric effects, junctions, and magnetic materials. Prerequisite: Engineering 50.

3 units, Win (Bube) TTh 9

190. Polymer Science — Relationships of structure and composition of polymers to their physical properties. Chemistry and structure of polymers; polymerization and phase transition in polymers. Transport, mechanical, electrical and optical properties of polymers. Fabrication of polymers. Prerequisite: Engineering 50 or equivalent.

3 units, Aut (Staff), not given 1975-76

192. Biomaterials—A study of the properties and functions of materials in the body environment. The electrical characteristics of skin and bone and their changes with change of physiological state of the body. The structure and function of membrane processes, ion transport and coagulation processes. Blood surface interactions, medical prosthesis of plastics and the application of polymers to artificial organs. A general attempt will be made to show the great similarity that exists between phase equilibria and growth processes dealt with in the mainstream of materials science and that observed in body tissues and structures. Prerequisites: Engineering 50 or equivalent.

3 units, Win (Tiller) TTh 11:00-12:15 alternate years, given 1976-77

200. Graduate Special Problems.
Any quarter (Staff) by arrangement

201. Principles and Methods of Crystal Growth—Main emphasis on principles and qualitative understanding. Broad look at the important phenomena involved in the growth and perfection of crystalline solids from the melt, solution, vapor or electrodeposition, etc. Application to electrical, metallurgical, chemical, geological and medical fields. Discussion of relative merits of different crystal growth techniques.

3 units, Spr (Tiller) TTh 2:15-3:30; optional 2 units lab. to be arranged

202A,B,C. Experimental Methods in Materials Science — Laboratory course involving experimental techniques in different areas of materials science. Typical experiments are listed below. 202A: crystal growth, structural determinations via optical microscopy, x-ray diffraction and electron diffraction. 202B: experiments on the thermodynamics and kinetics of materials including phase diagram determination, diffusion, oxidation, phase transformations. 202C: Experiments on the mechanical, electrical, optical and magnetic properties of solids. Prerequisites: previous or concurrent registration in
the Materials Science and Engineering 180 series or their equivalent.

2 units, Aut (Barrett), Win (Staff)
Spr (Bates, Nix)

203. Mineral Processing — (Enroll in Applied Earth Sciences 203.)

204. Workshop on Energy Storage—Topic areas will include both economic and technological aspects of current and proposed energy storage methods; small devices, large scale stationary energy storage systems, vehicular applications; scientific barriers and fundamental limits. Workshop format emphasizing student participation; output in form of coordinated report. Open to either undergraduates or graduate students, preferably in science or engineering.

3 units, Spr (Huggins) dhr

205. Strength and Microstructure — Mechanical properties of solids as viewed by the materials scientist or physical metallurgist. Basic aspects of dislocation theory and the role of dislocations and other defects on mechanical behavior of solids. The elastic, anelastic, and plastic properties of solids, stressing the relation between the internal structure of solids and the corresponding mechanical properties. Methods of hardening materials and mechanisms of hardening. Specific mechanical properties such as fracture, fatigue, and creep. Application of the concepts developed will be made to materials useful in technology. The course is directed primarily toward non-materials science majors. Prerequisite: upper division or graduate standing in Engineering or Science.

3 units, Aut (Sherby) TTh 11:00-12:15


3 units, Spr (Barnett) MWF 11

207. Metal Refining and the Nature of Liquid Metals — (Enroll in Applied Earth Sciences 207.)

209. Mathematical Methods in Materials Science—A study of the formulation and solution of boundary value problems in transport phenomena, diffraction, and elasticity, utilizing transform, matrix, variational, complex variables, and Green's function techniques. Emphasis on the physical and mathematical similarities in the continuum field theories which form the basis of a description of the behavior of materials. Prerequisite: Mathematics 130.

3 units, Spr (Barnett) MWF 9

210. Semiconductor Materials Processing—A survey of basic principles and present technology in the processing of semiconductor materials. Topics include: bulk and thin film crystal growth, diffusion, oxidation, masking, packaging, and analytical techniques used to study failures in processing. These topics are presented in the frame of reference of the inherent economic, dimensional and environmental limitations of the semiconductor industry. Frequent field trips will be made to observe industrial processing operations. Prerequisite: Engineering 50 or EE 111 or equivalent.

3 units, Win (Barrett and Stevenson) TTh 8:30-10:00

213. High Temperature Materials—Applications, product specifications, properties, and fabrication methods for refractory metals, dispersion alloys, reactive metals, graphite, ceramics, cermets, and intermetallic compounds.

3 units, Sum (Goetzl) TTh 10:30-12:00

214. Metallurgical Reaction Engineering—(Enroll in Applied Earth Sciences 214.)


3 units, Spr (Shyne) TTh 11:00-12:15, alternate years, not given 1975-76

222. Statistical Thermodynamics — Systematic development of the methods of statistical mechanics with application to problems in Materials Science. Prerequisite: 181.

3 units, Spr (Pound) MWF 10

224. Physical Properties of Disordered Materials—Examination, at a microscopic level, of our understanding of the structural, thermal, electrical, and mechanical properties of
alloys and amorphous materials. Emphasis of the course will change from year to year. Prerequisites: 180, 181, and 188 or equivalents.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Time/Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>225</td>
<td>Surfaces and Interfaces — (Enroll in Applied Earth Sciences 225.)</td>
<td>3</td>
<td>Win (Bates) TTh 10:00–11:30</td>
</tr>
<tr>
<td>226</td>
<td>Electrochemistry and Corrosion—Development of electrochemical principles with application to corrosion, electrolytic processes, and galvanic cells. Prerequisites: elementary thermodynamics.</td>
<td>3</td>
<td>Win (Stevenson) TTh 8:30–9:50</td>
</tr>
<tr>
<td>229</td>
<td>Principles of Steelmaking— (Enroll in Applied Earth Sciences 229.)</td>
<td>1</td>
<td>Aut (Staff) F 4:15</td>
</tr>
<tr>
<td>230</td>
<td>Materials Science Colloquium.</td>
<td>1</td>
<td>Aut (Staff) F 4:15</td>
</tr>
<tr>
<td>232</td>
<td>Point Defects in Crystals—Structure of point defects. Defect equilibria; influence of temperature, chemical and electrical potentials, interfaces, association. Solid-state electrochemical transducer effects; structural control, sensors, batteries, other applications.</td>
<td>3</td>
<td>Aut (Huggins) MWF 9</td>
</tr>
<tr>
<td>233</td>
<td>Quantum Theory of Energy States in Solids—Applications of wave mechanics and approximate methods of atomic systems, free electron model of metals, and energy bands in one and three dimensional crystals. Prerequisite: 188 or Electrical Engineering 322A.</td>
<td>3</td>
<td>Spr (Bates) MWF 1:15</td>
</tr>
<tr>
<td>234</td>
<td>Electronic Transport in Solids—Time dependent wave mechanics and wave packets. Electrical conductivity, mobility and scattering processes. Interpretation of the Boltzmann equation for galvanomagnetic, thermal, and thermoelectric processes in metals and semiconductors. Localized levels and Fermi level analysis of semiconductors. Prerequisite: 233 or Electrical Engineering 322B.</td>
<td>3</td>
<td>Win (Bube) MWF 2:15, alternate years, given 1975–76</td>
</tr>
<tr>
<td>235</td>
<td>Photoelectronic Properties of Solids—Seminar on selected topics in photoelectronic properties of solids, including photoconductivity, luminescence, photovoltaic effects, and methods of photoelectronic analysis of ordered and disordered materials. Prerequisite: 233 or Electrical Engineering 322B.</td>
<td>3</td>
<td>Spr (Bube) TTh 1:15, alternate years, given 1976–77</td>
</tr>
<tr>
<td>236</td>
<td>Diffraction Techniques in Materials Science—Discussion of advanced diffraction techniques in Materials Science. Topics include contrast theory in transmission electron microscopy, x-ray topography, x-ray diffraction from perfect crystals, use of Fourier analysis in diffraction, particle size line broadening, strain measurements, and diffraction from noncrystalline materials. Prerequisite: 180.</td>
<td>3</td>
<td>Spr (Bates) TTh 9, alternate years, given 1975–76</td>
</tr>
<tr>
<td>237</td>
<td>Dislocations in Crystals — Continuum elastic theory of dislocations including the interaction between dislocations and other sources of internal and external stress (dislocations, surfaces, interfaces, point defects, applied stresses), forces on dislocations, anisotropic effects. Continuous distribution of dislocations representing elastic cracks and slip lines. Eshelby’s transformation strain problem. Prerequisite: 206, 246.</td>
<td>3</td>
<td>Aut (Barnett) MWF 10, alternate years, given 1976–77</td>
</tr>
<tr>
<td>238</td>
<td>Fracture of Solids—(Same as Applied Mechanics 216B.) The stress fields about elastic cracks developed from both a conventional elastic and a dislocational approach. Energy of deformation and the Griffith-Irwin brittle fracture criterion, and the extensions to incorporate small-scale plastic yielding. Fracture toughness testing. Microscopic mechanisms of crack nucleation and propagation; mechanisms of ductile fracture.</td>
<td>3</td>
<td>Win (Barnett) MWF 11</td>
</tr>
<tr>
<td>240</td>
<td>Kinetics of Mass Transport and Growth Processes in Solids—General treatment of reaction kinetics, with emphasis on mass transport and structural transformations. Prerequisites: 182 and Mathematics 131.</td>
<td>3</td>
<td>Aut (Pound) MWF 1:15, alternate years, given 1975–76</td>
</tr>
<tr>
<td>244</td>
<td>Failure Analysis — A study of techniques and methods used in the analysis of failures in the field of materials science and engineering. Topics covered include optical and electron fractography, localized chemical analysis, x-ray techniques, voltage con-</td>
<td>3</td>
<td>Aut (Pound) MWF 1:15, alternate years, given 1975–76</td>
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245. Dislocation Dynamics—A study of dislocation dynamics and the mechanics of yielding in crystalline solids; delayed yielding and dislocation multiplication yield point phenomena; theoretical treatments of dislocation mobilities in imperfect crystals.

3 units, Aut, Win, Spr (Nix) by arrangement

246. Crystalline Anisotropy—Seminar on the application of tensor notation to the description and analysis of the properties of crystalline materials.

3 units, Aut (Barnett) MWF 11, alternate years, given 1975-76

248. Photoelectronic Materials and Devices Laboratory—(Enroll in Electrical Engineering 330.)

249. Time-Dependent Plasticity—Theories and mechanisms of creep. Temperature and strain rate effects on plastic flow of solids. Relation of high temperature strength and ductility of materials to structure. Prerequisite: 185 or 205 or Engineering 50.

3 units, Spr (Sherby) TTh 1:15-2:45

257. Fatigue of Metal Structures—(Enroll in Mechanical Engineering 245.)

258. Optical Properties of Solids—(Enroll in Electrical Engineering 332.)

259. Basic Quantum Mechanics—(Enroll in Electrical Engineering 322A.)

260A. Basic Quantum Mechanics—(Enroll in Electrical Engineering 322B.)

264. The Equilibrium Structure of Surfaces—Quantitative treatment of diffuse interfaces, gamma plots, thermal faceting, electrical double layers, adsorption, equilibrium forms, interface attachment kinetics. Application to nucleation, crystal growth, phase transformations, catalysis, stress corrosion cracking, etc. Prerequisite: 181, 240 or equivalent.

3 units, Aut (Tiller) TTh 11:00-12:15; alternate years, given 1977-78


3 units, Win (Pound) by arrangement

266. Scientific Foundations of Stress Corrosion Cracking—A new approach to this important technological subject which utilizes basic understanding of surfaces on an atomistic level and treats the corrosion event (uniform or catastrophic) as a phase transformation. Electron redistribution inside metals plus polarization in surface layer changes as a function of stress and dislocation passage events, ion redistribution in the environment phase and surface film formation will all be treated. The discussions will be on a basic level designed to provide a foundation for a quantitative predictive theory concerning corrosion events for gaseous, aqueous as well as liquid metal environments.

3 units, Win (Tiller) TTh 11:00-12:15, alternate years, given 1977-78


3 units Win (Stevenson) TTh 2:45-3:30, alternate years, given 1975-76

283. Irreversible Thermodynamics—This course deals with the statistical mechanical foundations of fluctuation theory and irreversible thermodynamics. Prerequisites: 181 and 222.

3 units, Aut (Pound) TTh 3:45-5:00, given 1976-77

288. Superconducting and Magnetic Materials—The electrical and magnetic properties of important classes of intermetallic compounds and alloys will be studied. Emphasis will be on currently active research areas such as the A-15 high temperature superconductors, the layered transition metal dichalcogenides and the rare earth permanent magnets.

Relationships between the physical prop-
properties and crystal structure, interatomic distance and coordination, the electron configuration and crystal field splitting, and electronic band structures will be utilized.

3 units, Win (Geballe) MWF 9, given 1975–76

297. Principles of Electron Microscopy — Goals: exposure to the general principles of electron microscopy; basic diffraction and optics, specimen as an optical device, nature of image contrast, image detection and interpretation, related photographic principles, specimen preparation and requirements, and some special techniques. Lectures and demonstrations. Prerequisite: Basic understanding of light microscopy.

1 unit, Aut, Win, Spr (Haydon)

300. Research.

Any quarter (Staff) by arrangement

340. Seminar in Kinetics — Discussion of important current topics in the area of phase transformations (solid, liquid, vapor) and diffusion. Particular emphasis will be placed on the statistical mechanics and irreversible thermodynamics of the various thermally activated rate processes.

2 units, Aut, Win, Spr (Staff) by arrangement

341. Seminar in Mechanical Properties of Solids.

1 unit, Aut, Win, Spr (Staff)

342. Seminar in Solid-State Electrochemistry — Selected topics related to point defect structure, use of solid state electrochemical cell techniques, solid electrolytes, fuel cells, batteries, electrochemically controlled growth processes. Prerequisite: 232.

1 unit, Aut, Win, Spr (Huggins) by arrangement


1 unit, Aut, Win, Spr (Bube)

344. Seminar in Amorphous Materials.

1 unit, Aut, Win, Spr (Bates)

345. Seminar on Advanced Topics in Materials Science.

1 unit, Aut, Win, Spr (Staff)

MECHANICAL ENGINEERING

Emeriti: Arthur Domonoske, Wilhelm Flügge, Henry O. Fuchs, Boynton M. Green, Miklós Hetényi, Lydik S. Jacobsen, Donovan H. Young (Professors)

Chairman: William C. Reynolds

Associate Chairman: Thomas J. Connolly

Division Directors: (Design to be appointed), George Herrmann (Applied Mechanics), Robert J. Moffat (Thermosciences)

Laboratory Directors: Robert L. Piziali (Medical Design), Daniel B. DeBra (Guidance and Control), Robert H. Eustis (High Temperature Gasdynamics), Robert J. Moffat (Thermosciences)


Associate Professors: David M. Barnett, Robert J. Mittelstadt (Architecture)

Consulting Professors: George P. Hill, III, Ralph M. Heintz, Anthony Leonard

Assistant Professors: Wilson C. Hayes, C-H Richard Liu, Robert L. Piziali, J. David Powell

Acting Assistant Professors: Michael E. Crawford, Harry T. Whitehouse

Lecturers: James Fadiman, John R. Manning

Teaching Specialist: David W. Beach


Affiliated Faculty: John V. Breakwell (Dynamics), Daniel Bershader (Acoustics), C. C. Chao (Elasticity), I. D. Chang (Fluid Mechanics), Gene F. Franklin (Controls), James M. Gere (Structures), Matthew S.
Kahn (Art), Krishnamurty Karamchet (Acoustics), Bruce B. Lusignan (Systems Design), Cedric W. Richards (Structures), Oleg D. Sherby (Materials), Robert L. Street (Fluid Mechanics), David A. Thompson (Biotechnology and Computer Graphics), Paul V. Turner (Art), Walter G. Vincenti (History of Technology)

**ORGANIZATION AND OBJECTIVES**

The programs in Mechanical Engineering are designed to provide background for a wide variety of careers. The discipline of Mechanical Engineering is very broad, but is generally understood to emphasize an appropriate mix of energy science and technology, applied mechanics, and design. Graduates at all degree levels typically go into various energy industries, into the product manufacturing industries, into government laboratories and agencies dealing with these problems, and into a variety of academic situations.

Since Mechanical Engineering is a very broad discipline, many students use the Mechanical Engineering undergraduate program as a springboard for graduate study in medicine, law, political science, and other professions where a good understanding of technology is often very important. The Mechanical Engineering undergraduate and graduate programs provide excellent technical background for persons who want to work in environmental pollution control, transportation, ocean engineering, and other multidisciplinary problems that concern our society. Throughout the various programs considerable emphasis is placed on the development of systematic procedures for analysis, effective communication of one's work and ideas, practical and aesthetic aspects in design, and on the responsible use of technology. This can provide a student with an approach and a philosophy of great utility, irrespective of an ultimate career.

The Department is organized into three divisions, Applied Mechanics, Design, and Thermosciences, each of which maintains its own laboratories, shops, and offices. The Applied Mechanics Division covers the areas of dynamics, mechanics of deformable solids, biomechanics, fluid dynamics, and experimental mechanics. The Design Division emphasizes the design process, and is specifically concerned with manufacturing technology, automatic controls, analytical and numerical design methods, optimization, design aesthetics, human factors, and systems design. The Design Division also offers an undergraduate program in Architecture and offers undergraduate and graduate programs in Product Design (jointly with the Art Department). The Thermosciences Division offers courses and specialized work in the areas of applied thermodynamics, energy systems, nuclear energy, pollution control, combustion, fluid mechanics, and heat transfer.

Many faculty members of the three divisions are involved in advanced mathematical analyses, and the Department as a whole provides a number of basic and advanced courses in applied mathematics.

**FACILITIES**

All three Divisions of the Department maintain modern laboratories which are used for both undergraduate and graduate instruction and graduate research work.

The Division of Applied Mechanics provides facilities for laboratory work in experimental mechanics and experimental stress analysis. Additional facilities, including an MTS electrohydraulic materials test system and a vehicle crash simulator are available through the School of Engineering Structures and Solid Mechanics Research Laboratory. Laboratories for biological experimentation are available through the School of Medicine. Individual accommodation is provided for the work of each research student. Weekly seminar meetings acquaint the students with a great variety of subjects in their field, and give opportunity to practice speaking on a selected topic. A variety of research projects are also conducted in Applied Mechanics. Qualified students participate in these as research assistants, engaged in thesis research, in close working association with the faculty director and fellow students. The projects include original experimental and theoretical investigations in the strength and deformability of elastic and anelastic elements of machines and structures; fracture mechanics, vibrations, and nonlinear dynamics; analysis, synthesis, and control of systems; flow dynamics of liquids and gases, including geophysical and astrophysical applications; and biomechanics.

The Design Division maintains shops and
laboratory space for use in instruction, for construction of project apparatus, and for graduate research work in various disciplines of interest to the Design Division faculty. The Design Division also has a unique "Product Design Loft," in which students in the Product Design program engage in creative activity, and other stimulating facilities for undergraduate students in architecture.

The Thermosciences Division has two primary laboratories. The Thermosciences Laboratory is equipped with representative power, fluid handling, refrigeration and heat and mass transfer equipment, and extensive special facilities for advanced graduate research in convective heat transfer and fluid mechanics, internal combustion engine research and other work relevant to energy systems. The High Temperature Gasdynamics Laboratory is deeply engaged in a variety of research activities relating to the practical generation of electrical energy from flowing plasmas, electrostatic precipitators, combustion, kinetics of pollutants, and gaseous lasers. Facilities in the HTGL include a large MHD power channel with normal and superconducting magnets, a shock tube, a variety of plasma diagnostic devices, and high-power laser systems. In addition, the Thermosciences Division has a small Nuclear Measurements Laboratory which includes a neutron source, a neutron accelerator, a variety of radiation detection instruments, and other instrumentation for environmental measurements pertinent to energy systems, and a Thermosciences Measurements Center, which houses information on all aspects of measurements. A wide variety of instrumentation, extensive shop facilities, utilities, and research space are all available within and shared by these laboratories.

The Guidance and Control Laboratory, a joint activity with the Departments of Aeronautics and Astronautics and Mechanical Engineering, specializes in the construction of electromechanical systems and instrumentation, particularly where high precision is a factor. Work in this laboratory ranges from space vehicle systems to feedback control of carburetors for automotive emission control. The faculty and staff of this laboratory work in close cooperation with both the Design and Thermosciences Divisions on device development projects of mutual interest.

Computation facilities at Stanford are excellent. Typewriter terminals in each laboratory provide for remote access to the Center for Information Processing's IBM 360/67. A Sigma V hybrid computer and an Addage computer with graphical input/output capability are operated by the School of Engineering. There are several minicomputers available within the Department's laboratories. In addition, Stanford is a member of the ARPA computational network, and as such has access to NASA's ILLIAC, a unique high-storage parallel-processor computer. Various groups within the Department now use all of these machines. The Thermosciences Division includes a group that is particularly strong in the numerical simulation of fluid flows, especially turbulence.

The library facilities at Stanford are also outstanding. In addition to the general library, there are special libraries for Engineering, Mathematics, and Physics, and other departmental libraries, of which engineering students make frequent use. In addition, each Division maintains a reading room and small library collection, and specific research collections in the areas of energy, high temperature gasdynamics, internal flow, nuclear energy, and noise pollution.

Graduate students participating in research are provided with office space in the laboratory buildings, and have access to substantial staff support from their research group and from the Office of Research Coordination, which is housed in the Thermosciences Laboratory building.

The Thermosciences Division faculty are deeply involved with activities of Stanford's Institute for Energy Studies. The Institute sponsors seminars, research, and other activities throughout the University, and acts as a focal point for energy at Stanford.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

Students desiring to specialize in mechanical engineering during their undergraduate period may do so by following the curriculum outlined earlier under School of Engineering. The University's basic requirements for the Bachelor's degree are discussed in the section "Degrees" in this bulletin.

A program for Product Design is offered by the Design Division and leads to the de-
degree of Bachelor of Science in General Engineering. It is recommended, however, that this should not be considered a terminal degree and that all students who elect this program continue on through the Master's degree in this field.

Bachelor of Arts in Architecture

This is a preprofessional curriculum, open to all undergraduates who intend to pursue careers in architecture, landscape architecture, planning, or any related field. Required courses for the architecture major provide the basis for a broad liberal arts background for continued study in a graduate, professional degree program. These courses are scheduled so that students may enter the architecture major program as late as the beginning of the junior year. However, freshmen may begin architecture course work in the first quarter.

Central to the curriculum is the architectural design studio, which is given in the senior year. This is a 3-quarter course in which the student is equipped to synthesize solutions to case-study problems by relating design determinants ranging from the visual principles of space, light, color, and scale to the philosophical values of architecture. This work is supported by courses in history and theory of architecture, building construction, professional practice, and the development of graphic skills in design communication.

The architecture program also shares courses and work space with other design disciplines within the School of Engineering. This arrangement provides opportunities for joint activities among students and faculties, and exposure to related design work which stimulates thinking beyond the normal scope of architectural education. The Design Division provides courses in basic design, visual thinking, product design, and manufacturing processes.

Other University resources add to the breadth of the architecture curriculum: the Art Department provides courses in drawing and sculpture and additional courses in design, and the history of art and architecture; the Department of Civil Engineering provides courses in advanced engineering and urban planning; the Urban Studies Program provides courses in social, political, economic and cultural analyses of urban problems. Other resources, such as the Stanford Workshops on Political and Social Issues (SWOPSI), provide courses in topical environmental concerns.

Students are encouraged to consider an interdisciplinary major, combining architecture with Product Design, Civil Engineering, Art, or Urban Studies.

Architecture students are subject to University Bachelor's degree requirements in addition to the Architecture Program requirements listed below.

1. Humanities and Fine Arts: 22 units minimum; Art Studio: 2 courses, to include Art 40; History of Art and Architecture: 4 courses to include Art 5, 175A, 175B
2. Science: 10 units minimum, to include Physics 21, 23
3. Mathematics and Computer Application: 9 units minimum, to include calculus and analytic geometry
4. Engineering: 16 units minimum, to include Engineering 7 and 11; Mechanical Engineering 101, 115A
5. Architecture: 48 units minimum, to include Architecture 42, 110, 120, 131, 132, 135, 141, 142, 143, 144, 145, 148, 160

Master of Science

Admission and Registration — The basic University requirements for the Master's degree are discussed in the section "Degrees" in this bulletin.

To be eligible for registration as a graduate student in the Department a student must have received a B.S. degree in engineering, physics, or some comparable science program. One's undergraduate record and personal recommendations must demonstrate capability of handling graduate level work and ability to complete the requirements for the M.S. degree. Students whose undergraduate backgrounds are entirely devoid of some of the major subject disciplines of engineering (for example, fluid mechanics, applied thermodynamics, applied mechanics, circuit theory) may find it desirable to take some undergraduate courses to fill in obvious gaps and prepare themselves to take graduate courses in these areas. Such students may require more than three quarters to fulfill the Master's degree requirements, as the make-up courses may not be used for other than the free electives (see item 5 below) in the M.S. degree pro-
gram. However, it is not the policy to require fulfillment of mechanical engineering B.S. degree requirements in order to obtain an M.S. degree, and furthermore students who have already fulfilled certain categories of the M.S. degree requirements as a result of their undergraduate work may find they have sufficient time under item 3 below to obtain the M.S. degree in the normal three quarters.

**Graduate Program** — Mechanical Engineering is a varied profession, ranging from primarily aesthetic aspects of design to highly technical scientific research. The discipline areas of interest to mechanical engineers include rigid and elastic body mechanics, materials, fluid mechanics, thermodynamics, heat transfer, nuclear reactor engineering, magnetohydrodynamics, human factors, systems engineering, to name a few of the more important. No mechanical engineer is expected to have a mastery of this entire spectrum. Breadth is particularly important for some, while for others depth in a single specialty may be more relevant.

The Master's degree program is normally expected to ensure breadth and provide an opportunity for modest depth in one or two areas. The student has a wide range of course choices which allow for individual interests. However, it is expected that each student's program include course work in several of the above listed areas. Students desiring a high degree of specialization should continue toward the degree of Engineer and/or Doctor of Philosophy, or include more than 45 units in their M.S. program.

The Master's degree program requires 45 units of course work taken as a graduate student. No thesis is required, although many students include some research work in their course program. At least 36 of these units must be taken at Stanford; any units transferred from other universities (up to 9 are allowed) must be graduate level courses taken while registered as a graduate student, and may not be applied toward fulfillment of item 2 below.

The Departmental requirements which must be met for the degree of Master of Science are:

1. **6 units** of mathematics from Mechanical Engineering 200–209, Computer Science 137A or B, Mathematics 106, 113, 131, 132. (Ordinary differential equations, e.g., Mathematics 130, may not be used to fulfill this requirement; it may be taken as a free elective, item 5 below.) Students who have already fulfilled the mathematics requirement in full or in part may place the released units in the approved elective category.

2. **18 units** of graduate level courses (200 series) in the Department of Mechanical Engineering. This program should include a focus on some subject area. In order to obtain exposure to a variety of thinking modes and a range of subject matter expected of mechanical engineers, students are encouraged to include courses from more than one division. M.E. 200–209, 291, and 292 may not be counted in this requirement.

3. **15 units** of approved electives (approved by adviser); these ordinarily should be in mathematics, physics, chemistry, or engineering. Courses in this category should be graduate level courses or, if in another department, they should be at least junior level courses with a minimum of introductory courses; specific exceptions to the graduate level rule are Engineering 104, 176; Mechanical Engineering 116B, 116C, and any courses listed under “Mezzanine Level Courses” listed below. Advisers will normally also approve a limited number of units in the Graduate School of Business or other areas in the University. A maximum of 9 units in Mechanical Engineering 291, 292, and 3 units in credit seminars, workshops, and colloquia may be included in this category.

4. Included in the above courses must be a minimum of work in Engineering Experimentation and in Engineering Synthesis. This requirement can be fulfilled as outlined below:
   a) In Experimental Engineering, a minimum of 3 units of Mechanical Engineering 292 (Experimental Project Work) by arrangement with a member of the faculty, or by completion of any one of the following courses: Mechanical Engineering 139, 210A,B,C, 225, 248, 249A, 268A,B, Aeronautics and Astronautics 131.
   b) In Engineering Synthesis, a minimum of 3 units of Mechanical Engineering 249B, 282, 291, 292 (Engineering Synthesis Work) by arrangement with a member of the faculty, or by comple-
tion of any one of the following courses:
Mechanical Engineering 210A,B,C, 212, 214, 220A,B, 223, 225, 249B, 273A, 275. Mechanical Engineering 113 can also be used if it was not taken as an undergraduate.

5. Free electives, to make a total of 45 units.

Candidates for the degree of Master of Science will be expected to have approval of the faculty, and to have a minimum scholastic average of 2.75 in the 45 units presented to fulfill degree requirements, regardless of grades in other courses that might be taken as a graduate student. (Courses with + grades can be included in the 45 units, but will not be counted in grade point computation.) Any courses used to fulfill items 1, 2, and 3 of the Department M.S. requirements should be graded courses (excluding seminars and courses for which a pass/no credit grade is given to all students).

Students falling below an overall average of 2.50 at the end of 20 units may be disqualified from further registration. Students failing to meet the complete degree requirements at the end of 60 units of graduate registration will be disqualified from further registration. An exception to the 60-unit rule will be units used to fill deficiencies arising from inadequate undergraduate preparation for mechanical engineering graduate work.

Product Design—A graduate program in the field of Product Design is intended primarily for those students who have completed the undergraduate program in this field and who are admissible to the graduate school. For these students, the 45 units of work specified below are all that is required for a Master of Science in Engineering (Product Design). Students with undergraduate engineering degrees from other schools will usually spend one additional year taking prerequisite undergraduate courses required for the B.S. in Product Design (see page 91 of this bulletin). A special program is also available in cooperation with the Art Department for students who have non-engineering undergraduate degrees in design. These students will register with the Art Department and, while they will take many of the courses listed below, will receive the degree of Master of Arts in Art.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
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<tbody>
<tr>
<td>M.E. 211A,B,C.</td>
<td>Product Design Master's Project</td>
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</tbody>
</table>

*Art 360. Master's Project 6
Art 261. Advanced Design I 3
M.E. 215. Human Factors in Design 3
M.E. 224. Advanced Manufacturing Technology 3
Indus. Engr. 263. The Engineering and Organization of Small Businesses 3
Approved electives 9
Free electives 6

* Taken jointly.

Admission requirements and grade point average graduation requirements are the same as for the Mechanical Engineering Master's Degree described above. If possible, applicants should also submit evidence of design ability (e.g., photos or slides of several design projects).


Degree of Engineer

The basic University requirements for the degree of Engineer are discussed in the section “Degrees” in this bulletin.

This degree represents nominally an additional year of study beyond the Master of Science degree, and includes a research thesis. This program is designed for students who desire to do professional engineering work upon graduation, and who desire an opportunity to engage in more specialized study than is afforded by the Master's degree alone.

The admission standards for this program are substantially the same as indicated under the Master’s degree. However, since thesis supervision is required, and the availability of thesis supervisors is strictly limited, the Department cannot admit a student to candidacy until the student has personally arranged with some member of the faculty to supervise a research project. This will frequently involve a paid research assistantship, and research assistantships are awarded by individual faculty members (usually from the funds of sponsored research projects under the direction of individual faculty members) and not by the Department, so again a personal arrangement is necessary. Students studying for their Master's degree at Stan-
ford and desiring to continue to the Engineer degree ordinarily make such arrangements during their M.S. degree year. Students holding Master's degrees at other universities will be admitted and allowed to register if they are sufficiently well qualified. However, the Department cannot guarantee thesis supervision or financial assistance, and the student must make such arrangements during his or her first quarter or two of residence.

The Departmental requirements for the degree include an acceptable thesis; up to 15 units credit will be allowed for thesis work. In addition to the thesis, 30 units of approved advanced course work in mathematics, science, and engineering are expected beyond the requirements for the Master of Science degree; the choice of courses is subject to the approval of the adviser. Students who have not fulfilled the Stanford M.S. degree requirements will be required to do so (with due allowance for approximate equivalence of courses taken elsewhere).

All candidates for the degree of Engineer will be expected to have approval of the faculty and to have a minimum scholastic grade point average of 3.0 for all courses (exclusive of thesis credit) taken beyond those required for the Master's degree.

It is the policy of the Department that students engaged in faculty supervised research and special study are obligated to provide the faculty supervisor with a minimum of 20 hours per quarter of reading and grading assistance in the faculty member's other courses, if the faculty member asks for this assistance. The student will be paid for this assistance unless precluded by a fellowship arrangement.

Product Design—A special two-year program in the field of Product Design leads to the degree of Engineer in Mechanical Engineering. It is intended for students who wish to augment in-depth graduate engineering study with education in the aesthetic and human qualities essential in new product development.

A typical program represents course and thesis content equivalent to the Master of Science in Mechanical Engineering plus the Master of Science in Engineering (Product Design). Alternatively, a program of interdisciplinary graduate study may be devised according to guidelines described on page 96 (e.g., in Biomedical Design, Computer-aided Design, or Man-Machine Systems). The thesis requirement for the degree of Engineer is satisfied mainly by documenting the M.E. 299A,B,C Master's Project.

The total of 90 units (including 20 or more in the Department of Art) can normally be completed in two academic years. Students deficient in prerequisite areas may take more time. Students who fulfill requirements for this program are awarded the M.S. in Engineering (Product Design) and Degree of Engineer in Mechanical Engineering (Product Design) simultaneously at its completion.

Admission to the program follows the same requirements as for the Master's degree in Product Design.

DOCTOR OF PHILOSOPHY

The basic University requirements are discussed in the section "Degrees" in this bulletin. The Doctor's degree is intended primarily for students who desire to pursue a career in research, advanced development, or teaching; for this type of work a broad background in mathematics and the engineering sciences, together with intensive study and research experience in a specialized area, are the necessary requisites.

The Department will allow a minor field of study, but does not require one. However, if a minor is waived, the candidate must show breadth of training by taking a group of courses in one or more related fields or departments.

A student studying for the Ph.D. degree ordinarily will not take an Engineer degree, although this is not precluded. However, the student must have a Master's degree, and must fulfill in essence the requirements for the Stanford M.S. degree in Mechanical Engineering.

Admission to the program involves much the same consideration as described under the Engineer degree. A sufficiently well-qualified student from Stanford or elsewhere will be admitted and assigned to an adviser. If the student has not arranged with a faculty member for supervision of research prior to admission, the student's adviser will assist him or her in making the arrangement. However, the Department cannot guarantee research supervision, as this involves a personal arrangement between the student and the individual faculty member, and such an arrangement is entirely the responsibility of the student. Once a student has obtained a
research supervisor, this supervisor becomes thereafter the student's academic adviser. Research supervisors may require that the student pass the Departmental Oral examination before starting on research work and before receiving a paid research assistantship. Note that research assistantships are awarded by the individual faculty research supervisors and not by the Department.

It is very strongly urged that students anticipating working for a Ph.D. degree arrange to do some research work under M.E. 291 or 292 prior to attempting to make a Ph.D. supervision arrangement. Faculty members supervising Ph.D. research will generally require some such proof that a student has research potential before committing themselves to Ph.D. supervision and a research assistantship. It is most efficient to carry out this preliminary research effort during the M.S. degree year.

Prior to being formally admitted to candidacy for the Ph.D. degree the student must demonstrate his knowledge of engineering fundamentals by passing the Departmental qualifying oral examination. The academic level and subject matter of this examination correspond approximately to the Master of Science degree program described above. The examination consists of four oral interviews, one of which must be in mathematics, and the other three are chosen from the areas of controls, mechanical engineering design, fluid mechanics, heat transfer, elastic body mechanics, dynamics, physics, nuclear reactor theory, or applied thermodynamics. A student must have the adviser's approval, and at least a tentative arrangement for research supervision, in order to take the examination. The examination is offered during the autumn and spring quarters and may in addition be offered at other times as the need arises. Normally the examination will be taken during the first post-Master's year.

The Ph.D. thesis normally represents one full year of research work and must be a substantial contribution to knowledge. Students may register for up to 45 units of course credit for thesis work (Mechanical Engineering 301) to help fulfill University residence requirements (payment of the equivalent of 9 quarters of full tuition), but they are not required to do so if they would prefer to fulfill residence by formal course work, and there is no minimum limit on registered thesis units.

The Department has a Breadth Requirement for the Ph.D. degree. Breadth may be provided either by completion of three courses outside of the four areas taken in the qualifying examination, or by a formal minor in another department. Courses chosen must be approved by the dissertation reading committee.

The Department also has a Non-Technical Breadth requirement for the Ph.D. degree. This can be satisfied by completion of six units of course work in the humanities and fine arts, approved by the thesis adviser. Alternatively, the student may demonstrate proficiency in a foreign language, normally French, German, or Russian.

All Ph.D. candidates are expected to participate each quarter in one of the following seminars: Mechanical Engineering 290, 293, 294, 295, 296, 298, Aeronautics and Astronautics 296 or 297.

The final University Oral Examination is conducted by a committee consisting of a chairman, appointed by the University, and four faculty members of the Department or departments with related interests. Usually the committee includes the candidate's adviser and the two faculty members chosen to read and sign the candidate's dissertation. The examination consists of two parts. The first part is open to the public and is scheduled as a seminar talk, usually for one of the regular meetings of a seminar series. The second part is conducted in private and covers subjects closely related to the dissertation topic.

*Note:* Prior to 1975–76 the Division of Applied Mechanics was a separate Department with its own degree requirements. Students who were admitted to graduate study at Stanford for the academic year 1975–76 or earlier may elect to receive their degrees in Applied Mechanics rather than in Mechanical Engineering. For information on the requirements for these degrees, consult the Office of the Division of Applied Mechanics.

**FINANCIAL ASSISTANCE**

The Department annually awards a number of fellowships, teaching assistantships, and research assistantships to graduate students. The fellowships are usually awarded to first-year graduate students, with the as-
sistantship used primarily for post-Master's degree students. Preference for the assistantships is generally given to students who obtain their Master's degree at Stanford. Research assistantships are awarded by the individual faculty research supervisors and not by the Department as a whole. Special fellowships are available for applicants from ethnic minorities.

Applicants for all three forms of assistance may obtain the necessary application forms from the University Admissions Office. However, post-Master's degree applicants for research assistantships are advised to contact directly the faculty member under whom they would like to work, because of the individual nature of these awards, and if they are successful they need not apply to the Department for assistance. Formal applications to the Department for research assistantships will be referred to the individual faculty research supervisors.

Research assistants can, and normally do, carry out their thesis research work and write their thesis as an integral part of the commitments of their assistantship.

**FRESHMAN LEVEL COURSES**

The following courses offered by the faculty of the Department are suitable for Freshmen.

**Course No.**  **Subject**

Engnr. 7. Energy, from Nature to Man
M.E. 30. Social Aspects of Nuclear Power
M.E. 101. Visual Thinking
M.E. 103. Manufacturing Technology
Architecture 42. Introduction to Architecture

**COURSES PRIMARILY FOR UNDERGRADUATES**

*Note.*—Laboratory sections in experimental engineering will be assigned in groups. Insofar as the laboratory schedule permits, students will be allowed, with due regard to priority of application, to arrange their own sections and laboratory periods. Enrollment with the instructor concerned, on registration day or the first day of University instruction, is essential in order that the laboratory schedule may be prepared. Enrollment later than the first week will not be permitted under any circumstances.

30. Social Aspects of Nuclear Power—This course will present an overview of the nuclear power industry, with the aim of examining the bases of public controversy surrounding nuclear power generation. Technical presentation is descriptive rather than analytical. The course includes: projected nuclear power demands (are they reasonable?); principles of nuclear reactor design (how a reactor supplies energy); different reactor types; breeding; the nuclear fuel cycle; radiological and environmental concerns; nuclear insurance; reactor safety; nuclear safeguards; and other topics as time permits. Open to any student who has had high school physics or chemistry. Engineering students desiring a more analytical treatment of nuclear reactor technology should take Engineering 176 instead.

*3 units, Aut (Sher) TTh 1:15–2:30*

32. Introduction to the Thermosciences—(Enroll in Engineering 32.)

33. Introductory Fluids Engineering—Elements of fluid mechanics, introduction to the use of thermodynamics and the momentum principle in the solution of fluids engineering problems; flow metering, energy losses in pipe flow, drag on a body, jet engine thrust, operation and performance of turbines, compressors and pumps. Prerequisite: Engineering 32.

*3 units, Spr (Johnston) TTh 10; lab. one afternoon by arrangement*


*3 units, Aut (McKim, Staff) lec. and lab. Sec 1 MW 1:15–3:05 Sec 2 MW 3:15–5:05*

102A. Design Communication Workshop I—Intended for students with little or no experience with engineering or architectural drawing. Orthographic, isometric and oblique projection. Dimensioning, lettering, symbols, use of basic drafting tools. Perspective construction and freehand pictorial drawing optional. Pass/no credit.

*1 unit, Aut (Staff) T 7–10*

102B. Design Communication Workshop II
Basic methods and materials for visualizing and communicating design concepts in three dimensions. Emphasis upon economical means that designers can use quickly, with high effect in relation to effort. Pass/no credit.

1 unit, Win (Staff) T 7–10

103. Manufacturing Technology — The capabilities and limitations of common manufacturing processes. Selection and specification of metallic and non-metallic engineering materials. Properties of materials as they affect and are affected by manufacturing processes. Engineering shop drawings—the interrelation of part description, dimensioning, tolerances, and process of manufacture. Laboratory experience in machining, casting, and welding. Various aspects of the course will be developed in a project to be designed, described in engineering drawings, and fabricated in shops.

4 units, Win (DeBra), Spr (Staff)
T 9, Th 9–11; lab. T, W, Th, or F
1:15–4:05 for first four weeks of quarter; additional hours by arrangement during last six weeks

104. Dynamic Response — (Enroll in Engineering 104.)

105. Control System Analysis and Design— (Enroll in Engineering 105.)

111. Stress, Strain and Strength—Analysis of basic engineering structures under load, the resulting stresses and strains, and failure criteria. Bending and torsion of bars, combined stresses, fatigue, fracture mechanics, buckling, corrosion and creep. Emphasis will be on actual industrial problems and will include engineering modeling and an introduction to experimental stress analysis. Prerequisite: Engineering 11.

3 units, Aut (Chilton) T 10, Th 10–12

112. Mechanical Systems—An investigation of the techniques used in design and development of complex mechanical systems. The relative role of test, cut-and-try development, intuition and analysis will be investigated. Critical parameters of mechanical system elements and transmission of force and motion through systems will be discussed. Typical mechanical systems and their design and development will be studied. Each student will design and build a simple mechanical system (model flying machine, tree shaker, stair climber, etc.). Prerequisites: Engineering 11 and 12 or equivalent and 111.

3 units, Win (Chilton) lec. TTh 10;
lab. W 2:15–5:05

113. Engineering Design—The design process involves the application of information from various sources in the creation of tangible objects and intangible system concepts to improve the quality of human life. In this course, design is both studied as a process and experienced by students as they work on a design project. Final project results are presented to a professional jury. Prerequisites: 101, 103, 111, and 112.

3 units, Spr (Chilton) TTh 2:15–5:05

115A. Introduction to Product Design—Active encounter with human values in design. Lectures survey central philosophy of product design program, with emphasis upon the relation between technical and human values, the creative process, and design methodology. Laboratory exercises include the development of simple product concepts visualized in rapidly executed three-dimensional mockups. Prerequisite: 101.

3 units, Win (McKim) MW 1:15–4:05

115B. Design Communication—A planning approach to communicating design concepts. Analyzing communication needs and language orientation of intended audiences. Choosing the most appropriate languages: charts, graphs, schematics, mechanical drawings, perspective renderings, free-hand sketches, three-dimensional models, photographs, spoken or written words. Organizing and delivering verbal-visual presentations. Closed circuit TV used as learning tool. Prerequisites: 101 and 102A,B, or consent of instructor.

3 units, Spr (McKim) MW 1:15–4:05

116A. Advanced Product Design — Small-scale projects carried to a high degree of refinement. Emphasis upon craftsmanship and aesthetics. Prerequisite: 115B.

3 units, Aut (Staff) TTh 12:00–2:05

116B. Advanced Product Design — New product innovation via need-finding. Prerequisite: 116A.

3 units, Win (Staff) TTh 12:00–2:05

116C. Advanced Product Design — Summary project utilizing knowledge, methodology, and skills obtained in 101, 113,
115A,B and 116A,B. Final presentation to professional jury. Prerequisite: 116B.

3 units, Spr (McKim) TTh 12:00-2:05

131A. Thermosciences—First of a three-quarter sequence that should be taken in consecutive quarters. Lecture and laboratory covering thermodynamics, fluid mechanics and heat transfer. The lecture sessions emphasize basic principles used in the energy sciences and their application in man-made systems. Laboratory sessions devoted to demonstration and experiments in the specific area of the lectures and cover basic experimental procedures, including measurement techniques, experiment design, data collection, processing, and evaluation. Prerequisites: Familiarity with basic principles of thermodynamics, and some elementary knowledge of fluid mechanics, equivalent to Engineering 32 and Mechanical Engineering 33. Mathematical background should include intermediate calculus and ordinary differential equations.

5 units, Aut (Johnston) MWF 10; lab. one afternoon by arrangement

131B. Thermosciences — Continuation of 131A.

5 units, Win (Crawford) MWF 10; lab. one afternoon by arrangement

131C. Thermosciences — Continuation of 131B.

4 units, Spr (Eustis) MWF 10; lab. one afternoon by arrangement

137. Air Pollution—Sources and effects of urban air pollution. Photochemical smog. Chemistry and fluid mechanics of pollutants in the atmosphere. Pollution control: devices and legislation. (Open to non-science students.)

3 units, Spr (C. Kruger) MWF 11


3 units, Aut (Bershader) MWF 3:15

139. Environmental Measurements — This course will consist of lecture, laboratory, and field experiments involving measurement techniques for determining environmental quality and pollutant concentrations. Air quality measurements will be particularly emphasized, but techniques applicable to other forms of pollution will also be covered. M.E. 137 recommended.

3 units, Win (Sher) TTh 10 plus lab. one afternoon by arrangement


3 units, Win (Piziali) MWF 11

176. Nuclear Energy—(Enroll in Engineering 176.)

180. Energy and Society—(Same as Human Biology 140.) A unified analysis of the effects on man's environment of the production, distribution and consumption of energy. Treatment will include: the kinds and magnitude of energy resources; the various technologies for conversion to electric energy and other consumer forms; priorities and strategies for future development; the social conflicts between growing demands and environmental degradation, technological assessment; the legal and economic framework of the energy industry. Presentation of technical information will be in terms understandable to the non-engineering student. Prerequisites: high school physics and junior standing or consent of instructor.

3 units, Spr (Connolly, Liebes) MWF 8

191. Engineering Problems and Experimental Investigation — Directed study and research for the undergraduate student on a subject of mutual interest to student and staff member. Student must find faculty sponsor and have approval of his adviser.

1 to 5 units, any quarter (Staff) by arrangement

ARCHITECTURAL COURSES FOR UNDERGRADUATES

42. Introduction to Architecture—A survey of architecture as artifact, commodity, environment, and as a profession, with discussions of the history, theory and methodology of architectural design and its relationships
to allied fields. Lectures, readings, and projects. Visiting professionals.

3 units, Aut (Mittelstadt) TTh 9–11

110. Manufactured Architecture—Explores common concerns of product design and architecture through design problems in the space and systems planning of mobile living modules, transportation units, and/or industrialized building, with emphasis on manufacturing processes and life support systems. Individual research, discussions, field trips and projects. Primarily for students in Product Design and Architecture. Prerequisites: Mechanical Engineering 101, 102A.

3 units, Win (Staff)

120. Architectural Theory and Criticism—A study of the intellectual and social history of architecture relative to the present. During the course half the emphasis will be placed on the development of critical, theoretical, and methodological awareness; the other half will be devoted to a critical analysis of contemporary architecture. Material will be approached through a series of discussions, slide presentations, readings, and papers. Prerequisite: 42.

3 units, Spr (Staff)

131. Structural Design I — Emphasis on structure as a form-generating resource, making a distinction between the abstractions of structural mechanics and the realities of materials and construction. Design of the structural systems of a series of buildings, study of appropriate uses of wood, steel, concrete, and masonry from a practical as well as an aesthetic viewpoint. Work performed in and outside class. Prerequisites: 142 and Engineering 11.

3 units, Win (Gray) F 1:15–4:05

132. Structural Design II—Continuation of 131. From the fairly simple structures studied in 131, the scope is widened to include more refined systems, tall buildings, very long spans, thin shells, manufactured buildings, and some of the more subtle aspects of seismic design. The intent is to develop skill in the use of current technology through complete drawings and calculations. Prerequisite: 131.

3 units, Spr (Gray) F 1:15–4:05

135. Environmental Control for Buildings—A survey of mechanical, thermal, and electrical systems used to control the indoor environment. Topics will include heating, cooling, and ventilation system design with emphasis on energy conservation. Conventional and alternative utility systems—i.e., solar, geothermal, wind, and others—will be discussed. The intent of the course is to provide architecture majors with a basic knowledge of the outlined material for direct application in the work of Architectural Design I, II, and III. Primarily for architecture majors. Prerequisites: Engineering 7, 142, Physics 21, 23.

3 units, Aut (Wilde) TTh 9–10:30

141. Design Communication—Exercises in architectural graphics. Drawings and rendering techniques in various original and reproductive media incorporating line, texture, shade and shadow. Includes axonometric and perspective projection. Studio format with lectures and individual criticism. Prerequisites: Art 40, Mechanical Engineering 101 and 102A, or equivalent.

3 units, Win (Staff) TTh 3:15–5:05

142. Building Technology—A study of the physical systems, materials, construction procedures, and documentation constituting a building project. Separate elements (plumbing, electrical systems, etc.) will be studied in the sequence in which they are encountered in the course of construction, with emphasis on the coordination of these elements. Lectures, readings, short papers, field trips, and discussions. Primarily for architecture majors. Prerequisites: 42, Engineering 7 and 11.

3 units, Aut (Staff) WF 3:15–5:05

143. Architectural Design I—Study of the synthesis of architectural design, beginning with exercises in the principles of space, light, scale, proportion, color, and function, and then proceeding, through exploration of design methodology, to problems in the design of environments. In the design studio instructors will act as catalysts and critics, giving lectures and reviews, generating discussions and arranging field trips, and engaging in individual consultation and criticism. In addition, visiting specialists give lectures in areas related to student projects; visiting professionals participate in design reviews. Students are expected to participate in project research and group discussion besides working on their own design projects. Development of skills in graphic and
verbal presentation techniques is an important part of the design studio. Recommended for seniors only. Prerequisites: 141 and 142.

6 units, Aut (Mittelstadt and Staff)  
TTh 1:15-5:05

144. Architectural Design II—Continuation of 143 with emphasis on building and site planning through case study design problems. Prerequisite: 143.

6 units, Win (Mittelstadt and Staff) TTh 1:15-5:05

145. Architectural Design III — Continuation of 144 with emphasis on building in the urban context: analysis of the effects of economic, legal, social and physical systems on architectural form through case-study design problems. Prerequisite: 144.

6 units, Spr (Mittelstadt and Staff) TTh 1:15-5:05

148. Architectural Practice — Provides the graduating architecture major with professional knowledge regarding the functions, responsibilities, and challenges of the practicing architect. Examines related fields contributing to the design of the man-made environment and how they interact with the architectural profession to achieve common goals. Seminar with lectures, visitors, field trips, discussions and readings. For architecture seniors. Prerequisites: 142 and concurrent enrollment in 145.

3 units, Spr (Mittelstadt) To Be Arranged

160. Principles of Urban Design—A study of the elements of architecture, city planning, the social sciences, and environmental engineering, emphasizing urban form and appearance. Exploration through lectures, readings, and studio projects of space, form, human activities and life styles, and urban mechanical systems—all factors in a dynamic process by which urban design becomes an expression of changing public policy in contrast to the relative permanence of architecture. Prerequisite: 42.

3 units, Aut (Okamoto)

MEZZANINE LEVEL COURSES

The following courses are especially suitable both for advanced undergraduates and for graduates, and may be used to satisfy the M.S. requirement, item 3, 15 units of approved electives.

Course No.  Subject
M.E. 105. Control System Analysis and Design (Enroll in Engineering 105)
M.E. 113. Engineering Design
M.E. 137. Air Pollution
M.E. 138. Noise Pollution
M.E. 139. Environmental Measurements
M.E. 161. Engineering Vibration
M.E. 176. Nuclear Energy (Enroll in Engineering 176)
M.E. 180. Energy and Society
M.E. 215. Human Factors in Design
M.E. 224. Advanced Manufacturing Technology
M.E. 225. Control System Analysis and Design (Enroll in Engineering 206)
M.E. 220A,B. Engineering Systems Design (Enroll in Engineering 235A,B)
M.E. 250A. Heat Transfer
M.E. 255. Gasdynamics

COURSES PRIMARILY FOR GRADUATES

ENGINEERING MATHEMATICS


3 units, Aut (Ferziger) MWF 11


3 units, Aut (Ferziger) MWF 9

200C. Mathematical Methods in Mechanical Engineering — A number of topics in
mathematics applicable to engineering will be covered but the coverage will change from year to year. Topics may include advanced numerical analysis, tensor calculus, asymptotic methods and expansions, calculus of variations, integral equations. Prerequisites: 200A,B, or equivalents.

3 units, Spr (Ferziger) MWF 9

201. Applications of Complex Variables—The theory of analytic functions and contour integration with applications to physical problems of conformal mapping, integral transforms, and asymptotic methods. A knowledge of the algebra of complex numbers and of the derivative of a complex function is assumed.

3 units, Spr (Van Dyke) MWF 10

206. Similarities in Engineering Mechanics—The reduction of physical problems, dimensional analysis; supplementary information; similarity rules; self-similar solutions by dimensional analysis and other groups of transformations; existence, uniqueness, and numerical integration; application of self-similar solutions; local solutions; self-similar solutions with concealed exponent. Prerequisite: Mathematics 131 or consent of instructor.

3 units, Win (Van Dyke) MWF 11, alternate years, given 1977–78

207. Perturbation Methods in Engineering Mechanics—Examples of perturbation solutions in fluid mechanics, solid mechanics, dynamics, and other fields; asymptotic expansions; series and iteration schemes; regular perturbations; slow variations; singular perturbation problems; the methods of matched asymptotic expansions, multiple scales, and other; improvement of series. Prerequisites: Mathematics 106 and 131, or consent of instructor.

3 units, Win (Van Dyke) MWF 11, alternate years, given 1976–77

208. Vector Analysis and Cartesian Tensors with Applications—(Enroll in Aeronautics and Astronautics 192.)

209A. Linear Transforms and Their Applications to Engineering Problems I—(Enroll in Aeronautics and Astronautics 291A.)

209B. Linear Transforms and Their Applications to Engineering Problems II—(Enroll in Aeronautics and Astronautics 291B.)

DESIGN AND CONTROLS

210A,B,C. Engineering Design—Experience in the formulation, design and analysis of real engineering projects presented by local industry. Designs will be developed by small groups of students, each group under supervision of an instructor from the Design Division faculty and in close cooperation with the industrial sponsor. Projects will be carried through construction and testing of prototype, and first design revision. Instruction in design methodology, safety, liability, and patents for engineers. Students should enroll for all three courses. Grading will be deferred until completion of 210C. Limited enrollment. Prerequisite: 113 or equivalent.

210A. 4 units, Aut (Piziali, Liu) TTh 1:15–4:05

210B. 2 units, Win (Piziali, Liu) Th 2:15–5:05

210C. 3 units, Spr (Piziali, Liu) W 1:15–4:05

211A,B,C. Product Design Master’s Project—Three-quarter graduate design project guided by a diverse faculty team. In the first quarter, the student uses rational and intuitive problem-finding procedures to identify a design project within an unexplored area of need, presents a project proposal, and performs research. In the second quarter, the student prepares a design program, develops concepts, performs necessary experiments, and carries project to the stage of a working prototype. In the third quarter, the student refines design from the standpoint of cost and production, builds demonstration model, and presents project to professional jury. (For Product Design majors only.)

211A. 4 units, Aut (McKim, Staff) by arrangement

211B. 4 units, Win (McKim, Staff) by arrangement

211C. 4 units, Spr (McKim, Staff) by arrangement

212. Computer-Aided Design—The use of machine computation as a design tool. A discussion of techniques and algorithms which increase the rationality of the design process and lead to more nearly optimum solutions. The emphasis is on extending the designer’s potential, and not on automating his activities. Topics are taken from all phases of the
design process. Students will be expected to program algorithms and complete a design project. Prerequisite: FORTRAN (or ALGOL or LISP) programming ability.

3 units, Aut (Roth) MWF 12

214. Philosophy of Design — The course stresses creativity, examines values, and emphasizes the interpersonal processes involved in design. Students will experience and develop their capacities for design in various ways—such as synectics and brainstorming. Emphasis on experiential learning by design and construction of unusual devices. Directed reading in the literature of creativity. Limited enrollment; open to graduate students of all disciplines.

3 units, Spr (Adams) M 2:15-5:05


3 units, Spr (Staff) TTh 10-12

216. Design of Optimal Components—Optimizing multivariable, constrained, nonlinear mechanical, thermal structural and chemical devices. Students apply theory of monotonicity, power functions, and geometric programming to design devices of their choice; turbines, transmissions, steering gear, bearings, chemical reactors, heat exchangers, shells, plates, and beams. Prerequisite: calculus, matrix algebra.

3 units, Win (Wilde) MWF 11


3 to 4 units, Spr (Wilde) MWF 10


222. Kinematic Synthesis of Mechanisms—The rational design of linkages is the central theme of this course. The problem of determining linkage proportions to fulfill various design requirements is treated analytically. Topics include: three- and two-dimensional displacements and motions, the theory of higher plane curves, higher-order path-curvature analysis, circle and center-point theory.

3 units, Spr (Roth) MWF 12

224. Advanced Manufacturing Technology—Capabilities and limitations of high production and specialized manufacturing processes, including numerically controlled machining, small-scale joining, deposition, etching, electrical discharge machining and high-rate forming. Automation in fabrication and assembly. Selection and specification of polymers, adhesives, composites, coatings, and materials with extreme properties. Field trips will be integrated into course content where possible. Prerequisite: 103 or equivalent first-level materials and processes course.

3 units, Spr (Adams) Lectures MW 11
Field trips F 1:15-5:05

225. Control Systems Analysis and Design—(Enroll in Engineering 206.)

226A. Digital Control I—(Enroll in Engineering 207.)

226B. Digital Control II—(Enroll in Engineering 208.)

227A. Optimal Control of Dynamic Systems—(Enroll in Aeronautics and Astronautics 278A.)

227B. Optimal Estimation and Control Logic in the Presence of Noise—(Enroll in Aeronautics and Astronautics 278B.)

227C. Differential Games—(Enroll in Aeronautics and Astronautics 278C.)

228. On-Off Control Logic—(Enroll in Aeronautics and Astronautics 277.)


3 units, Spr (DeBra), alternate years, given 1976-77
MECHANICS OF SOLIDS

230. Advanced Kinematics — Discussion of kinematics from both the mathematical and engineering viewpoints. Introduction to algebraic geometry. Application of matrix, tensor, and dual-quaternion methods to kinematic analysis and synthesis. A survey of current research and unsolved problems in kinematics. Prerequisite: 222.

3 units, Win (Roth) by arrangement

231A. Dynamics — Partial rates of change of position and orientation. Generalized particle and rigid body kinematics. Generalized active and inertia forces for holonomic and nonholonomic systems.

3 units, Aut (Kane) T 10 and Th 9–11

231B. Dynamics — Inertia properties, potential energy, dissipation functions, kinetic energy, virtual work. Lagrange's form of D'Alembert's principle, Lagrange's equations of motion.

3 units, Win (Kane) T 10 and Th 9–11

231C. Dynamics — Initial value problems, constraint forces and forces of interaction, impulsive motions. Momentum and energy integrals, Hamilton’s canonic equations, canonic variables and transformations, the Hamilton-Jacobi partial differential equation, variation of parameters.

3 units, Spr (Kane) T 10 and Th 9–11


3 units, Spr (Piziali) T 8–10, Th 8–9


3 units, Spr (Kane) W 2:15–4:05 plus one hour by arrangement, alternate years, given 1975–76


3 units, Win (Kane) T 2:15–4:05 plus one hour by arrangement, alternate years, given 1976–77

235. Vibrations — Development of equations of motion for continuous systems, lumped systems and approximations of continuous systems, Rayleigh Ritz, Galerkin, Collocation, and finite element methods. Solution techniques for the eigenvalue problem and forced responses. Prerequisites: 161 or equivalent, and computer programming ability.

3 units, Spr (Piziali) T 8–10, Th 8–9


236A. 3 units, Win (Staff) TTh 2:15–3:30

236B. 3 units, Spr (Staff) TTh 2:15–3:30, alternate years, given 1976–77


3 units, Aut (Herrmann) MWF 10


3 units, Win (Herrmann) MWF 10

238C. Theory of Elasticity — Continuation of 238B: Problems of elastic contact. Funda-
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tenals of thermoelasticity: coupled and uncoupled formulations; applications to selected boundary value problems. Fundamentals of theories of elasticity with microstructure with applications. Prerequisites: 238A,B or equivalents.

3 units, Spr (Herrmann) TTh 11:00-12:15


3 units, Aut (Steele) MWF 1:15, alternate years, given 1975–76


3 units, Spr (Lee) MWF 11, alternate years, given 1975–76


3 units, Aut (Lee) MWF 2:15, alternate years, given 1976–77

240B. Advanced Theory of Viscoelasticity — Equivalent mathematical representations of stress-strain relations for linear response and connections between them. Stress analysis problems for simple boundary conditions, mixed conditions, and consideration of moving boundaries. Temperature effects. Prerequisites: 238A and 240A.

3 units, Win (Lee) MWF 2:15, alternate years, given 1976–77

241A. Theory of Plates — Analysis of stress, deformation in plates bent by transverse loads. Applications to circular, rectangular, other shapes. Vibrations, buckling and large deflection plates. Prerequisite: Civil Engineering 114.

3 units, Aut (Steele) MWF 9

241B. Theory of Shells — Axisymmetric deformation of shells of revolution. Asymptotic expansions; direct and bending stresses. Application to design of domes, pressure vessels, expansion joints and pressure sensing devices. Membrane theory for general surfaces; hyperbolic paraboloids. Prerequisite: Civil Engineering 114.

3 units, Win (Steele), MWF 9


3 units, Spr (Steele) MWF 9

242A. Introduction to Nonlinear Continuum Mechanics — Definitions of general states of stress and deformation of continua. Discussion of constitutive equations, and influence of material symmetries. Applications of the theory with particular reference to finite elasticity. Prerequisite: 238A.

3 units, Spr (Lee) TTh 11:00–12:15, alternate years, given 1975–76

242B. Introduction to Nonlinear Continuum Mechanics — Application of theory of continua to nonlinear viscoelastic materials. Thermodynamic effects including thermoelastic coupling for nonlinear elasticity at finite strain. Prerequisite: 242A.

3 units, Aut (Lee) MWF 10, alternate years, given 1976–77


3 units, Spr (Staff) TTh 1:00–2:15, alternate years, given 1976–77

Interaction with fluids, e.g., flow through pipes and impinging jets, as well as other bodies.

244A. 3 units, Spr (Herrmann) TTh 2:15–3:30, alternate years, given 1976–77

244B. 3 units, Aut (Herrmann) alternate years, given 1977–78


3 units, Win (Fuchs) MW 3:15–4:30

247A. Strength and Microstructure — (Enroll in Materials Science 205.)

247B. Fracture of Solids — (Enroll in Materials Science 238.)

248. Introduction to Experimental Mechanics — Transducers and measurement systems. Experimental design and statistical evaluation of data. Use of strain gages, photoelasticity, accelerometers, displacement transducers and closed-loop materials test systems. Laboratory applications to: 1) Static and dynamic stress analysis; 2) Shock and vibration; 3) Materials testing; 4) Structural mechanics.

3 units, Win (Hayes, Piziali) T 1:15 plus lab by arrangement


3 units, Spr (Hayes) T 4:15–6:05 plus one lab by arrangement

249B. Advanced Work in Experimental Mechanics — Individual projects on selected subjects. Extension of 248 and 249A to advanced topics such as dynamic or three-dimensional photoelasticity, vibrations, composites, fracture mechanics or biomechanics. By arrangement with instructors.

3 to 5 units, Aut, Win, Spr (Hayes, Piziali) by arrangement

HEAT TRANSFER, FLUID MECHANICS, AND TRANSPORT PROCESSES

250A. Heat Transfer — An applications-oriented first course open to all graduate students and to undergraduates outside of Mechanical Engineering. The course covers the basic techniques of solving heat transfer problems involving conduction, convection, and radiation. It may stand alone or serve as the introductory course for M.E. 250B or for the M.E. 252 series. The fundamental techniques of control volume analysis, lumped parameter modeling and thermal circuit description are used in formulating solvable heat transfer problems based on physical systems. Existing heat transfer data from standard sources are used: emphasis is on the simplifications and assumptions required to model a real problem, and on the response of the system. Ordinary differential equations will be used and some familiarity with the computer would be desirable, but may be concurrently acquired.

3 units, Spr (Hayes) TTh 11:00–12:15

250B. Heat Transfer — Advanced applications in heat transfer. The course covers the analysis of complex systems of conduction, design of heat exchangers and cooling towers, and treatment of radiation exchange with several interacting bodies. Prerequisite: 250A or an equivalent undergraduate level course in heat transfer is required.

3 units, Win (London) TTh 11:00–12:15


3 units, Aut (Eustis) MWF 8

252A. Boundary Layer Processes — Heat, mass, and momentum transport in boundary layers and duct flows. Formulation of the basic equations, fundamental solutions, integral methods for approximate analysis, numerical methods for complex cases. Emphasis on laminar flow, with introduction to
some turbulent flow aspects, and application in engineering design. Prerequisite: 251.

3 units, Win (Moffat and Kline) MWF 10

252B. Boundary Layer Processes—Continuation of 252A, with emphasis on turbulent flow.

3 units, Spr (Kays) MWF 8

254. Design of Internal Flows—Application of integral theorems, potential flow theory, and boundary layer analysis to internal flows of interest in engineering design, such as diffusers, nozzles, mixers, headers, ejectors, etc. Prerequisites: 251, 252A, or equivalents.

3 units, Aut (Kline) alternate years, given 1976–77

255. Gasdynamics—Introduction to compressible flow. Sound waves and normal shock waves. Quasi-one-dimensional steady flows in variable area ducts with friction, heating and cooling, etc. Other topics to be selected from oblique shock waves, Prandtl-Meyer expansions, shock wave structure, relation of continuum conservation equations to simple kinetic theory. Prerequisite: graduate standing or consent of instructor.

3 units, Aut (Spreiter) TTh 2:45–4:00

256. Fluid Dynamics of Turbomachinery—Operation, theory and elements of the design of turbines, bladed pumps and compressors, windmills, propellers and other machines that perform by the dynamic interaction of a moving fluid with a bladed rotor. Emphasis to be placed on the problem of efficient exchange of energy between the fluid stream and the mechanical elements of the machine. Prerequisites: 251 and 255 or equivalents.

3 units, Spr (Johnston) TTh 8:35–9:50, alternate years, given 1976–77


3 units, Aut (Spreiter) TTh 2:45–4:00

258B. Fluid Dynamics—Continuation of 258A. Mathematical analysis of selected two- and three-dimensional flows and wave motions involving effects of compressibility, rotation, free-surfaces, and density stratification. Application to surface waves, acoustics, aerodynamics of thin wings and slender bodies at subsonic, transonic, and supersonic speeds, and selected geophysical and astrophysical phenomena.

3 units, Win (Spreiter) TTh 2:45–4:00

259. Viscous Flow—Analytic and numerical solutions of the full Navier-Stokes equations; flows at low Reynolds number; solution of the boundary-layer equations: self-similarity, series expansions and numerical integration, jets and wakes, separation, compressibility effects, unsteady motion; hydrodynamic stability and transition to turbulence.

3 units, given 1976–77

260. Geophysical Fluid Dynamics—Introduction to fluid flow and wave phenomena in the atmosphere, oceans, and interior of the Earth, in interplanetary space, and in the solar atmosphere. Effects of rotation, stratification, gravity, and electromagnetic forces. Application to general circulation, mountain lee waves, and Rossby waves in the atmosphere, surface and internal gravity waves and wind-driven circulation of the oceans, hydromagnetic dynamo processes in the liquid core, and solar-wind flow and waves in interplanetary space. Prerequisite: 258B.

3 units, Spr (Spreiter) TTh 2:45–4:00, given 1976–77

261. Turbulence—Introduction to the basic concepts of turbulence structure, kinematics, dynamics, with emphasis on shear flows and mixing processes.

3 units, Spr (Reynolds) MWF 2:15, alternate years, given 1976–77

262A. Physical Gas Dynamics—The fundamentals of high-speed, high-temperature flow of a gas from the molecular point of view; molecular concepts and simple kinetic theory; equilibrium properties of gases and gas mixtures as obtained from kinetic theory,
chemical thermodynamics, and statistical mechanics.

3 units, Aut (C. Kruger) MWF 10

262B. Physical Gas Dynamics — (Enroll in Aeronautics and Astronautics 211B.)

263. Introduction to Partially Ionized Gases — An introduction to the main microscopic concepts that enter into a description of partially ionized gases, and a discussion of how the macroscopic properties of gases may be calculated from a knowledge of the microscopic processes. Some of the topics covered include cross sections for collisional and radiative processes, reaction rates, recombination, velocity distribution functions, Rutherford scattering, Saha equation, principle of detailed balancing, transport coefficients of mixtures, electrical conductivity, plasmas, the Debye length, plasma frequency, sheaths. Familiarity with some of the material in 262A is desirable, but not necessary.

3 units, Win (Mitchner) MWF 11

264. The Physics of High-Temperature Gases — This is a one-quarter course especially designed for students with a conventional mechanical engineering background. It provides an introduction to some of the fundamental ideas in electromagnetic theory and in quantum mechanics. Emphasis is placed on the relationship of these ideas to atomic processes in high-temperature gases. Topics to be covered will include radiation from an accelerated charge, black body radiation, deficiencies of classical theory, de Broglie waves, the uncertainty principle, Schrödinger’s equation and its solutions. Prerequisite: familiarity with partial differential equations.

3 units, Spr (Mitchner) MWF 3:15, alternate years, given 1975–76


3 units, Spr (C. Kruger) MWF 3:15, alternate years, given 1976–77

266. Atmospheric and Space Physics — (Enroll in Aeronautics and Astronautics 227.)

267. Magnetofluidmechanics — Interaction of conducting fluids with electric and magnetic fields. MHD one-dimensional channel flow, boundary layers, power generation and fluid acceleration. Calculations of electrical conductivity of equilibrium and non-equilibrium partially ionized gases.

3 units, Spr (Mitchner) MWF 1:15

268A. Experimental Methods in the Thermosciences — Planning experimental programs, uncertainty analysis and the selection of instrument systems. Steady-state measurements of heat flux, temperature, pressure, and flow rate. Mean-velocity and mean-temperature measurements in the boundary layers. Advanced laboratory problems in heat transfer and fluid dynamics. Prerequisite: graduate standing or consent of instructor.

4 units, Spr (Moffat) MWF 10 plus one 3-hour lab. by arrangement

268B. Experimental Methods in the Thermosciences — Special topics in measurement techniques of the thermosciences. Transient temperature, pressure, and flow. Hot-wire anemometry in boundary layer studies. These topics will be studied analytically and experimentally. Planning research programs. Proposal writing, sources of funding, evaluation criteria. Budget estimation. Student teams will select an existing major technical paper and develop a plausible proposal, time schedule, budget and program which could have led to that research. Prerequisite: graduate standing or consent of the instructor.

3 units, Sum (Moffat) MWF 10 plus lab. or discussion period by arrangement

269. Computer Laboratory in Thermosciences — A “laboratory” supplement to the fluid mechanics and heat transfer sequences. Solution of ordinary differential equations and applications to self-similar flows. Solution of parabolic partial differential equations and application to boundary layer and related flows. Solution of elliptic equations and application to recirculating flows.
Established computer programs will be available for each aspect of the course; the students will have the opportunity to use them, modify parameters and modify the programs themselves. Prerequisites: 252B and familiarity with computer.

3 units, Sum (Ferziger) MWF 9

THERMODYNAMICS AND ENERGY CONVERSION

270A. Engineering Thermodynamics — Thermodynamic analysis of engineering systems including thermodynamics of gas mixtures, physical chemistry of combustion and thermodynamic bookkeeping methodology for mass, energy and entropy. Applications to internal combustion engines, power cycles, refrigerator cycles, compressors, turbines, heat exchangers, combustion chambers, cooling towers, etc. for performance predictions and the evaluation of losses (irreversibilities).

3 units, Aut (London) MWF 1:15

270B. Engineering Thermodynamics — A continuation of 270A including a critical review of the fundamental thermodynamic concepts and principles and a study of the current literature of thermodynamics.

3 units, Win (London) MWF 1:15

271. Combustion and Pollution — Thermo
dynamic analysis of chemically reacting systems. Adiabatic flame temperature, chemical composition of products of combustion, flame propagation. Production of pollutants in combustion systems. Kinetics of reactions, particularly with regard to emissions of oxides of nitrogen. Reduction of pollutant emissions by modification of combustion parameters. Application to combustion systems including internal combustion engines and power plants. Familiarity with some of the material in 262A is desirable, but not necessary.

3 units, Win (C. Kruger) MWF 2:15

273A. Thermodynamics of Propulsion Systems — Analysis of the performance of propulsion prime movers from thermodynamic and dynamic points of view including rocket, ramjet, turbojet, and fanjet systems as well as piston, gas turbine and compound piston-turbine type engines.

4 units, Aut (London) MWF 1:15 plus one hour by arrangement, given 1976–77

273B. Thermodynamics of Propulsion Systems — A continuation of 273A including the thermodynamics and kinetics of combustion reactions as applied to internal combustion engines of both the piston-cylinder and turbine types.

4 units, Spr (London) MWF 9 plus one hour by arrangement, given 1976–77

274. Coal Conversion Processes — Analysis of the reactions, processes and conditions for conversion of coal to synthetic natural gas, low BTU gas, liquid fuels and chemicals, solvent refined coal, and other products; coal pyrolysis and hydrogenation; chemical character of coal products, fundamental engineering challenges.

3 units, alternate years, given 1976–77


3 units, Spr (Ferziger) MWF 11

276. Nuclear Energy — A one-quarter course in the theory and design of nuclear energy systems: radioisotope heat sources, fission chain reactors and concepts of fusion reactors. The effects and the shielding of nuclear radiation emitted by these systems. Prerequisite: graduate standing (undergraduates enroll in Engineering 176).

3 units, Win (Connolly) MWF 11

277A. Nuclear Reactor Theory — Fundamentals of reactor analysis, including: the fission process; neutron-nuclear interactions and cross sections; infinite-medium criticality calculations for homogeneous systems; neutron slowing-down theory; one-group neutron diffusion theory; multi-group techniques for thermal and fast reactors; critical-
ity calculations for bare homogeneous reactors.

3 units, Aut (Sher) MWF 10

277B. Nuclear Reactor Theory — Continuation of 277A. Reflected reactors; heterogeneous reactors; resonance capture in homogeneous and heterogeneous reactors; point reactor kinetics, the inhour equation; poisoning and burn-up; control rods; perturbation theory. Prerequisites: 277A and concurrent registration in 200B or Mathematics 131.

3 units, Win (Sher) dhr

277C. Advanced Nuclear Reactor Theory—Neutron transport theory, the Boltzmann equation; approximation and numerical techniques for solving the Boltzmann equation; reactor shielding: analytic and semi-empirical methods; reactor stability and safety analysis. Prerequisite: 277B.

3 units, Spr (Sher) dhr

278. Nuclear Reactor Design — The development of a reactor design from a set of specifications. The synthesis of reactor theory, heat transfer, properties of materials, and economics, in reactor design. The use of digital computer codes in reactor design. Prerequisite: 277A or consent of instructor.

3 units, Spr (Connolly) TTh 11:00-12:15

279. Controlled Thermonuclear Fusion — The fusion reaction. Fundamentals of plasma physics as applied to plasma creation and containment in a fusion device. Experimental devices: pinch, mirror, stellerator, Tokamak. Concepts of fusion reactors and fusion-electric generators. Prerequisite: consent of instructor.

3 units, Spr (Staff) by arrangement, given 1975-76

BIOMECHANICS


3 units, Aut (Hayes) MW 4:15-5:30


3 units, Win (Hayes) MW 4:15-5:30

282. Special Problems in Orthopaedic Biomechanics — Multidisciplinary approach by engineers and orthopaedic surgeons to the analysis of orthopaedic procedures. Participants choose a subject of current interest, propose a research plan and then perform preliminary analyses and experimentation. Prerequisite: 281.

3 units, Spr (Hayes) by arrangement

283. Mechanics of Hearing — The unresolved question is—how do we hear? Attention is on the mechanical function of the middle and inner ear in the transformation of an acoustic signal into sound perception. Discussion of fundamental observations of von Békésy and various models for the elastic-fluid interaction in the inner ear, including the simple explanation of the basic basilar membrane motion. Possible mechanisms of neural excitation. Damage due to high intensity sound. Novel systems of hearing in echo-locating bats and dolphins, dinosaurs, and insects. Prerequisite: Aeronautics and Astronautics 135 or equivalent.

3 units, Win (Steele) MWF 11

284. Dynamics of Viscous Fluids and Suspensions—(Enroll in Aeronautics and Astronautics 209.)

285. Cardiovascular Dynamics and Respiration — (Enroll in Aeronautics and Astronautics 229.)

SPECIAL AREAS

287. Methods and Experiences in Engineering Education — Analysis of effective teaching in an engineering college. Theories of how people learn, use of media, when and how to lecture, self-paced learning, student and teacher evaluation, writing of instructional objectives. Emphasis will be on gaining experience and self-evaluation by such methods as practice teaching with videotape recording. Available to advanced graduate students from all disciplines with an interest in a college teaching career.

3 units, Win (Chilton) by arrangement
288. The Individual and Technology—This course is intended to be an intensive personal experience in which the participants’ career objectives and psychological orientation are compared with existing social values and conditions. The emphasis is on helping the individual to assess his role as a person and engineer in modern society. Stereotyped views of engineers and engineering are critically evaluated. The relevance of current political, social, and humanistic thought to technology is considered. Students are asked to do readings, participate in field trips, and complete a term project. Limited registration. Prerequisite: graduate standing or consent of instructor.

3 units, Win (Roth) F 1:15-4:05

289. The Social Impact of Technology and Science—(Enroll in Engineering 221.)

DIRECTED STUDY AND SEMINARS

290. Research Project Seminar—Review of work in a particular research program and presentations of other related work.

1 unit, any quarter (Staff) by arrangement

291. Engineering Problems — Directed study for graduate engineering students on subject of mutual interest to student and staff member. May be used to prepare for experimental research during a later quarter under 292. Student must find a faculty sponsor.

1 to 5 units, any quarter (Staff)

by arrangement

292. Experimental Investigation of Engineering Problems — Graduate engineering student may undertake experimental investigation under guidance of staff member. Previous work under 291 may be required to provide background for experimental program. Student must find a faculty sponsor.

1 to 5 units, any quarter (Staff)

by arrangement

293. Experiential Workshop in Design Education—Experiential and intellectual study of psychological influences on the design process: awareness, inhibition, repression, communication, and group dynamics. Prerequisite: advanced graduate standing in Design. (Concurrent with Engineering 2, Popledynamics Lab.)

1 unit, Aut, Win, Spr (Wilde)

T 1:15-5:05

294. Design Research Colloquium — Students, faculty, and visitors survey research results from design-related science and technology.

1 unit, Aut (Staff and Students) F 2:15

Win, Spr (Staff and Students)

M 2:15

295. Seminar in Solid Mechanics — Problems in all branches of solid mechanics. All Ph.D. candidates in solid mechanics are normally expected to attend.

1 unit, Aut, Win, Spr (Steele)

Th 4:15-5:30

296. Design Forum — Presentations, discussions, and happenings; matters of concern to entire Design community which do not fit into regular courses.

1 unit, Aut, Win, Spr (Staff and Students)

Th 4:15 plus one day-long Saturday retreat

297. Energy Policy Seminar — Weekly presentations and discussions on energy policy with emphasis on technological aspects. The status of various national programs for the advancement of energy technology will be reviewed. Views on the political, social and economic aspects of projects to which engineers devote their efforts will be presented. Prerequisite: graduate standing in engineering.

1 unit, Aut, Win, Spr (Connolly)

by arrangement

298. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)


2 to 15 units, any quarter (Staff)

by arrangement


2 to 15 units, any quarter (Staff)

by arrangement
The Department offers programs leading to the Master of Science and Doctor of Philosophy. Under the Graduate Division Special Ph.D. Programs, it is also possible to arrange a well-considered program that is a combination of Operations Research with some other departmental area. Some possibilities are either Computer Science, Statistics or Economics.

Among the many areas of operations research the Department has special competence in the following: applied probability; dynamic programming; inventory, queueing, and reliability theory; linear, nonlinear, and integer programming; and networks, graphs, and combinatorial theory.

Adequate office facilities are available for visiting scholars and doctoral students. In addition, the Department has its own library, remote-access computer terminal, minicomputer and plotter.

**Programs of Study**

**Bachelor of Science in Mathematical Sciences**

Although the Department of Operations Research does not have an undergraduate degree program in Operations Research, it participates with the Departments of Computer Science, Mathematics, and Statistics in a program leading to the degree of Bachelor of Science in Mathematical Sciences. See Program in Mathematical Sciences on page 536 of this Bulletin.

**Master of Science**

The program leading to the degree of Master of Science in Operations Research is designed to prepare individuals for high-level professional work in applying operations research. Thus, the emphasis is on providing a solid foundation for a life-long professional career involving the formulation, solution, and implementation of operations research models for analyzing complex systems problems in business or government.

In addition to the University’s basic requirement for the Master’s degree discussed in the section “Degrees” in this bulletin, a candidate is expected to complete an approved course program of 45 units. This program normally can be completed in one academic year (three academic quarters) of full-time work. A number of operations research workers in local industry also attend part-
time, taking one or two daytime classes per quarter, under the Honors Cooperative Program. Each student will normally fulfill the following requirements for the Master of Science degree:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Op. Res. 240</td>
<td>Linear Programming</td>
<td>3</td>
</tr>
<tr>
<td>Math. 113</td>
<td>Linear Algebra and Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>Math. 115*</td>
<td>Fundamental Concepts of Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 116</td>
<td>Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>Stat. 217</td>
<td>Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 218</td>
<td>Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 219</td>
<td>Statistical Inference</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 220</td>
<td>Statistical Inference</td>
<td>3</td>
</tr>
<tr>
<td>Electives from the offerings of the Department of Operations Research or from authorized courses in other departments</td>
<td>11</td>
<td></td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>45</strong></td>
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</tbody>
</table>

No thesis is required. A minimum grade point average of 2.75 is expected.

* Comp. Sci. 135 (or 137A) may be substituted with the permission of the student's adviser.

**Doctor of Philosophy**

The program leading to the degree of Doctor of Philosophy in Operations Research is directed to those primarily interested in a career of research and perhaps teaching in a university, business, or government position. Therefore, emphasis is given to the scientific foundations of operations research. In particular, the program is focused on:

1. the study of the abstract mathematical structure of models derived from real life situations such as allocation models of an enterprise or an economy, network flow models of transportation and communication systems, reliability models of complex engineering systems, queueing models of congestion, modeling and control of dynamical systems arising in physical, economic, or management contexts, discrete selection models for routing and pattern cutting, policy decisions for production and inventory control, and models for conflict resolution, and

2. the development of the mathematical theory, including the theory of optimization, necessary for the solution of these models. Examples of the applied mathematical disciplines studied include mathematical programming, dynamic programming, control of dynamic, stochastic systems, stochastic processes, network and combinatorial theory, reliability, queueing theory, inventory theory, and game theory.

Candidates for the Ph.D. in Operations Research will normally satisfy the course requirements shown below. An individual student in consultation with the adviser may make adjustments in the program to reflect his or her special interests.

1. Prerequisites: Mathematics 113, 115, 116; Statistics 116, 119, 120; Computer Science 106, Engineering-Economic Systems 212A.

In addition to the course requirements, the doctoral candidate must fulfill several University requirements, as described in the section "Degrees" in this bulletin. These include passing a University oral examination and completion of a dissertation which represents an original contribution to knowledge expressed in a satisfactory form. The Department of Operations Research also requires that the candidate have a reading knowledge of at least one foreign language and successfully complete a set of written comprehensive examinations.

A student performing satisfactorily in the Ph.D. program normally would be eligible to receive a Master of Science degree in Operations Research, if he or she so desires, after completing 45 units of course work.

**Fellowships and Assistantships**

Financial aid is available on a competitive basis for qualified doctoral candidates. This includes a number of fellowships as well as some research assistantships supported by departmental research grants and contracts. Although these research assistants work closely with the faculty on their research projects, they usually are able to take close to a full course load. Supplementary financial aid can sometimes be obtained by grad-
ing, assisting in special projects, or University loans.

All applicants for financial assistance are required to take the Aptitude Test and the Advanced Test (in the field of the applicant’s choosing) of the Graduate Record Examination.

Applications for fellowships and assistantships should be made to the Financial Aids Office by March 1.

COURSES

A. UNDERGRADUATE COURSES

The undergraduate offerings are Operations Research 50, 151, 152, 153 and 180. Operations Research 50 is an introductory course designed for students who wish to become familiar with the basic terminology and ideas of operations research without using any mathematics beyond high school algebra. Important socio-economic problems are analyzed using operations research methods. Operations Research 151 or 152, and 153 is a two-quarter introductory sequence which covers the basic concepts of operations research at a post-calculus level. Each technique presented is illustrated by examples drawn from a variety of fields where operations research has been applied. Operations Research 151 is similar to 152 except that it is aimed at the undergraduate student with more mathematical preparation.

50. Models and Applications of Operations Research in Society—Analysis of important socio-economic problems by methods of operations research. Problem areas include the environment, health, urban planning, and criminal justice systems. Intended for students in the social sciences or pre-engineering desiring a broad introduction to the potential role of operations research in modern society. (Graduate students enroll in 150.) Prerequisite: high school algebra.

3 units, Win (Hillier) MWF 10
Spr (Dantzig) MWF 10

150. Models and Applications of Operations Research in Society—Lectures same as 50, but a term paper is required.

3 units, Win (Hillier) MWF 10
Spr (Dantzig) MWF 10

151. Introduction to Operations Research I—Theory and computation of optimal selection of decisions under certainty with common or conflicting objectives. Linear programming (simplex method and dual theorem), network flows, dynamic programming, game theory (minimax theorem), nonlinear programming. Applications drawn from problems in pricing resources, production planning, inventory control, transportation, pollution control, taxation, personnel assignment, construction management, political tactics, equilibria of competitive economies, and financial management. (Graduate students enroll in 252.) Prerequisite: Mathematics 43 and 113 or consent of instructor.

3 units, Aut (Veinott) TTh 4:15–5:30

152. Introduction to Operations Research I—Same as 151 except that knowledge of Linear Algebra and Matrix Theory (Math 113) is not required. (Graduate students enroll in 252.) Prerequisite: Mathematics 43.

3 units, Win (Eaves) TTh 4:15–5:30

153. Introduction to Operations Research II—Introduction to stochastic models in operations research. Stochastic processes and their use in analysis of industrial problems. Emphasis on discrete and continuous time parameter Markov chains. Queueing theory, linear and dynamic programming under uncertainty, including the use of certainty equivalents with quadratic costs. (Graduate students enroll in 252.) Prerequisites: Statistics 40 or 110 or 116 or Mathematics 123.

3 units, Spr (Lieberman) MW 4:15–5:30

180. Applications of Operations Research—Applications of operations research to important problems arising in business, industry, government, and society will be discussed. Formulation and analysis of complex systems problems. Case studies. (Graduate students enroll in O.R. 280.) Prerequisites: O.R. 151 or 152, O.R. 153 (concurrently) or equivalent.

3 units, Spr (Eaves) MW 4:15–5:30
Sum (——) TTh 3:15–5:00

B. COURSES PRIMARILY FOR MASTER'S CANDIDATES AND GRADUATE STUDENTS IN OTHER DEPARTMENTS

These courses are all applications oriented. Operations Research 252 covers the basic concepts of operations research, and its purpose is to acquaint students from other disciplines with the techniques that may be
useful in their field. Operations Research 240, 250, 251 and 257 form a basic one-year course in operations research, aimed at students who desire a mathematical science professional career in business, government, or industry. Operations Research 245, 250, and 290 A,B form a group of elective courses covering a variety of specialized topics and applications.

240. Linear Programming—This course will survey linear programming, emphasizing standard model formulation, fundamental theorems, variations of the simplex method and parametric programming. The orientation is applied and directed to students who anticipate doing project work in government or industry which involves deterministic systems. Corequisite: Mathematics 113.

3 units, Aut (Chvátal) TTh 1:15-2:30
Sum (———) TTh 1:15-3:00


3 units, Win (Chvátal) TTh 2:45-4:00

250. Deterministic Models in Operations Research—Formulation, solution, and analysis of mathematical programming models in operations research, including those of integer programming, nonlinear programming, network flow theory, dynamic programming, and game theory. Prerequisite: 240.

3 units, Win (Cottle) TTh 4:15-5:30

251. Stochastic Models in Operations Research—This course is an introduction to stochastic modeling. The orientation is applied and directed to students who anticipate doing project work in government or industry which involves stochastic modeling. The course content will stress formulation, solution, and analysis of stochastic models in operations research. Topics covered will include queuing theory, inventory theory, Markov decision processes, dynamic programming, simulation, and reliability theory. Prerequisites: Statistics 116 and 218 (concurrently) or Mathematics 123 and 124 (concurrently).

3 units, Spr (Hillier) TTh 4:15-5:30
Sum (———) MW 1:15-3:00

252. Operations Research—A one-quarter introduction to techniques and models of operations research which may be useful in other fields. It is intended for students from other departments who have not had the equivalent of O.R. 152 and O.R. 153. Topics are similar to those of O.R. 152 and O.R. 153. Prerequisites or corequisites: calculus and Statistics 40 or 110 or 116.

4 units, Win (Jacobs) TTh 4:15-5:30
Sum (———) TTh 3:15-5:30

257. Simulation—Generation of uniform and non-uniform random numbers, discrete-event simulations, simulation languages, design of simulations, statistical analysis of the output of simulations, applications to modeling stochastic systems in computer science, engineering, and operations research. Prerequisites: a working knowledge of FORTRAN or ALGOL; Statistics 217 or Mathematics 124 or the equivalent.

3 units, Spr (———) TTh 2:45-4:00
Sum (———) MW 3:15-5:00

250. Applications of Operations Research—Same as O.R. 180. Prerequisites: O.R. 240, 250, 251 (concurrently) or equivalent.

3 units, Spr (Eaves) MW 4:15-5:30
Sum (———) TTh 3:15-5:00

290A,B. Projects in Operations Research—Case studies and field work. Seminar paper required. Students must enroll in both 290A and 290B to receive credit. Prerequisite: consent of instructor.

290A. 0 units, given 1976-77
290B. 3 units, given 1976-77

299. Independent Study—Intensive study of literature of special topics.

Any quarter (Staff) by arrangement

C. COURSES PRIMARILY FOR DOCTORAL STUDENTS

These advanced courses are concerned with the development of the mathematical theory of operations research.

314. Matrix Analysis and Inequalities—A study of various topics in matrix theory and inequalities having applications in computer science, operations research and statistics. The subjects covered will be chosen from the following list: matrix factorizations, patterned matrices, determinants, pivot theory, special classes of matrices, linear inequalities, matrix inequalities, mo-
ment inequalities, stochastic inequalities, condition number inequalities, unification of certain types of inequalities, extremal problems; integrals and functional equations with matrix argument. Prerequisites: Mathematics 102 or 113, and consent of instructor.

3 units, Aut (Cottle) MWF 9:00

340A. Mathematical Programming — Formulation of standard linear programming models, Simplex method and lexicographic resolution of degeneracy. Theory of polyhedral convex sets, linear inequality, alternative theorems, and duality. Matrix games. Variants of the simplex method including the dual simplex method, the revised simplex method with product form of the inverse, and parametric linear programming. Prerequisite: Mathematics 113 or consent of instructor.

3 units, Aut (Eaves) TTh 1:15-2:30

340B. Mathematical Programming — Introduction to large-scale linear programming, network programming, integer programming, quadratic programming, and linear complementarity. The decomposition principle and upper bounding methods. Techniques for solving transportation, transshipment, and distribution problems. Cutting plane and enumerative methods of integer programming. Unified treatment linear programming, quadratic programming, and bi-matrix game problems via linear complementarity theory and its pivotal methods. Prerequisites: 340A and Mathematics 115 or consent of instructor.

3 units, Win (Dantzig) TTh 1:15-2:30


3 units, Spr (Cottle) TTh 1:15-2:30

341. Large-Scale Systems in Mathematical Programming — Specializes the methods of 340. Development of efficient solution methods for optimizing special large-scale linear inequality systems such as those encountered in control theory, programming in a Markov chain, investment and economic planning, multi-commodity network flows, multi-item production and distribution models; and those that arise as a solution procedure for non-linear, integer, and stochastic programming problems. The decomposition principle, partitioning proposals, compact inverse schemes will be developed and applied to various special structures. The role of flexible computer languages to assist in the experimental development will be discussed. Prerequisite: 340B.

3 units, given 1976-77

344. Methods of Nonlinear Programming — This course is concerned with numerical procedures for solving nonlinear programming problems in finite-dimensional spaces. The algorithms studied will include the steepest descent method, Newton's method, the conjugate gradient method, David-Fletcher-Powell method, feasible direction methods, the gradient projection methods, the generalized reduced gradient method, penalty and barrier function methods, cutting plane methods and fixed point methods. Students will be encouraged to use the computer to gain acquaintance with the nonlinear programming problems and their solution. Prerequisite: 340C.

3 units, Aut (Veinott) TTh 11:00-12:15

348. Lattice Programming — A qualitative theory of optimization designed to predict the direction of change of optimal decisions resulting from altering problem parameters without computation. Partially ordered sets, semilattices, lattices, distributive lattices, completeness, interval topology, isotope selection, fixed points, sub* functions. Characterization of subadditive functions. Representation of subsemilattices, sublattices, and subjoin functions. Existence of isotope optimal solutions to extremal problems. Applications to inventory control, conjugate functions, duals of weighted distribution problems, project scheduling, approximation theory, substitutes and complements in network flows, consumer budgeting, statistical decisions. Prerequisite: Mathematics 115 and consent of instructor.

3 units, Win (Veinott) TTh 10:00-11:15

351. Dynamic Programming and Stochastic Control — Sequential decisions under uncertainty with emphasis on discrete-time Mar-

3 units, Spr (Veinott) TTh 9–11


3 units, Aut (Iglehart) TTh 2:15–3:30

356. Inventory Theory—Characterization and computation of optimal inventory policies for single and multi-item dynamic inventory models with convex or concave cost functions and known or uncertain requirements. Myopic policies. Bayes and minimax policies. Multi-echelon models. Prerequisites: 340C and 351, or consent of instructor.

3 units, Aut (Jacobs) TTh 8–10

358. Queueing Theory—Structure of queueing processes, limit theorems for single and multiple server queues in light and heavy traffic. Emphasis will be on non-parametric assumptions and classical limit theorems. Prerequisite: 359.

3 units, Win (Iglehart) TTh 2:45–4:00


3 units, Spr (Jacobs) TTh 8–10

360. Advanced Applied Probability—This course will cover basic topics in applied probability at the advanced probability (measure theoretic) level. Topics selected from renewal theory, random walks, functional limit theorems, diffusion processes, extremal processes, and point processes. Prerequisites: 359; Mathematics 230A,B, or Statistics 230A,B,C.

3 units, given 1976–77

363. Analysis of Competitive Strategies—(Enroll in Business 363.) This course extends the basic concepts and methods of decision analysis and noncooperative games to the analysis of competitive strategies under uncertainty.

4 units, Spr (Wilson) by arrangement

370. Seminar in Mathematical Programming—Advanced topics. Prerequisite: 340B.

3 units, given 1976–77

371. Seminar in Combinatorial Analysis and Integer Programming—Advanced topics.

3 units, given 1976–77

372. Seminar in Nonlinear Programming—Advanced topics. Prerequisite: 340C.

3 units, given 1976–77

375. Seminar in Network Theory—Advanced topics. Prerequisite: 345.

3 units, given 1976–77


3 units, Aut (Eaves) by arrangement

377. Seminar in Game Theory—Advanced topics.

3 units, given 1976–77

381. Seminar in Dynamic Programming—Advanced topics. Prerequisites: 351 and Mathematics 205A.

3 units, given 1976–77

384. Seminar in Applications of Point Processes.

3 units, given 1976–77

385. Seminar in Reliability Theory—Advanced topics. Prerequisite: 355.

3 units, given 1976–77

386. Seminar in Inventory Theory—Advanced topics.

3 units, given 1976–77

387. Seminar in Probabilistic Models—Advanced topics. Prerequisites: 359 and Mathematics 230A.

3 units, Spr (Jacobs) by arrangement

388. Seminar in Queueing Theory—Optimal design and control of queueing systems. Prerequisite: 358.

3 units, given 1976–77
389. Seminar in Applied Probability—Advanced topics. Prerequisite: 359 or consent of instructor.

3 units, Aut (Iglehart) TTh 9:00–11:00

390A, B. Advanced Topics in Operations Research. Two seminars will be offered, topics to be announced. Prerequisite: second-year graduate standing or consent of instructor.

390A. 3 units, Sum (——) by arrangement

390B. 3 units, Sum (——) by arrangement


Any quarter (Staff) by arrangement

468. Multi-Person Decision Theory—(Enroll in Business 468.) Subjects covered include methodology and applications of welfare economics; axiomatic theory of social choice, including revealed preference theory, Arrow's Possibility Theorem and related results; game-theoretic analysis of exchange, public goods, and voting processes.

4 units, Win (Wilson) by arrangement

469. Management Science Workshop—(Enroll in Business 469.)

4 units, Aut (——) by arrangement

Win (——) by arrangement

Spr (——) by arrangement
SCHOOL OF HUMANITIES AND SCIENCES

Dean: Halsey Royden
Associate Deans: Lewis W. Spitz, Arnice Streit
Assistant Deans: Sydney G. Burkhart, Sally S. Monfort

ORGANIZATION

The School of Humanities and Sciences includes all members with the rank of instructor or above of the Departments of Anthropology, Applied Physics, Art, Asian Languages, Biological Sciences, Chemistry, Classics, Communication, Computer Science, Drama, Economics, English, French and Italian, German Studies, History, Humanities Special Programs, Linguistics, Mathematics, Music, Philosophy, Physics, Political Science, Psychology, Religious Studies, Slavic Languages and Literatures, Sociology, Spanish and Portuguese, and Statistics.

Members of the School of Humanities and Sciences are listed under their respective departments, or under the staff for Special Interdepartmental Programs.

UNDERGRADUATE PROGRAMS

A student wishing to take a departmental major leading to the degree of Bachelor of Arts should consult appropriate sections of the announcements given on the following pages. Further information concerning requirements may be obtained from the department concerned.

A student desiring to fulfill the requirements for the degree of Bachelor of Arts or Bachelor of Science in one of the special interdepartmental programs (see Humanities Special Programs, Interdepartmental Major, Physical Sciences General Program, and Social Sciences Special Program in following sections of this bulletin) should consult the Director of Special Programs in the Humanities, the Dean of Undergraduate Studies, the Chairman of the General Program in the Physical Sciences, or the chairman of the interdepartmental program in the Social Sciences. For general statements of the requirements for the degree of Bachelor of Arts or Bachelor of Science in these programs, students should see appropriate sections of the announcements following.

The School of Humanities and Sciences offers several survey courses in Geography which are listed separately in this publication. It is not possible, however, for a student to elect Geography as a major or minor field.

GRADUATE PROGRAMS

Candidates for the degree of Master of Arts, Master of Science, or Doctor of Philosophy should consult appropriate sections of the announcements following and should also consult the department in which they intend to specialize.

For regional, area studies, or other special graduate programs leading to the degree of Doctor of Philosophy, see listing under Graduate Division Special Programs.

UNDERGRADUATE PROGRAM IN AFRICAN AND AFRO-AMERICAN STUDIES

Committee-in-Charge: Thom Rhue, Director, St. Clair Drake, Sr. Research Associate, David Abernethy, Frederick Bowser, Clay Carson, John Cochran, James Gibbs, J. Paul Irwin, Kennell Jackson, Tetteh Kofi, Bridget OLaughlin, Arnold Rampersad; Student Representative: Glenn Jordan

STATEMENT OF PURPOSE

This interdepartmental program is designed as a major sequence for students who
wish to increase their knowledge and understanding of what is sometimes referred to as "The Black Experience," combined with training in a traditional academic discipline. The focus is upon sub-Saharan Africa and those societies in the Western Hemisphere where peoples of African descent are a significant element in the population.

ADMISSION TO THE PROGRAM

Students interested in majoring should consult with the Program Director. Ordinarily, students should declare a major by the last quarter of the sophomore year.

REQUIREMENTS

A major involves 50 units of credit for a bachelor's degree in African and Afro-American Studies. Twenty-five of these will be in "core" courses, i.e. the Core Seminar and 20 units from departmental offerings. An additional twenty-five units are to be presented as "collateral" courses; and, normally, these will be earned in one department with which the student has chosen an affiliation. Majors in the Program may offer an African language, Hausa, Swahili, or Yoruba, for core course units.

The precise content of each student's program will be worked out in consultation with an adviser from the department with which he or she is affiliated. Majors in the Program may offer an African language, Hausa, Swahili, or Yoruba, for core course units.

In the senior year each student will write a substantial research paper or carry out a comparable project in consultation with his or her adviser. (Program requirements may change in Autumn quarter 1974.)

CORE COURSES

Courses are often offered by the Program. The student should consult the quarterly Time Schedule for these listings.

African and Afro-American Studies 101, Core Seminar, is offered during the Winter Quarter. Emphasis is upon recurrent themes in relations between peoples of Africa and populations of African descent in the New World since 1500 A.D. Concepts and methods used in studying the impact of the various segments of "The Black World" upon each other are examined by case analysis (e.g., Pan-African movements and cultural retentions and reinterpretations in religion, music, art, language, and social institutions). The seminar topic is "Dependency: Africa and the Americas" for 1975–76. Various faculty members from several departments will team teach the core seminar.

CORE COURSES OFFERED BY DEPARTMENTS

ANTHROPOLOGY

104. Race and Culture Contact in the Caribbean
    5 units, Spr (Drake) MWF

106. Racism and Power: Anthropological Perspectives
    5 units, Win (Drake) MWF 11

108. Peoples of Africa
    5 units, Win (O'Laughlin) MWF 10:00

109. African Systems of Production
    5 units (O'Laughlin) given 75–76

110. Urbanization in African Societies
    5 units, Aut (Drake) MWF 10:00

111. Myth and Ritual in Sub-Saharan Africa
    5 units, Spr (O'Laughlin) MWF 2:15

130. Seminar on Primitive Curers
    5 units, Aut (B. Paul) M 2:15-5:05

135. Racism and Power: Anthropological Perspectives
    5 units, Win (Drake) MW 11:00

147. Socio-Political Integration in Contemporary Africa
    5 units, Win (Drake) 2:15

267. Languages of Africa
    5 units, Win (Greenberg) TTh 4:15-6:05

126A,B,C. Black Performing Arts. Prerequisite Sophomore standing and consent of instructor (Cochran)

ECONOMICS

106. The World's Food Economy
    3 units, Aut (Johnson)

108A,B. Undergraduate Workshop in World Food Problems
    5 units, Win, Spr (Jones, Taylor)

109. An Introduction to Welfare Theory
    5 units, Spr (Scitovsky)

118. Economics of Underdevelopment — (Same as Economics 118.)
    5 units, Aut (Yotopoulos) MTWThF
ANTHROPOLOGY

127A, B. Economic Development Problems of Third World Economies with Colonial Heritage I and II
5 units, Win (Kofi)

160. Trade and Development Problems of Tropical Africa
3–5 units (Pearson)

ENGLISH

161. Afro-American Fiction
5 units, Win (Rampersad)

261B. Afro-American Poetry
5 units, Aut (Rampersad)

HISTORY

147. Kingdoms of Africa: Society and History
5 units, Spr (Jackson) MTWTh

148A. The History of West Africa
5 units, Aut (Irwin) MTWTh 1

148B. Colonial Africa
4 units (Irwin) given 1976–77

162A, B. Urban History of the United States
5 units, Aut, Win (Carson) MTWTh 9

182. Latin America and the African
4–5 units, Win (Bowser) MTWTh 10

LINGUISTICS

185A, B, C. Beginning Hausa
5 units, Win, Spr (Leben) MTWThF 12

186A, B, C. Intermediate Hausa
Aut, Win, Spr (Staff) by arrangement

190A, B, C. Beginning Swahili
5 units, Aut, Win, Spr (Staff)

191A, B, C. Intermediate Swahili
5 units, Aut, Win, Spr (Staff)

193A, B, C. Beginning Yoruba
5 units, Aut, Win, Spr (Kaufman)

POLITICAL SCIENCE

118A. Government and Politics in Tropical Africa
5 units, Aut (Abernethy) MWF 9

118B. Government and Politics in Southern Africa
5 units, Win (Abernethy) MWF 9

131C. International Dependency
5 units, Spr (Abernethy) MWF 10

SOCIOLGY

160. Ethnic Relations in Modern Society
3–5 units, Win (Olsen) MWF 9

ANTHROPOLOGY

Chairperson: Frank Cancian


Associate Professors: Harumi Befu, George A. Collier, Arthur P. Wolf

Assistant Professors: Jane F. Collier, James A. Fox, M. Bridget O’Laughlin, Michelle
SCHOOL OF HUMANITIES AND SCIENCES

Z. Rosaldo (on leave 1975-76), Renato I. Rosaldo, Jr. (on leave 1975-76), Sylvia Yanagisako, Ezra B. W. Zubrow
Visiting: Robert A. Paul
Lecturers: Suzanne Chevalier-Skolnikoff (Spring quarter), Louise S. Spindler

OFFERINGS AND FACILITIES

The courses offered by this department are designed (1) to provide undergraduate students with instruction in anthropology, a discipline treating man from the broad viewpoints of biological heritage, culture, society, and personality; (2) to provide undergraduate majors in anthropology with a program of work leading to the Bachelor's degree; and (3) to prepare candidates for advanced degrees in the discipline.

PROGRAMS OF STUDY

BACHELOR OF ARTS

There are three different undergraduate programs leading to the Bachelor of Arts degree with a concentration in Anthropology. General requirements for all majors are as follows:

Students wishing to declare a major in Anthropology must apply to the Department's Committee on Undergraduate Studies. The Committee will appoint an advisor with whom the student will plan a program of courses that satisfies the requirements for the major and meets the needs and interests of the students. The department maintains a file for each majoring student, which documents progress toward fulfillment of degree requirements. It is the individual student's responsibility to make certain that these records are kept up to date.

All majors are required to have or attain a reading competence in a modern foreign language. Such competence is usually demonstrated by completing a course on the second-year level, but the requirement may be met by certification in writing from the language department involved that the student has demonstrated a reading proficiency in a foreign language, by presentation of superior S.A.T., G.R.E., or foreign language placement scores, or by special examination.

In the course work that is to count for the Anthropology degree requirements, only 5 units may be taken for pass/no credit grading; the remaining required units must be taken for letter-grading.

Major in Anthropology. For the regular Bachelor's degree in Anthropology, 45 units of course work are required. Five units of course work in either Psychology or Sociology may be counted toward the major. The remaining 40 units must be in Anthropology and must include Anthropology 90. To obtain a balanced view of the field, students are required to take at least one course in each of the following topical categories: (a) Area Studies 100–129, 200–229; (b) Social and Cultural Anthropology, 1, 2, 6, 7, 8, 9, 130–169, 230–269; (c) Linguistic Anthropology 3, 170–179, 270–279; (d) Archaeology and Biological Anthropology 4, 5, 180–189, 280–289. Undergraduate majors who have completed prerequisites are encouraged to take 100- and 200-level seminars. Undergraduates may also take part in field work on local archaeological sites (Anthropology 183, 191), obtain training in museum methods by doing directed research relating to the Stanford anthropological collections (Anthropology 195), or apply for summer funds to support field research in social anthropology.

Honors Program in Anthropology. The Honors Program in Anthropology is open to all majors who have a 3.5 grade point average in Anthropology courses, and who wish to pursue a program of independent research culminating in an honors thesis in their senior year. Candidates of sophomore or junior standing should apply for admission to the Honors Program with the department's Committee on Undergraduate Studies no later than the end of the fourth week of the spring quarter. The application should include a transcript, a short paper, and a letter of recommendation from the professor who will supervise the honors project. Students who do not meet these requirements in full but who nonetheless wish to be considered for admission to the honors program should petition the Committee on Undergraduate Studies for special consideration. Successful applicants will meet on a regular basis with their advisors and will be required to attend a noncredit seminar on research methods during the autumn quarter of their senior year. The completed honors thesis must be presented to the student's honors advisor no later than four weeks prior to the end of the quarter in which graduation is anticipated.

For the Bachelor's degree in the Honors
Program, 50 units of course work are required. Ten units of course work in either psychology or sociology may be counted toward the major. The remaining 40 units must be in Anthropology, fulfilling the distribution requirements for the regular major, and including at least 5 units of Anthropology 95. Students wishing to write an honors thesis without following the above program may petition for special consideration to the department's Committee on Undergraduate Studies. This petition must be supported by a faculty member who agrees to supervise the writing of the honors thesis and who accepts responsibility for finding a second reader for the thesis.

Major in Social Sciences (Anthropology). The major in Anthropology who is interested in pursuing an approved program of interdisciplinary study in the social sciences may wish to declare for the Bachelor's degree in "Social Sciences (Anthropology)." To do so the student must declare for this program no later than the beginning of the winter quarter of his/her junior year.

For the Bachelor's degree in Social Sciences (Anthropology), 50 units of course work are required. Thirty units must be Anthropology and must include Anthropology 90. The remaining 20 units must be selected in consultation with the advisor from the course offerings of one or more other departments in the social sciences (Communication, Economics, Political Science, Psychology, Sociology) and, with special arrangements, Linguistics.

Students wishing to combine concentration in anthropology with an interdisciplinary interest not represented by a field in the social sciences (e.g., Classics) are advised to arrange for a special major in the University's Program for individually designed majors.

Advanced Degrees

Prospective graduate students should apply formally through the Graduate Admissions Office, which will transmit their dossiers to the department for consideration when application requirements have been completed.

An applicant for admission to graduate work must file a report of his or her scores on the Aptitude Test of the Graduate Record Examination. This examination may be taken at most American universities (see your Registrar for further information). Applicants who do not have access to testing centers should write well in advance, either to the department or directly to the Educational Testing Service, Box 955, Princeton, New Jersey 08540, concerning possible arrangements.

The Department of Anthropology offers the Master of Arts and the Doctor of Philosophy degrees. The A.M. degree is normally granted as a step toward eventual fulfillment of requirements for the Ph.D. degree. Ordinarily the Department will not admit students who wish to work only toward the A.M. degree unless they are enrolled in a Ph.D. or M.D. program in another division of the University.

Master of Arts

The requirements for the A.M. degree consist of residence at Stanford University as a graduate student for one year, with a minimum of 45 quarter units in anthropology with a grade of B or better in each course, and additional graduate or undergraduate course work in anthropology or a discipline in which the student is a doctoral candidate. Specific requirements will be determined by the department depending on the student's program.

Anthropology Minor

The requirements for a Minor in Anthropology are the same as those for the A.M. as described in the preceding section.

Doctor of Philosophy

The Ph.D. degree is earned by fulfilling the following requirements:
1. Pass during the first year, at an acceptable graduate level, four of the courses designated as "core courses" by the faculty.
2. Submit an acceptable, substantial research paper in the spring quarter of the first year.
3. Gain teaching experience by serving as a teaching apprentice during one quarter of graduate work, normally during the second year.
4. By the end of the second year pass, at a satisfactory graduate level, four courses distributed in at least two of the following areas: Archaeology, Biological Anthropology, Linguistics, Statistics.
5. Pass, by the end of the second year of
graduate study, an examination in a foreign language in which there exists a substantial body of literature relevant to the student's program of study.

6. Pass a Special Examination (written and oral), normally given during the spring quarter of the second year or the autumn quarter of the third year, covering the candidate's major topic of specialization and one major ethnological area of the world. The oral part of this examination is normally taken as the University Oral.

7. Prepare a dissertation proposal to be approved by the student's dissertation committee before undertaking doctoral research.

8. Present an approved dissertation based upon independent research.

**FINANCIAL SUPPORT**

The Department endeavors to provide financial support (tuition plus scholarship) when needed, to anyone admitted as a graduate student and maintaining a satisfactory level of graduate work.

**COURSES OPEN TO ALL STUDENTS**

1A. Introduction to Cultural Anthropology

-An introduction to social and cultural anthropology, including the assumptions underlying various approaches, the interaction between man's institutions and his biological characteristics, and the relation of language to culture.

- 5 units, Aut (Wolf) MTWThF 1:15
- 5 units, Win (G. and L. Spindler) MTWThF 1:15

1B. Introduction to Cultural Anthropology

-The major viewpoints which anthropology contributes to the understanding of man and his behavior, with focus on the range of diversity in human culture and societies as well as the common features which underlie that diversity. Attention to anthropological assumptions, concepts and methods in order to acquaint the student with the types of analyses of cultural and social institutions which are done by anthropologists and to provide him or her with some opportunity to attempt such analyses himself or herself. Provides the student with perspective on his or her own culture and her or his ethnocentrism. Entering students may enroll for additional credit in a special section taught by the instructor. Contact the Program of Seminars for Entering Students.

- 5 units, Spr (Gibbs) MTWThF 9


- 5 units, Aut (Greenberg, et al.) MWF 10

4. Great Sites and Lost Peoples—This is an introductory examination of the discipline of archaeology. It considers theory, methodology, and data in the context of the discovery of famous prehistoric sites and cultures as well as the romantic element in archaeology.

- 5 units, Spr (Zubrow) MWF 10

5. The Development of Man—Human evolution; early man; racial and other differences in modern man; early development and differentiation of culture. Introduction to physical anthropology and prehistory.

- 5 units, Win (Gerow) MWF 10

6. Racism and Power: Anthropological Perspectives—Distinction between the use of the concept of race in physical anthropology and its use as a social category; the functions of racism as distinguished from ethnocentrism within various types of social systems; the historical role of anthropology in research and social action related to racism and its consequences.

- 5 units, Win (Drake) MWF 11

7. Marriage and the Family—An analysis of the nature of marriage and the family in selected societies.

- 5 units, Spr (Wolf) MWF 11

8. Anthropological Perspectives on American Culture—Areas of convergence and divergence in values, life styles, and psychocultural attributes are analyzed for mainstream, minority, and variant cultural patterns in United States society. Processes of boundary maintenance and identity reference are discussed. Current social movements are placed in the perspective of counter-culturalism, liminality, and cultural
change. Field studies of relevant phenomena will be encouraged.

5 units, Spr (G. and L. Spindler)
MWF 1:15

9. Women in Cross-cultural Perspective—
(Same as Modern Thought and Literature 248.) A lecture course on various traditional anthropological concerns as these are illuminated by a study of the position and behavior of women. Topics include: the place of women in kinship, political, economic, and ritual systems.

5 units, Aut (J. Collier) MWF 11

UNDERGRADUATE AND GRADUATE COURSES

SPECIAL OFFERINGS FOR MAJORS

90. Theory in Social Anthropology—Lecture course designed as an overview of anthropological theory for undergraduate majors. Key controversies in anthropology will be discussed as a way of understanding divergent approaches to the analysis of culture and society. Special attention will be given to the relation between theory and method in anthropological traditions of investigation.

5 units, Win (O'Loughlin) TTh 9–10:15

95. Honors Program—Directed independent study and honors thesis work for students admitted to this program.

Any quarter (Staff) by arrangement

96. Directed Individual Study—For undergraduate students with special needs, and showing capacity to do independent work. Prerequisite: 1 or consent of instructor.

Any quarter (Staff) by arrangement

98. Seminar on Selected Topics—Normally open to anthropology majors.

5 units (Staff) given 1975–76

AREA STUDIES

102. Natives of North America—Focus on the history, cultural background, and contemporary situation of major tribes and groups in North America. (Graduate students enroll in 302.)

5 units (Staff) given 1976–77

103. Peoples of Mesoamerica—Lecture course surveying the cultural development culminating in the high preconquest civilizations of Mexico and Guatemala, and tracing postconquest changes in Indian peasant traditions. Emphasis falls on the broader contexts of Mesoamerican society since the time of the Spanish conquest. Not open to those who have completed 105A,B.

5 units, Spr (G. Collier) MWF 11

105A,B. Peoples of Latin America—Survey of cultural development culminating in high preconquest civilizations of Mesoamerica and South America. Tracing postconquest continuities and changes in indigenous cultures. Consideration of broader contexts of Latin American society since Spanish conquest and significance of regional variations. Credit offered only for two-quarter continuous enrollment.

5 units (G. Collier and R. Rosaldo)
given 1976–77

107. Race and Culture Contact in the Caribbean—Lecture course on types of social systems and cultural patterns in the West Indies arising from relations between Europeans, West Africans, and Asians, with implications for development and social change. (Graduate students enroll in 307.)

5 units, Spr (Drake) MWF 1:15

108. Peoples of Africa—An introduction to the ethnography, languages and prehistory of sub-Saharan Africa; special attention will be given to the analyses of problems in the African literature which have led to theoretical advances within social anthropology.

5 units, Aut (O'Loughlin) MWF 9

109. Seminar in African Systems of Production—The interrelationship of environment, technology, historical processes and the social organization of production in selected societies of rural sub-Saharan Africa. (Graduate students enroll in 309.)

5 units, Win (O'Loughlin) TTh 2:15–4:05

111. Seminar on Socio-political Integration in Contemporary Africa—"Westernization" and "Modernization" as specific forms of the acculturation process; neocolonialism and decolonization since World War II; civilian and military elites in the resolution of conflicts arising from shifts in power, authority, and legitimacy, and from the continuing viability of ethnic and kin loyalties as well as traditional political structures. (Graduate students enroll in 311.)

5 units, Spr (Drake) M 2:15–5:00

113. Peoples of the Pacific—Ethnology of
the Malayo-Polynesian speaking world focusing on linguistics, ecology, social structure, and cultural history. Emphasis on the importance of this area to a variety of general problems in anthropological theory. Prerequisite: 1 or consent of instructor.

5 units (Frake) given 1976–77

115. Peoples of Island Southeast Asia—A survey of history and the contemporary situation of ethnic peoples in Indonesia, the Philippines, Madagascar, and portions of Malaysia. Among topics discussed are: prehistory, the process and impact of colonization, the contrast between hill and valley peoples, subsistence modes, social organization, and religion.

5 units, Win (R. Paul) MWF 11

117. Traditional Chinese Society—Course of lectures which analyzes the society, culture, polity, and economy of late traditional China as a total system. Secondary attention is given to the nature of premodern social change. Prerequisite: 1 or Sociology 1 or 3 or consent of instructor.

5 units (Skinner) given 1976–77

118. Communist Chinese Society—An examination of social and cultural change and political and economic development in the People’s Republic of China in light of current social-science theory. Prerequisite: 117.

5 units, Aut (Befu) MWF 11

120. Religion and the Family in China—Lecture course analyzing family life and religion in traditional and Communist China. The analysis is presented as an example of anthropological interpretation, and attention is given to the theoretical implications of the Chinese case.

5 units, Win (Wolf) MWF 10

121. Japanese Society and Culture—Racial, cultural, social characteristics, and background. Relationships between the Japanese and other peoples of East Asia. Opportunities for reading in special subject areas. Prerequisite: 1 or consent of instructor.

5 units, Aut (Befu) MWF 11

123. Seminar on Japan—Analysis of, and research on, selected topics on Japan, such as kinship, modernization, industrial organization, demography, urbanization, sociolinguistics, non-verbal communication. Emphasis on comparison with other cultures. Prerequisite: 121.

5 units (Befu) given 1976–77

127. Ethnography of Italy and the Mediterranean—Comparative study of rural society and cultures of Mediterranean Europe: Italy, Greece, Spain and Portugal. Consideration of family, kinship and forms of land tenure; relation of peasants to community and region. Special attention paid to urban-rural relations in Italy and Greece; the effects of migration on sending and receiving areas.

5 units (Siegel) given 1976–77

SOCIAL AND CULTURAL ANTHROPOLOGY

130. Seminar on Primitive Curers—Primarily for advanced anthropology majors and anthropology graduates, centering on the recruitment and performance of such ritual specialists as shamans, medicine men, midwives, bonesetters, spirit mediums, and diviners, and on the nature of their supernatural powers. Initially instructor will present Mayan Indian case material; thereafter participants will discuss readings and plans for individual term papers. Limited enrollment. Prerequisite: consent of instructor.

(Graduate students enroll in 330.)

5 units, Aut (B. Paul) M 2:15–5:05

132. Modernization, Development, and Population—This lecture course will review concepts of “modernization” and “development” from an anthropological stance, seeking non-ethnocentric formulations appropriate to each concept. Anthropological models of modernization and development will be compared with those from other social science disciplines. Various ethical issues will be examined, such as those of growth maximization versus equity, central versus local control, and short-term versus long-term benefits. One module of the course is designed to familiarize the student with the relevance of rapid population growth to modernization and development; in this module a computer-interactive learning technique (requiring no previous computer experience) will be employed. Case study materials (with some emphasis upon Japan and Thailand) will illuminate various processes of modernization and development—planned and unplanned, successful and otherwise. Prerequisite: declared major in any social science or history, or consent of instructor. (Graduate students enroll in 332.)

5 units, Aut (Textor) TTh 2:15–4:05
134. Art and Culture—This course offers an anthropological approach to aesthetic visual phenomena. First, it is concerned with the elaboration of a cross cultural notion of the aesthetic response of a subject to an object. Second, aesthetic phenomena are analyzed as cultural: their integration in a cultural system and their relationships with other elements of the system are considered. The empirical validation of hypotheses is stressed.

5 units, Spr (Maquet) dhr to be arranged

135. Cultural Dynamics—Interrelations between cultural, social, psychological processes; innovation, group responses to stress, social and cultural transformations, social implications of economic and political development. Prerequisite: 1 or consent of instructor.

5 units (Siegel) given 1976-77

136. Culture Change — Long and short range processes and theories of sociocultural growth and change, including cultural evolution, diffusion, syncretism, acculturation (culture contact), and directed culture change, with illustrative examples drawn from Mesoamerica and other culture areas. Prerequisite: 1 or consent of instructor.

5 units (Staff) given 1976-77

137. Applied Anthropology — Anthropologists have been called upon to apply their knowledge and skills in a variety of situations, including: establishing American Indian claims to land; developing and evaluating medical care delivery systems and educational programs at home and abroad; assisting in the transmission of technological innovations and measuring their impact; and serving as administrators and advisors for community development programs. The course addresses itself to the substance of such programs, the potential utility of anthropological findings and techniques in solving contemporary problems, the limitations of both findings and methods for these purposes, and the ethics of professional practice.

5 units, Aut (Barnett) MWF 11

139. Seminar on Ethnic Boundaries—Seminar investigating the nature of ethnicity, the mechanisms of ethnic boundary maintenance, and the role of ethnic groups in social, cultural, and ecological systems.

5 units (Frake) given 1976-77

140. Seminar on Social Stratification—Systems of social and economic inequality in small communities in comparative perspective. Attention will be given to egalitarian societies. Prerequisite: four or five courses in anthropology and/or sociology. (Graduate students enroll in 340.)

5 units, Aut (Cancian) TTh 9-10:15

141. Comparative Social Systems — Lectures and discussion to provide a common framework for comparative analysis of societies involving the interrelationship of resources, technology, and social systems in adaptation to environmental constraints and opportunities. An examination of case materials from film, lectures and reading on societies of increasing degree of scale (population size, density and differentiation) in the anthropological literature.

5 units (Siegel) given 1976-77

143. Kinship and Social Organization — Analysis of interpersonal and group relations in terms of kinship, cultural notions of marriage, parenthood, the family, and intergroup principles of alliance and enmity.

5 units, Win (Befu) MWF 11

146. Urban Anthropology—(Same as Sociology 253.) Lecture course introducing students to anthropological approaches to urban phenomena. Sociological, demographic, and geographical conceptions of the city as well as anthropological contributions to the understanding of urbanization and urbanism will be critically reviewed. Current theoretical and methodological issues of urban research will be explored. The interrelationship of urban phenomena with demographic, cultural, and economic factors will be investigated. Prerequisite: 1 or consent of instructor.

5 units, Win (Yanagisako) MWF 1:15

152. Symbolic Anthropology—The past and current trends in the analyses of symbolism and symbolic action in primitive ritual, myth, and social organization. General theories of the symbolic process will be covered as well as particular methods of analyses and interpretation.

5 units, Aut (R. Paul) MWF 10

153. Anthropological Approaches to the Study of Religion—(Same as Modern Thought and Literature 249.) An examination of religious symbolism, belief and prac-
tice in light of major social science theories of religion.
5 units (Staff) given 1976–77

154. Mythology and Folklore—Anthropological contributions to understanding these fields of human activity; comparisons with Western literature.
5 units (Gerow) given 1976–77

155. Political Anthropology — A lecture course reviewing findings of anthropologists about politics in primitive, historical and developing societies. Critical examination of alternative approaches to political anthropology, comparative analysis of political systems in these societies, and consideration of the relevance of anthropology to contemporary politics. Prerequisite: 1 or consent of instructor.
5 units, Win, Spr (J. Collier) to be arranged

156. Anthropology of Law — Theories of law, social control and conflict resolution set in ethnographic perspective. Prerequisite: consent of instructor.
5 units, Win, Spr (J. Collier) to be arranged

158. Seminar on Anthropology and Demography—Devoted to the relationship between family organization and population trends, including the problems involved in determining the frequency of various forms of marriage, adoption, and the quantitative characteristics of the family cycle. Special attention will be given to the Chinese, Japanese, and premodern Western European cases. Limited enrollment. Prerequisite: 168 or consent of instructor. (Graduate students enroll in 369.)
5 units, Spr (Barnett) W 2:15–5:05

160. Seminar in Advanced Medical Anthropology—Devoted to examination in depth of selected research problems requiring medical and behavioral science collaboration. Prerequisite: 168 or consent of instructor. (Graduate students enroll in 369.)
5 units, Spr (Barnett) W 2:15–5:05

LINGUISTIC ANTHROPOLOGY

5 units, Win (Fox) MWF 10

171A. Linguistic Field Methods I—(Same as Linguistics 175A.) Rapid introduction to descriptive phonetics, and to principles of
phonetic transcription and phonological analysis. Applications to the descriptive analysis of one or more languages, eliciting data in class from native speakers. Limited enrollment. May but need not be followed by Linguistic Field Methods II. Prerequisite: introductory course in linguistics or consent of instructor. (Graduate students enroll in 371A.)
5 units (Fox) given 1976-77

171B. Linguistic Field Methods II—(Same as Linguistics 175B.) Rapid review of principles of grammatical analysis: word-morphology and syntax. Introduction to correlative problems in semantic analysis and lexicographic compilation. Application to data elicited in class from native speakers. Limited enrollment. Prerequisite: Linguistic Field Methods I or equivalent satisfactory to instructor. (Graduate students enroll in 371B.)
5 units (Fox) given 1976-77

172. History of Linguistic Theories—(Same as Linguistics 114.) Historical survey of ancient, medieval, and modern theories of language mainly in the Western tradition but including medieval Arab and Jewish contributions. (Graduates enroll in 372.)
5 units, Spr (Greenberg) dhr to be arranged

173. Language and Social Interaction — (Same as Linguistics 247.) Seminar on examining ways in which people use language to signal and create social identities, relationships and meanings. We will explore a number of topics on sociolinguistics, linguistic theory, and the philosophy of language (especially the study of speech acts and performatives) in asking how language shapes and is shaped by the contexts of language use. (Graduate students enroll in 373.)
5 units (Staff) given 1976-77

174. Typology and Universals of Language —(Same as Linguistics 208.) The methodology of structural comparisons of languages; the connection between typological analyses and generalizations about language; universals of language in phonology, grammar, and semantics; problems concerning deductive explanation of universals. Limited enrollment. Prerequisite: elementary linguistic course or consent of instructor. Seminar.
5 units (Greenberg) given 1976-77

5 units, Aut (Fox) MWF 9

176. Cognitive Anthropology — Investigation of the relation between cognitive process and cultural behavior. Selected topics from the fields of perception, language, and belief will be considered. Prerequisite: 1 or consent of instructor.
5 units (Frake) given 1976-77

177. Spoken Quiche Maya—(Same as Linguistics 182.) Introduction to the language of the Quiche Maya Indians of Guatemala. Full set of tapes and textbook available.
5 units, Aut (Fox) given 1976-77
5 units, Win (Fox) given 1976-77
5 units, Spr (Fox) given 1976-77

178. Spoken Yucatec Maya—(Same as Linguistics 183.) Introduction to the language of the Yucatec Maya Indians of Mexico. Full set of tapes and textbook available.
5 units, Aut (Fox) MTWThF by arrangement
5 units, Win (Fox) MTWThF by arrangement
5 units, Spr (Fox) MTWThF by arrangement

179. Seminar on Mayan Hieroglyphic Writing—Mayan paleography and epigraphy. Grammatical outline of Colonial Yucatec Maya. Principles of decipherment. Decipherment project. Implications of current progress in decipherment for Mayan culture and language history. No prerequisites, but Anthropology 175 and 178, or equivalent, would be helpful.
5 units, Spr (Fox) M 2:15-5:05

ARCHAEOLOGY AND BIOLOGICAL ANTHROPOLOGY

181. Prehistoric Archaeology of the Old World—Lecture on the methods, findings in this field; correlations of prehistory of Europe and Near East with that of other zones over the world. Prerequisite: 5 or consent of instructor.
5 units, Spr (Gerow) MWF 11

182. Prehistoric Archaeology of the New World—This course is a survey of the known
prehistoric cultural record in terms of both
time-space systematics and models for cul-
tural change and growth. It will attempt to
assess the adequacy of the models in terms
of comparative data from various cultural
areas in both North and South America.

5 units, Aut (Zubrow) MWF 10

183. Geological Archaeology — (Same as
Applied Earth Sciences 178.) This course ex-
ploring the relationship between a wide vari-
ety of archaeological and geological topics
through informal classes, geological and
archaeological field trips, and the examina-
tion of specific problems through a “clinical
hands on” approach. Some broad areas of
discussion will be: the comparative history,
content, and methodology of geology and
archaeology; problems in cultural and en-
vironmental interpretation; an examination of archaeological data and geochronology;
methods of geophysical and archaeological
exploration; application of statistical an-
alysis to archaeological and geological prob-
lems. The course includes guest lectures
from the geological and archaeological sci-
ences.

5 units, Spr (Zubrow) TTh 3:15-5:05
Lab and Field trips to be arranged

184. Prehistoric Peoples of California — A
review of the major available literature in
terms of methods, techniques and models of
interpreting the life styles of the aboriginal
inhabitants of the California culture area
and their adaptations to diverse local en-
vironments. Such problems as dietary an-
alysis, skeletal analysis and grave-lot analy-
ysis will be viewed with the space-time con-
tinuum of 7000 years. Relationships with
adjoining culture areas (Great Basin, North-
west Coast, Southwest) and with the pres-
ent-day Indians of California will be ex-
plored. Enrollment limited to about 15
students with previous archaeological
coursework or experience, or consent of the
instructor.

5 units (Geroto) given 1976-77

185. Evolution of Primate Behavior—Intro-
duction to evolutionary theory, including
such concepts as population, variation,
genetics, the forces of evolution and adap-
tation, and the process of speciation. Brief
survey of the fossil record. Classification,
distribution, and general behavioral adapta-
tions of the major groups of contemporary
primates. Primate dispersal patterns and
their relevance to the evolution of human
behavior.

5 units, Spr (Skolnikoff) TTh 1:15-3:05

187. The Nature and Origins of Sex Differ-
ences—(Same as Human Biology 175.) This
course will combine biological, psychologi-
cal and cultural perspectives on the devel-
opment of sex differences. Included will be
a review and discussion of: (a) the course
of biological differentiation, (b) the nature
and possible origins of sex differences in
psychological functioning, (c) how sex dif-
fences develop in various cultural settings.

5 units, Spr (J. Collier, Davidson and
Maccoby) to be arranged

RESEARCH METHODS

190. Statistical Methods — Introduction to
theory and use of parametric and nonpara-
metric statistics with special emphasis on
applications in anthropology. Open to De-
partmental majors in their senior year and
to anthropology graduate students. Con-
tinuous enrollment through autumn and
winter quarters required for credit.

A. 5 units, Win (G. Collier) MWF 9
B. 5 units, Spr (G. Collier) MWF 9

191. Archaeological Field Methods—Stud-
ies, excavations of local archaeological sites,
and related work in the department archaeo-
logical laboratory. Prerequisite: 5 or consent
of instructor.

4 units (Staff) by arrangement

192. Anthropological Research Methods
with Implications for Education—(Same as
Education 254.) This course will devote pri-
mary attention to ethnographic methods and
techniques, such as the collection of gene-
alogies and life histories, the interviewing of
key informants in depth, various forms of
participant observation and the coordina-
tions of such ethnographic approaches with
more structured approaches. Students will
participate in role-playing or other simu-
lated field situations designed to develop
empathy and sensitivity. Where appropriate,
students are encouraged to collect and
analyze their own field data, or carry out
analyses of available live data. Open to all
graduate students, and to juniors and seniors
with consent of instructor. (Graduate stu-
dents enroll in 392.)

3 to 5 units, Win (Textor) Th 7-10 p.m.
193. Seminar on Methods of Research on the Local Community — The course focuses on theoretical comprehension of, and practical experience with, problems and techniques of anthropological field research. Participants will be expected to carry out a project of anthropological field research within the greater Bay area. Enrollment limited. Prerequisite: consent of instructor.

5 units, Aut (Yanagisako) W 2:15–5:05

195. Museum Methods — Directed work on anthropological collections. Can be taken for one or two quarters with consent of instructor.

1 to 4 units, Spr (Gerow) dhur

COURSES FOR GRADUATES AND ADVANCED GRADUATES

AREA STUDIES

203. Mesoamerican Social Organization — Problems in the social organization of Mesoamerica with an emphasis on inter-ethnic relations. Prerequisite: 103 or 105.

5 units, Spr (B. Paul) W 2:15–5:05

204. Mesoamerican Culture Change — Seminar for anthropology majors and graduates on selected topics and problems, with primary or comparative focus on historical and contemporary changes in the culture of communities in southern Mexico and highland Guatemala. Prerequisite: graduate standing in the department or consent of instructor.

5 units, Spr (B. Paul) W 2:15–5:05

217. Social Change in Chinese Society — Seminar treating social structure in late Imperial, Republican, and Communist China. Special attention is given social change and problem of cultural and structural continuity. Prerequisite: 121, 122 or 123 or course-work on China in other social sciences, including history.

5 units (Skinner) given 1976–77

220. Religion and the Family in China — Seminar analyzing family life and religion in traditional and Communist China. The analysis is presented as an example of anthropological interpretation, and attention is given to the theoretical implications of the Chinese case. Prerequisite: consent of instructor.

5 units (Wolf) given 1976–77

223. Education in Japan — Examination of the relation of education to society, emphasizing Japan's modernization. Stress on interdependency of education and other social institutions (family, business, etc.) as well as cultural and political values. Other topics to be covered are: historical background, early socialization, school competition, student activism, social mobility, adult socialization as related to educational institutions.

5 units, Win (Befu) M 2:15–5:05

SOCIAL AND CULTURAL ANTHROPOLOGY

238. Education and Sociocultural Change — (Same as Education 306C.) This course examines the role of education in modernization from a cultural and social-structural perspective, relying on theories of social and cultural change and on case material from modernizing areas both outside and inside the U.S. The concept of "development" is analyzed in both pan-cultural and culture-specific terms. Role-playing and other experiential techniques will complement a lecture and discussion group format.

5 units, Spr (Textor) TTh 2:15–4:05

239. Seminar on Ethnic Identity — This seminar focuses on ethnic identity as an ideological system. We will explore the interrelationship between ethnic identity as a system of symbols and meanings and other ideological domains using a limited number of well-documented ethnographic cases. Initial sessions will entail readings and discussion of theoretical approaches to ethnic identity; later sessions will be devoted to analysis of cases. Prerequisite: graduate standing or consent of instructor.

5 units, Spr (Yanagisako) M 2:15–5:05

241. Comparative Peasant Societies — Seminar treating selected topics in the comparative analysis of traditional agrarian societies. The focus is on urbanization and regional systems, in particular the manner in which the mode and extent of peasant integration and cultural variation reflect the structure of city-centered regions. Prerequisite: consent of instructor.

5 units, Aut (Skinner) Th 2:15–5:05

243. Social Organization — Examination of theories and findings in the area of culturally defined interpersonal relations, focusing on kinship, and local group organization. Pre-
requisite: graduate status in anthropology or consent of instructor.

5 units, Spr (Befu) TTh 10:30–11:45

251. Narrative Pattern in Oral Literature—Seminar on problems and theories of origin, form, transmission and function of folktales and myths will be reviewed. Students will examine cross-culturally, or from some other specific perspective, patterns or collections of patterns primarily from native America, Africa, and the Pacific region. Reports on their findings will form the basis of discussion in the latter half of the quarter. Open to qualified undergraduate students.

5 units, Aut (Geroto) T 2:15–5:05

252. Advanced Studies in Comparative Modes of Thought—Current approaches to the study of primitive thought, exploration of its intellectual history. The problems confronted by such neglected thinkers as Frazer, Wundt, Bastian, Levy-Bruhl, and others, will be related to more current psychoanalytic, structuralist, and hermeneutical trends.

5 units, Win (R. Paul) W 2:15–5:05

253. Primitive Religion—Readings in classical social theory (Weber, Durkheim, Freud, Levy-Bruhl) on the nature of primitive religion, followed by more contemporary works which continue and further interpretations of such phenomena as religious sects, worship, rites of passage, magic, shamanism, and dreaming. Prerequisite: consent of instructor.

5 units (R. Rosaldo) given 1976–77

254. Structural Studies of Myth—The purpose of this seminar will be to develop a critical language for discussing, evaluating, and applying Levi-Strauss’s theories to the study of mythology. The first sessions will involve a discussion of theory; in the last weeks, structural methods will be applied to a body of related myths. Limited enrollment. Prerequisite: consent of instructor.

5 units (M. Rosaldo) given 1976–77

255. Political Anthropology — Proseminar treating the political process in traditional societies ranging from bands to agrarian civilizations. Attention is also given political development in such societies. Prerequisite: graduate standing.

5 units, Aut (Skinner) TTh 10:30–11:45

261. Economic Anthropology—Seminar on the economic organization of peasant and tribal peoples; special attention given to the displacement of pre-capitalist modes of production and questions of transition. Prerequisite: graduate standing or consent of instructor.

5 units (O’Laughlin) given 1976–77

265. Advanced Psychological Anthropology—Analysis of selected psychocultural processes, including attention to group and individual adaptations to rapid cultural change and urbanization. Prerequisite: consent of instructor.

5 units, Win (G. & L. Spindler) TTh 4:15–6:05

266. Cultural Transmission—(Same as Education 315.) The transmission of values, implicit cultural assumptions, and the patterning of education in cross-cultural perspective, with special attention to American culture. Prerequisite: consent of instructor.

5 units, Aut (G. Spindler) T 7–10 p.m.

268. Family Ecology — This seminar acquaints students with a range of family structures in our society and helps the student understand the impact of illness on the family and the effect of the family’s behavior on health and disease. Arrangements are made for each student to follow a family during the quarter, interviewing, observing, and studying them at their home and in a clinical setting. The seminar provides the student with interview and observation skills and sensitizes him to his reaction to others and their reactions to him. It helps the student understand the meaning of illness from the patient’s point of view and defines the role, responsibility, and impact of professional intervention. The field experience is supplemented by readings and seminar discussion on topics arising from the field contacts.

5 units, Win (Barnett) by arrangement

LINGUISTIC ANTHROPOLOGY

272. Seminar on Language Adaptivity—(Same as Linguistics 359.) The structural response of language to functional change, with special reference to pidgins, creoles, jargons, argots, baby talk, foreigner talk, rhetorical, ritual, and poetic language, and their implications for the study of linguistic universals. Critical examination of the functions of language in the speech community.
Prerequisite: Anthropology 175 or equivalent, or consent of instructor.

5 units, Spr (Fox) T 2:15–5:05

276. Ethnographic Semantics—Problems of data elicitation and analysis to uncover systems of lexical meaning in languages not native to the investigator. Seminar participants will work jointly on a selected lexical domain in an unfamiliar language. Limited enrollment; preference will be given to students familiar with descriptive linguistics (including knowledge of phonetic transcription). Prerequisite: graduate standing or consent of instructor.

5 units (Frake) given 1976–77

277. Languages of Africa—(Same as Linguistics 281.) A survey of the history of African linguistic investigation, characteristics of African languages, and sociolinguistics in Africa, including the formation of standard languages, language and educational policy, and language in connection with colonialism and national policy.

5 units, Win (Greenberg) TTh 4:15–6:05

RESEARCH METHODS

290A. History of Anthropological Theory—A historical treatment of the chief theoretical trends in anthropology up to approximately 1930.

5 units, Aut (Greenberg) TTh 9–10:15

290B. The Historical Background of Contemporary Anthropology Theory—A critical treatment of contemporary anthropological theory and its historical background.

5 units, Win (Greenberg) TTh 9–10:15

292. Epistemology of Anthropological Theory—The members of the seminar will select works representing different methodological approaches, such as “participant observation,” “behavioral anthropology,” “experiential anthropology,” “single-case study,” “committee anthropology,” and the emic/etic dichotomy. The books will be analyzed and discussed from an epistemological point of view. We shall try to assess their cognitive value and their objectivity, and to answer the question: what kind of “reality” is reached or constructed by each approach?

5 units, Spr (Maquet) by arrangement

293. Field Training in Cultural Anthropology—Instruction and practice in data gathering methods and analyses in native or ethnic settings. Prerequisites: graduate standing in department and consent of instructor.

3 to 12 units, Sum (Staff)

294. Design of Field Research—A seminar treating research design and the research process, with special attention to the interrelation of both with theory and method. Consideration is also given to problems or preparing dissertation proposals and applications for research grants. Limited enrollment. Prerequisite: consent of instructor.

5 units, Spr (Skinner) TTh 3:15–5:05

295. Seminar: Research Paper—Forum for guiding first-year graduate students in Anthropology in preparation of their required research papers. Prerequisite: graduate standing in Department.

5 units, Spr (Wolf) TTh 3:15–5:05

296. Anthropological Ethics—An exploration of the political, social and personal implications of anthropological research in terms of the ethical problems they pose for practicing anthropologists. Seminar; limited enrollment. Prerequisite: consent of instructor.

5 units, Win (Drake) M 2:15–5:05

297. Directed Individual Study—Provides opportunities for advanced students to explore special areas of interest.

Any quarter (Staff) by arrangement

298. Teaching Apprenticeship—Supervised experience as assistant in one undergraduate course.

5 units, any quarter (Staff) by arrangement


Any quarter (Staff) by arrangement

AREA STUDIES


311. Socio-Political Integration in Contemporary Africa—See 111.
**SOCIAL AND CULTURAL ANTHROPOLOGY**

334. Art and Culture—See 134.
340. Social Stratification—See 140.
368. Medical Anthropology—See 168.
369. Advanced Medical Anthropology—See 169.

**LINGUISTIC ANTHROPOLOGY**

371A. Linguistic Field Methods I—See 171A.
371B. Linguistic Field Methods II—See 171B.
373. Language and Social Interaction—See 173.

**RESEARCH METHODS**

392. Anthropological Research Methods with Implications for Education—See 192.

Graduate courses offered in other departments, institutes, and schools within the University may also be elected for graduate credit provided the course concerned is approved by the advisor as fitting into the student's program.

**APPLIED PHYSICS**

*Emeritus:* Rudolf Kompfner (Professor)

*Chairman:* Theodore H. Geballe


*Associate Professors:* Malcolm R. Beasley, Robert L. Byer, Vahe Petrosian, Arthur B. C. Walker, Jr., Mitchel Weissbluth

*Lecturer:* Robert M. White

*Senior Research Associates:* Bertram A. Auld (Hansen Laboratories), H. John Shaw (Hansen Laboratories), John M. Wilcox (Institute for Plasma Research)

**Offerings and Facilities**

The program in Applied Physics offers to qualified students with backgrounds in physics or engineering the opportunity for graduate course work and research in those areas of physics which may be relevant to technical applications, and to natural phenomena. These areas include solid state, superconductivity, plasmas, quantum electronics, space science, astrophysics, and physics of biological macromolecules. Student research is supervised by the faculty members listed above and also by various members of other departments such as Materials Science and Electrical Engineering, who are engaged in related research fields. Research activities are carried out in the W. W. Hansen Laboratories of Physics, the Stanford Electronics Laboratories, the Institute for Plasma Research, and the McCullough Laboratory.

The number of graduate students admitted to Applied Physics is limited. Applications should be received by January 15, 1976. Graduate students may normally enter the Department only at the beginning of autumn quarter.

**Programs of Study**

Requirements for admission to candidacy for the M.S. and Ph.D. degrees in Applied Physics include a Bachelor's Degree in Physics or an equivalent Engineering degree. Students entering the programs from an engineering curriculum should expect to spend at least an additional quarter of study acquiring the background to meet the requirements for advanced degrees in Applied Physics.

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this bulletin. Thirty-six units of applied physics, physics, engineering, and mathematics are the minimum requirements for the degree. Up to 6 units of transfer credit for post-B.S. work taken elsewhere may be granted by validation in individual cases. Minimum subject matter requirements for the Master's degree include Physics 170, 171, 220 (or Electrical Engineering 342), Physics 230, 231, 232 (recommended but not required), Applied Physics 213, 215 (or Physics 210, 211), one quarter of advanced laboratory (chosen from Physics 200, 201, Applied Physics 354, 356S, 358A, 358B,
or Electrical Engineering 329A,B,C) plus sufficient additional approved courses in applied physics, physics, chemistry, engineering, or mathematics, to total 36 units. A minimum grade average of B is required in the courses taken toward the Master's degree.

**DOCTOR OF PHILOSOPHY**

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" in this bulletin. Each candidate for this degree will be required to pass an oral qualifying examination before an application for the Ph.D. degree is accepted and before the end of the sixth quarter of registration, excluding summers. This examination will consist of a seminar given by the candidate on a suitable technical topic, and questioning by a faculty committee on that topic and related material.

Minimum subject matter requirements for the Ph.D. degree include: Applied Physics 213, 215 (or Physics 210, 211); Physics 220 (or Electrical Engineering 342); Physics 221; Physics 230, 231, 232 (or Electrical Engineering 322A, 322B, Applied Physics 237); and two quarters of advanced laboratory (chosen from Physics 200, 201, Applied Physics 354, 356S, 358A, 358B, or Electrical Engineering 329A,B,C). Additional course requirements are 12 units in a major field (such as solid state physics or quantum electronics), 9 units in minor fields (specialized courses outside the major field), and 9 additional units of advanced or specialized courses. The total requirement, including units in research as well as courses, is 80 units beyond the B.S. degree. A minimum grade average of B during the last five quarters is required in the courses taken toward the Ph.D. degree.

**FELLOWSHIPS AND ASSISTANTSHIPS**

Besides the University fellowships open to all students, there are available in the Department several special fellowships and a number of assistantships involving research. Information on application procedures and deadlines should be obtained from the Graduate Awards Office.

**COURSES**

**15. The Nature of the Universe** — This course is intended to familiarize undergraduates, with or without scientific background, with the structure, origin and evolution of our universe. It will describe our growing knowledge of the objects which make up the universe: galaxies, stars, planets, etc. Some enigmas of modern astronomy, such as quasars, X-ray sources and pulsars, will also be discussed. The presentation will be non-mathematical and will be illustrated with slides and films. There will be opportunities for telescopic observations.

3 units, Aut (Petrosian) MWF 10

**101. Solar System Astronomy** — (Enroll in Astronomy 101.)

**102A,B,C. Astronomy Laboratory** — (Enroll in Astronomy 102A,B,C.)

**103. Stellar and Galactic Astronomy** — Introduction to stellar, galactic, and extragalactic astronomy: stars, galactic structure, interstellar medium, galaxies. Stellar evolution: star formation, energy generation, H-R diagram. Modern developments, pulsars, X-ray stars, black holes. Techniques and technical problems. Prerequisites: one year of college physics, or chemistry, or engineering, or Astronomy 101.

3 units, Win (Sturrock) TTh 2:15–3:30

**105. High Energy Astronomy** — Introduction to cosmology, extragalactic astronomy and nonthermal phenomena of astrophysics: radio and X-ray radiation and the production of high energy particles (cosmic rays) by the sun, neutron stars (pulsars), galaxies, and quasars. Discussion of models and evolution of the universe. Prerequisites: one year of college physics or chemistry or engineering, or Applied Physics 103.

3 units, Spr (Petrosian) TTh 2:15–3:30

**Astronomy, Astrophysics, and Space Science**

Applied Physics students may specialize in one of the above fields. Courses relevant to these studies are offered in Applied Physics and other departments. For further information, please see Courses and Degrees entries on "Astronomy Course Program" and "Space Science and Related Programs."
193B. Senior Seminar, X-Ray Astronomy—(Enroll in Astronomy 193B.)

193C. Senior Seminar, Peculiar Stars and Close Binary Systems—(Enroll in Astronomy 193C.)

195. Principles of Applied Superconductivity—A phenomenologically oriented account of the physical principles of superconductivity and its practical applications. Applications discussed will include those which are already highly developed, such as superconducting magnets, quantum interference devices (SQUIDS), and high-Q microwave cavities. Also included will be applications which are still being developed, such as superconducting ac and dc motors and generators, Josephson junction computers, superconducting infrared detectors and mixers, power transmission lines, and magnetically levitated high-speed trains. Prerequisite: good undergraduate electromagnetism and thermal physics. No previous knowledge of superconductivity will be assumed.
3 units, Aut (Beasley) TTh 1:00-2:30, alternate years, given 1975-76

213. Methods of Theoretical Physics — A course designed to give basic background mathematics needed for physics and engineering. Topics covered will include: operators in function space, eigenfunction expansions, Fourier series, contour integrals, boundary value problems, generalized functions, Green's function for operators with discrete and continuous spectra, special functions. Prerequisites: Mathematics 130 and 131 or equivalent.
3 units, Aut (Weissbluth) MWF 11

215. Computer Methods for Physicists and Engineers—This course is designed to emphasize the principles behind methods of using the computer. Elementary FORTRAN or ALGOL is assumed and computer exercises will be part of the course. The subject matter is as follows: (1) basic numerical methods — polynomial fitting to functions and data — Lagrange formula, Gauss integration, Tchebychev polynomials, Padé approximants, fast Fourier transforms, Monte Carlo methods of integration, Newton-Raphson method, differential equations — Euler and Runge-Kutta methods, matrix inversion and solution of simultaneous equations, boundary value problems and eigenvalue methods, partial differential equations; (2) advanced numerical methods and introduction to non-numerical methods—optimization methods, linear programming, ill-conditioned systems and inversion of the Laplace transform; List processing, lambda conversion, recursive functions, Turing machines, introduction to LISP. Prerequisites: Mathematics 113 and 130 or equivalent.
3 units, Spr (Doniach) TTh 11:00-12:15

232, 233. Atomic and Molecular Physics — A systematic development of the structure and interactions of atoms and molecules based on quantum mechanical methods and concepts. Topics will include Dirac, Pauli and Schrodinger formulations, multiplet structure by Racah methods, Hartree-Fock calculations, hyperfine couplings, group theory, vibrational-rotational structure, molecular orbitals, ligand-field theory as well as the physical content of various experimental methods. Prerequisite: Applied Physics 213 and Physics 131 or Electrical Engineering 322B.

232. 3 units, Win (Weissbluth) MWF 11

233. 3 units, Spr (Weissbluth) MWF 11

237. Quantum Mechanics of Atomic Systems—Directed toward application to solid state, magnetics, quantum electronics, etc. Includes the density matrix; quantization of the EM field; second quantization; interaction of EM radiation and matter; multiple-quantum effects. Prerequisite: Electrical Engineering 322B or Physics 231.
3 units, Spr (Staff) MWF 11

238. Electric and Magnetic Properties of Solids — (Enroll in Electrical Engineering 238.)

239. Solid State Physics — The emphasis is on general concepts of solid-state physics and the application to specific problems. Topics include diffraction, energy bands, statistics and equilibrium properties, electron and hole dynamics, transport and optical properties, lattice vibrations, defects and dislocations, phenomenological theory of magnetism and superconductivity. Prerequisite: Physics 57 or equivalent.
3 units, Win (Harrison) MWF 10

240. Solid State Chemistry — Electronic structure as the basis for understanding the properties of matter. Covalent, ionic, and metallic bonding and their relation to energy bands. Crystal structures and the different solid types. Dielectric properties, effective
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charges and piezoelectricity. Defects, solid surfaces and their properties. Free electrons and bonding in metals. Electronic structure and properties of amorphous materials and glasses. Prerequisite: Physics 57 or equivalent; Applied Physics 239 is not required.

3 units, Spr (Harrison) MWF 10

250. Wave Phenomena in Electronic Devices I—Wave theory and coupling of waves in various active and passive media. Particular emphasis on wave phenomena relevant to electronic devices. Includes space charge waves in plasmas and electron beams, acoustic waves, waves in periodic media, guided optical waves, momentum and energy of waves. Prerequisites: Physics 111 and 122, or Electrical Engineering 241N or the equivalent.

3 units, Aut (Chodorow) TTh 9:00-10:15


3 units, Win (Chodorow) TTh 9:00–10:15


3 units, Spr (Auld), alternate years, given 1975–76


3 units, Spr (Auld), alternate years, given 1976–77


3 units, Aut (Harrison) given 1976–77

290. Directed Studies in Applied Physics—Special studies under the direction of a faculty member for which academic credit may properly be allowed. Such studies may include laboratory work or directed reading.

Any quarter (Staff) by arrangement

300. Thesis Research.

Any quarter (Staff) by arrangement


339. 3 units, Win (Staff)

340. 3 units, Spr (Staff)

354. Solid State Physics Laboratory—Combined lecture and laboratory course which considers fundamental properties of solids including X-ray and crystal structure, phase transition theory, heat capacity, ferroelectricity, magnetism, superconductivity, semiconducting and acoustic properties and solid state spectroscopy. Experiments include X-ray and crystal symmetry, phase transition measurements, macroscopic quantum properties of superconductors, acoustic properties, bulk semiconductor measurements and spectroscopy. Limited enrollment. Prerequisite: consent of instructor.

3 units, Sum (Staff) MW 9 plus lab. by arrangement

356S. Superconductivity and Low Temperature Physics Laboratory—Combined lecture and laboratory course which discusses important concepts in superconductivity in-
Including phenomenological theories, phase transitions, magnetic properties, type I and II superconductors tunneling and Josephson effect. Experiments include low temperature thermometry and phase transition measurements, magnetic properties, solenoid design, superconducting cavity properties, levitation, power transmission line properties and ac Josephson effect. Limited enrollment. Prerequisite: consent of instructor.

3 units, Sum (Staff) MW 9 plus lab. by arrangement

358A. Quantum Electronics Laboratory I—Combined lecture and laboratory course emphasizing laser theory and device operation. The lasers studied include HeNe, Argon ion, Nd:YAG, CO$_2$, and dye. The topics discussed are properties of lasers, laser theory, Gaussian beam and laser cavities, modulation and Q-switching and interferometry. Experiments are performed with emphasis on laser device properties. Limited enrollment. Prerequisites: Electrical Engineering 231 and 232 or consent of instructor.

3 units, Win (Byer) MW 9 plus lab. by arrangement

358B. Quantum Electronics Laboratory II—Combined lecture and laboratory course emphasizing laser interaction with matter. The lasers are considered as a source for optical experiments which include laser modulators, propagation in anisotropic crystals, harmonic generation, Raman, Brillouin and parametric scattering and acousto-optic interactions. Optical pumping atomic and molecular spectroscopy experiments using tunable dye and parametric sources are also possible. Limited enrollment. Prerequisites: Electrical Engineering 231 and 232, or Applied Physics 358A, or consent of instructor.

3 units, Spr (Byer) MW 9 plus lab. by arrangement

360. Solar Terrestrial Relations — Origin and characteristics of the solar wind. Magnetosphere and bow wave; radiation belts; aurorae. Phenomena caused by solar flares: interplanetary shock waves; geomagnetic storms; Forbush effect. Prerequisite: Physics 220 or Electrical Engineering 241N, or equivalent.

3 units (Staff), alternate years, given 1976–77

361. The Sun and Solar Activity — Photosphere, chromosphere, and corona. Fraunhofer spectrum. The solar cycle. Active phenomena: sunspots, prominences, flares, radio bursts. Prerequisites: Physics 221, Electrical Engineering 241N or equivalent. (Physics 131 desirable.)

3 units (Staff), alternate years, given 1976–77

362. Physical Processes in Stars — Astronomical data on stars and star clusters; classification; Hertzsprung-Russell diagram. Equations of hydrostatic equilibrium and energy transport; equation of state for normal and degenerate matter; opacity; nuclear and neutrino processes. Stellar evolution from main sequence to white dwarfs, neutron stars and black holes. Prerequisites: Physics 220 or Electrical Engineering 243, or consent of instructor. (Physics 132 desirable.)

3 units, Spr (Petrosian), alternate years, given 1976–77


3 units (Staff), alternate years, given 1976–77

366. Cosmology and High-Energy Astrophysics—Observational properties and theoretical models of selected astrophysical phenomena involving nonthermal electromagnetic processes, such as pulsars, X-ray sources, quasars, radio galaxies, Seyfert-type galaxies, and cosmic rays. Discussion of basic observational data and theories of the structure and evolution of the universe, with emphasis on the physical processes in the early phases of the big bang universe. Prerequisite: Physics 221 or equivalent. Recommended: Applied Physics 364.

3 units, Win (Petrosian), MWF11, alternate years, given 1975–76

367. Physical Processes in the Galaxy — Structure and physical constitution of the Galaxy: nucleus, spiral arms, stellar populations, and interstellar medium. Mechanisms for production of radio, X-ray and gamma-
ray radiation from supernovas, pulsars, and X-ray stars. Prerequisite: Physics 220 or equivalent.

3 units, Spr (Sturrock), TTh 2:15–3:30, alternate years, given 1975-76

385. Magnetism and Superconductivity — Magnetism and superconductivity will be discussed within the context of real materials. The microscopic mechanisms underlying these phase transitions as well as their consequences on physical properties will be developed. The similarities and differences of these phenomena will be stressed. Experimental results of a wide range of materials will be analyzed. The format will consist of two-part lectures, which in succeeding years will emphasize either superconductivity or magnetism. Prerequisites: Applied Physics 270, 339, 340, or consent of instructor.

2 units, Spr (Geballe, White) 12:00–1:45

388. Many Body Problems in Solid State Physics — Topics will include—the normal state: Green’s function theory of linear response, impurity scattering and electrical resistivity; instabilities of the interacting Fermi gas: ferro and antiferromagnetism, superconductivity and the insulator-metal transition; localized states in a fermion system: the X-ray problem and the Kondo effect. Prerequisites: Applied Physics 239 and 240, or equivalents.

3 units, Win (Doniach), given 1976-77

390A. Solid State Physics Seminar—Discussion of current research and literature in solid state physics is offered by faculty, students and outside specialists.

1 unit, Aut, Win, Spr (Beasley) Th 4

390B. Physics of Biological Systems — A seminar devoted to the discussion of biological systems from the standpoint of physics. Research problems and current literature on topics including molecular properties, energy transfer, transport phenomena and instrumental developments.

1 unit, Aut, Win, Spr (Weissbluth) T 4:15

ART

Emeriti: Daniel M. Mendelowitz (Professor); Victor M. Arnautoff (Assistant Professor)

Chairman: Lorenz Eitner


Associate Professors: Keith Boyle, Suzanne Lewis, Richard Randell, Isabelle Raubitschek

Assistant Professors: James N. Johnson, John-David P. laPlante, Jan W. Molenkamp, Paul Turner

Lecturers: Art History—Studio—Leo Holub, Robert Parker. Visiting: Alfred Frankenstei

Principal Advisor to Undergraduate Studio Majors: Keith Boyle

Principal Advisor to Undergraduate Art History Majors: Isabelle Raubitschek

Director of Graduate Studies in Art History: Dwight C. Miller

OFFERINGS AND FACILITIES

The Department offers courses of study in three areas: (1) in the history of art, (2) in the practice of drawing, painting, sculpture, design, printmaking, and photography, and (3) in art education. The undergraduate program of the Department is designed to introduce students to the humanistic study of the visual arts. The courses are intended to increase the students’ understanding of the meaning and purpose of the arts, of their historical development, their role in society, and their relationship to such other humanistic disciplines as literature, music, and philosophy. The work in classroom and studio is designed to intensify the students’ visual perception of the formal and expressive means of art and to encourage insight into a variety of technical processes. The collections of the Stanford Museum and the exhibitions program of the Stanford Gallery supplement the regular academic program of the Department.

PROGRAMS OF STUDY

Undergraduates may major in Art History or the Practice of Art (Studio). A freshman or sophomore intending to major in one of these areas should consult with an advisor appointed by the Department in order to plan his or her course of study.

Graduate programs are offered in Art History, Studio (including Product Design), and Art Education.
All graduate students are required to take an active part in the practical work of the Department as part of their requirement for the degree. This work is to be determined in consultation with their advisers.

During the first two years of their resident graduate work at Stanford, students are required to live in the immediate proximity of the University. Exceptions may be granted only on the basis of a petition formally submitted to the Chairman of the Department.

HISTORY OF ART

BACHELOR OF ARTS

The major program in the history of art must include the following:

4 units—Art 1
32 units in courses in art history
Total units—36. These units must be taken for a grade, may not be taken pass/no credit. University units earned by placement tests or advanced placement work in secondary school will not be counted within the 36 units required.
Art 40 and Art 50—Recommended, but not required

Each undergraduate major in the history of art shall take at least one year of beginning German, French, or Italian, or present proof of reading ability in one of these languages. (Students are encouraged to become proficient in two languages.)

MASTER OF ARTS

The Department of Art offers the Master of Arts and the Doctor of Philosophy degrees. The Master of Arts degree is normally granted as a step toward eventual fulfillment of requirements for the Doctor of Philosophy. The Department does not admit students who wish to work only toward the Master of Arts degree.

The University's basic requirements for the Master's degree are set forth in the section "Degrees" in this bulletin. The following are Departmental requirements:

Admission to Candidacy—Completion of the University's requirements for a Bachelor of Arts degree in the history of art, or an approximately equivalent training, is required of students entering a program of study for the Master of Arts. After acceptance and before beginning the program, students shall take a preliminary counseling test to determine the degree of the students' previous preparation. The students will be required to remedy deficiencies indicated by this test.

Recommendation for the Degree—To be recommended to the University Committee on Graduate Studies for the degree of Master of Arts in the history of art, the student must have satisfied the following requirements:

1. Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.
2. Completion of a total of at least 36 units of graduate work in the history of art in courses at the 200 level. Students will also be required to take a seminar in art historiography and methods of research.
3. Reading knowledge of two foreign languages, preferably German and French or Italian. For oriental art history, reading knowledge of two oriental languages or one oriental language and either French or German.
4. Submission of two from among the term papers written during the year, for consideration by the faculty.
5. Demonstration to the faculty, by coursework and/or examination, that the student has adequate knowledge of the major areas of the history of art.

DOCTOR OF PHILOSOPHY

The University's basic requirements for the degree of Doctor of Philosophy are set forth in the section "Degrees" in this bulletin.

Admission to Candidacy—The graduate student does not become a formal candidate for the Ph.D. degree until he or she has fully satisfied all the requirements which govern the A.M. program in the history of art (see above), and has been accepted as a candidate by the University Committee on Graduate Studies. Immediately upon acceptance of a student into the Doctoral program, a committee of at least three art historians shall be formed which shall take responsibility for advising and evaluating that student through the obtaining of the degree. It shall be left to the discretion of the committee whether or not the student will take examinations to test competence in the ma-
The committee shall also decide on the type of examination if one is required. The committee shall also pass on the candidate's satisfying of the language requirements.

The principal thesis adviser shall be the committee chairman. It is the responsibility of the incoming student to contact his or her advisors before registration in order to be interviewed and counseled on a program of course work.

Having satisfied all preliminary requirements, the candidate will submit a concise written statement of his or her dissertation topic to the Department. Departmental approval of the projected dissertation is necessary for admission to candidacy for the Ph.D. degree.

**Residence**—In order to be eligible for the doctoral degree, the student must have completed three years of full-time graduate work in the history of art, and must have spent at least one of them in residence at Stanford.

**Collateral Studies**—The student should be prepared to take 15 units in one or, at most, two supporting fields of study (such as history, literature, classics, anthropology, or philosophy), determined in consultation with the Departmental Advisors.

**Dissertation**—A senior member of the Department will act as the student's dissertation advisor and as chairman of his or her dissertation committee. The final draft of the dissertation must be in the advisor's hands at least four weeks before the University deadline in the quarter during which the candidate expects to receive his or her degree. Dissertations may not be submitted during the summer quarter. The dissertation must be completed within five years from the date of the student's acceptance to candidacy for the Ph.D. degree. A candidate taking more than five years will be required to reinstate his or her candidacy.

**Oral Examination**—The oral examination is taken after completion of the dissertation, and its acceptance by a majority of the committee, including the principal adviser. It serves primarily as a defense of the dissertation, but may range, at the committee's discretion, over a wider field.

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**PRACTICE OF ART (STUDIO)**

**Bachelor of Arts**

The major program in the studio area must total 65 units. Students may major in one of five areas: Painting/Drawing, Sculpture, Lithography, Design, or Photography.

**Requirements for Painting/Drawing:**

Art 40, 50, 60
Art 140, 141, 142 (These drawing classes need not be taken in sequence. Any of the drawing classes may be taken concurrently with Art 145-Painting I)
18 units of painting courses
12 or more units of the Modern Art series (Art 120A through Art 121B)
**TOTAL UNITS REQUIRED: 48**

**Requirements for Sculpture:**

Art 40, 50, 60, 70
Art 140, 141, or 142 (Two quarters required)
18 units of sculpture courses
12 units of Modern Art series
**TOTAL UNITS REQUIRED: 49**

**Requirements for Lithography:**

Art 40, 50, 60, 70
Art 140, 141, 142 (These drawing classes need not be taken in sequence. Any of the drawing classes may be taken concurrently with Art 145-Painting I)
Art 145 and 146
18 units of lithography courses
Art 120A, 121A, and 122
**TOTAL UNITS REQUIRED: 57**

**Requirements for Design:**

Art 40, 50, 60, 70
Art 1
ME 101 or ME 115A (Mechanical Engineering)
Art 160, 161, 162, 166, 167 (Intermediate Design)
Art 261, 268 (Advanced Design)
Art 140, 145, or 150 (Intermediate Fine Arts)
Two courses in art history
**TOTAL UNITS REQUIRED: 57**

**Requirements for Photography:**

Art 40, 50, 60, 70
Art 140, 141, or 142 (One quarter required)
Art 148
15 units of photography courses
12 or more units of the Modern Art series (Art 120A through 121B)
**TOTAL UNITS REQUIRED: 45**

The above requirements for a major in one of the five areas are part of the total of 65 units. A major in studio may take units pass /
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no credit in courses outside the requirements in the major area of interest.

Students are required to formulate their program in careful consultation with their advisors. A program expressing the concerns of the student should evolve.

MASTER OF FINE ARTS

Programs for the Master of Fine Arts degree are offered in the areas of painting, lithography, sculpture, photography and product or graphic design.

The Graduate Program in Painting, Sculpture, Lithography, and Photography provides an environment sympathetic to the needs of advanced students who are ready to involve themselves fully in these areas. Participants are chosen for the program on the basis of work which shows artistic individuality, motivated by the students' own goals and principles, and which indicates an ability to work without further need of close faculty supervision.

The Graduate Program in Design is focused upon mature study in an area of design largely defined by the student's own interest. Master's projects have involved urban design, transportation, recreation, film animation, housing, seating, signing, medical and therapeutic facilities, musical instruments, informational systems, and a great many other areas. The Graduate Program is structured to balance independent concentration with rich utilization of the University and the community, and personal interaction with the students and faculty of the Graduate Design Program.

The Design Program is formally undertaken in collaboration with students and faculty of both the Art Department and the Design division of the Department of Mechanical Engineering. Physical facilities, such as shops and individual studio space, are shared by all the students. Similarly, faculty members from both departments serve as planners, advisers, and critics to the entire group. Students interact with faculty and one another through seminars, critiques, and informal working contact. The program centers on a master's project, and may also include work in advanced art, design, and technical courses.

A Master of Arts Degree in Design is offered to qualified students who prefer to participate in the graduate program for only one year.

Admission to candidacy for the degree of Master of Fine Arts is based on:

1. The equivalent of a Bachelor of Arts degree in art at this University.
2. A grade point average of B- in at least 65 units of undergraduate work in art.
3. Formal admission to candidacy granted by the University Committee on the Graduate Division.
4. Candidates for admission must submit six or more slides of paintings, lithographs or sculpture and six or more slides of drawings. Photography candidates must submit at least twelve photographs of recent work. Design candidates must submit a portfolio of twelve or more slides or photos of creative work, including original work when possible. A stamped self-addressed envelope should also be enclosed, for the return of the slides.
5. Applications and portfolios for the studio program must be submitted by February 1. No original work should be submitted unless the candidate can arrange for pick-up and delivery. They will be reviewed the first week of February. Students accepted are admitted for the beginning of the following Autumn Quarter only; no applicants for mid-year entrance will be considered.

The requirements for the degree of Master of Fine Arts are:

1. Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.
2. Completion of the equivalent of 54 units of selected third- and fourth-year undergraduate and graduate courses. At least 39 units of this work must be in art with a grade of B or above and distributed as follows:
   a) 15 units in one of the five areas of concentration: (a) Drawing and Painting, (b) Sculpture, (c) Design, (d) Printmaking, or (e) Photography.
   b) A total of 6 units in the remaining areas of concentration.
   c) 18 units of work on thesis or creative project.

The studio faculty reserves the right to make use of graduate painting, sculpture, lithographs, and photographs in exhibitions.
serving the interests of the Graduate Program.

ART EDUCATION

MASTER OF ARTS IN TEACHING

The degree of Master of Arts in Teaching is offered by this Department and the School of Education for teachers who wish further to strengthen their academic preparation. The candidate must have a teaching credential. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements are outlined in the section “School of Education” in this bulletin.

DOCTOR OF EDUCATION AND DOCTOR OF PHILOSOPHY IN EDUCATION

In cooperation with the School of Education the Department offers work leading to the Ed.D. and Ph.D. degrees with a concentration in Art Education. Consult the section on "Graduate Degrees" listed in the "School of Education" section in this bulletin. Complete information concerning these degrees may be secured from the Office of the Dean of the School of Education.

TEACHING CREDENTIAL (SECONDARY)

A program leading to a Master of Arts degree with a specialization in art education and/or including a California Teaching Credential in art is offered in art education by the School of Education. This program is available to students who have majored in art at the undergraduate level, who have had no teaching experience, and who wish to become teachers of art at the elementary or secondary levels. For details with respect to this program consult the "Teaching Credential Program" listed in the "School of Education" section in this bulletin.

COURSES IN HISTORY OF ART

BASIC COURSES

1. Introduction to Art—A topical introduction to the history and appreciation of architecture, sculpture, and painting.
   
   4 units, Aut (Elsen)

5. Birth of European Art—The formation of the Classical tradition in Ancient Greece and Rome and its transformation in the Middle Ages.
   
   4 units, Win (Lewis, Raubitschek)

10. Survey II—Main currents in the history of Western art from the Renaissance to the present.

   4 units, Spr (Miller)

INTERMEDIATE COURSES

100A. Ancient Art I—The Pre-Hellenic Cultures: Egypt, Mesopotamia, Crete, Mycene.
   
   4 units, Aut (Raubitschek)

100B. Ancient Art II—Greece from the Geometric period to the Hellenistic, with emphasis on sculpture and painting.
   
   4 units, Win (Raubitschek)

100C. Ancient Art III—Rome from the Prehistoric and Etruscan periods to the early Christian.
   
   4 units, Spr (Raubitschek) given 1976–77

101. Greek Architecture—From its origins to the Hellenistic Age, with emphasis on the Classical period.
   
   4 units, Spr (Raubitschek)

103. Byzantine Art—Art and architecture of the Byzantine Empire from the founding of Constantinople (330) to the Turkish Conquest (1452), centered on patterns of imperial patronage in the capital.
   
   4 units, Aut (Lewis), given alternate years, 1976–77

104A. Medieval France—Art and architecture from the First Crusade (1095) and the major monastic centers of the Pilgrimage Roads, Cluny and Provence, through the formation and flowering of the Gothic style at Chartres, Paris, Amiens and Reims up to the reign of Charles V (1375).
   
   4 units, Aut (Lewis)

104B. Medieval Germany—Art and architecture of the Germanic Middle Ages from the Frankish Holy Roman Empire of Charlemagne and its Ottonian successor through the Romanesque, Gothic and Late Medieval Styles of 12th-15th centuries, centered on the issues of patronage, the investiture controversy and northern mysticism.
   
   4 units, Win (Lewis)

105A. Medieval Italy—Art and architecture from the fourth-century transformation of the Late Roman Empire through the barbarian kingdoms of the Ostrogoths and Lombards, the Byzantine reconquest, the Norman Kingdom of Sicily and the development
of Tuscan city-states in the twelfth and thirteenth centuries.

4 units, Spr (Lewis)

105B. Medieval Britain—Art and architecture in England from the Early Saxon and Irish Dark Ages, through the Anglo-Saxon Kingdom, the Norman Conquest and Gothic period of 13th-15th centuries.

4 units, Win (Lewis), given alternate years, 1976–77

107. Medieval Architecture—Development of functional and symbolic structures within the context of major medieval institutions and patronage: monasteries, castles, cathedrals and towns of Western Europe.

4 units, Spr (Lewis)

108. 15th Century Netherlandish Painting—Rediscovery of the visual world and the development of realism in the art of France and the Low Countries: the International Style, Van Eyck and Rogier van der Weyden, their Flemish and Dutch followers, the French assimilation, the visionary mistique of Hugo van der Goes, and the pessimism of Bosch on the eve of the Reformation.

4 units, Spr (Lewis), given alternate years, 1976–77

110A. Italian Renaissance Art I—Architecture, sculpture, and painting of the fourteenth and earlier fifteenth centuries. Concentration on Tuscan art of the time of Giotto and the Lorenzetti brothers, on civic programs of the early fifteenth century in Florence (Donatello, Ghiberti, Brunelleschi), on patronage in Milan, Mantua (Alberti, Mantegna), Urbino (Piero della Francesca), and Venice.

4 units, Aut (Forster)

110B. Italian Renaissance Art II—Art and architecture from Leonardo and Michelangelo to Titian and Palladio. Focus on coherent programs of patronage in Medici Florence, papal Rome, Venice, and Mantua; consideration of the role of artists and the changing function of art.

4 units, Spr (Forster)

111A. Northern Renaissance Art I—Art in German-speaking countries during the Reformation: painting, sculpture, and printmaking from Schongauer and Pacher to Dürrer, Grünewald, and Holbein.

4 units, Aut (Forster) given alternate years, 1976–77

112. Renaissance Architecture from Brunelleschi to Palladio—Major enterprises and their builders in the context of urban expansion and renewal in Italy, 1400–1600.

4 units, Win (Forster), given alternate years, 1976–77

113. Michelangelo and the Art of his Time—A study of the life and works of Michelangelo in the context of Italian Renaissance art and architecture. The training, patronage, and working conditions of artists, as well as contemporary writings on art and biography will be discussed.

4 units, Spr (Forster)

115A. Baroque Painting in Italy—Important developments in painting with emphasis on Bologna and Rome; major trends of style and problems of iconography.

4 units, Win (Miller)

115B. Painting in the Low Countries and France during the Seventeenth Century—Major artistic developments in the Low Countries and France during the seventeenth century focused on the great personalities and important episodes during this period. The question of the artist’s position in his society will serve as the basic point of departure.

4 units, Win (Miller), given 1976–77


4 units, Spr (Miller)

118. The Age of Rembrandt in Dutch Painting—The focus of this course is on Rembrandt, but the more general character of Dutch painting and other major figures of Rembrandt’s period will also be studied.

4 units, Spr (Miller), given 1976–77

120A. Modern Art I—Rococo to Revolution. Main currents in European art in the periods of the Enlightenment and Neoclassicism. Watteau, Boucher, Tiepolo, Chardin, Hogarth, Greuze, Fragonard, Robert, Piranesi, and early works of David, Goya, and Blake.

4 units, Aut (Eitner), given 1976–77

120B. Modern Art II — Romanticism and Naturalism. Main currents in European art in the time of the Napoleonic Wars, the Restoration, and the era of middle class dominance. The later works of David, Goya, and
Blake; the German Romantics; Ingres, Gericault, Delacroix, Daumier, Courbet, Millet, Manet, and Degas; the landscape art of Turner, Constable, and the Barbizon Painters.

4 units, Win (Eitner), given 1976-77

120C. Modern Art III—Realism and Impressionism—The origins of Impressionism in mid-nineteenth century realist art and in the work of the Barbizon School. The main masters of Impressionism, Monet, Sisley, Pissarro, are dealt with in detail, as well as the painters, such as Manet and Degas, who shared some of their goals and interests, without fully identifying themselves with Impressionism.

4 units, Win (Eitner)

120D. Modern Art IV—Alternatives to Impressionism—European art 1880-1900, Cézanne, Van Gogh, Seurat, Gauguin, Symbolism, Lautrec, Ensor, Munch.

4 units, Win (Elsen), given alternate years, 1976-77

120E. English Painting in the Age of Turner—A survey of English art of the first half of the 19th century, with special emphasis on the tradition of landscape painting, culminating in Girtin, Turner, and Constable.

4 units, Aut (Eitner)

121A. Modern Art V—Twentieth Century Painting I, 1900-1920—Fauvism, Matisse, German and Austrian Expressionism, Picasso, and Cubism, Orphism, Futurism, and Abstraction.

4 units, Spr (Elsen), given alternate years, 1976-77


4 units, Win (Elsen), alternate years


4 units, Win (Elsen)

123. Rodin—The art of Rodin and its relation to the time in which he lived. The course lectures are supplemented by sessions in the Stanford University Museum of Art's collection of Rodin's art and the Legion of Honor Collection in San Francisco.

4 units, Win (Elsen), given alternate years, 1976-77

123A. Modern Sculpture — Modern sculpture from Rodin to David Smith. The course focuses on major changes in sculpture and the art of Brancusi, Matisse, Picasso, Lipchitz, Arp, Giacometti, Gonzalez, Moore, and others.

5 units, Spr (Elsen)

125A. Oriental Art I — The arts of India, China, and Japan from the Neolithic through the sixth century A.D.

4 units, Aut (LaPlante)

125B. Oriental Art II — The arts of India, China, and Japan from the seventh century A.D. to the Mongol Invasion (thirteenth century).

4 units, Win (LaPlante)

125C. Oriental Art III—The arts of India, China, and Japan after the thirteenth century.

4 units, Spr (LaPlante)

126A. Introduction to Chinese Art.

4 units, Win (Sullivan)

126B. Introduction to Chinese Painting.

4 units, Spr (Sullivan)

126C. The Art of Japan.

4 units, Spr (Sullivan), given 1976-77

126E. The Meeting of Eastern and Western Art—The interaction between the art of the Far East, Europe, and America from the sixteenth century to the present day.

4 units, Aut (Sullivan)

130A. Art in Nineteenth Century America—Major developments and personalities in painting in 19th century America.

4 units, Win (Frankenstein)

130B. Art in Twentieth Century America—Major developments and personalities in painting in twentieth century America.

4 units, Aut (Frankenstein)

175A,B. Modern Architecture I, II—A two-quarter course tracing the development, largely in Europe, which led to the present state of architecture and urbanism. Emphasis on the designer's responses to totally new materials, technology and environmental conditions.

4 units, Win, Spr (Turner)

176. American Architecture and Urbanism—The development of architecture and city planning in the United States since colonial times, concentrating on those characteristics
and problems which are distinctively American.

4 units, Aut (Turner) given 1976–77

ADVANCED UNDERGRADUATE
AND
GRADUATE COURSES

4 units, Aut, Win, Spr (Raubitschek)

201. Studies in Greek Architecture.
4 units, Spr (Raubitschek)

202. Seminar in the Art of Cyprus—Cyprus from the Bronze Age to the Roman period, with emphasis on the objects from the Cesnola collection.
4 units, Spr (Raubitschek)

4 units, Aut (Lewis), given alternate years, 1976–77

204A. Studies in Medieval French Art and Architecture.
4 units, Aut (Lewis)

204B. Studies in Medieval German Art and Architecture.
4 units, Win (Lewis)

205A. Studies in Medieval Italian Art and Architecture.
4 units, Spr (Lewis)

205B. Studies in Medieval British Art and Architecture.
4 units, Win (Lewis), given alternate years, 1976–77

206A. Colloquium in Medieval Art.
4 units, Win (Lewis)

207. Studies in Medieval Architecture.
4 units, Spr (Lewis)

4 units, Spr (Lewis), given alternate years, 1976–77

4 units, Aut, Win (Forster)

211A. Studies in Northern Renaissance Art.
4 units, Aut (Forster), given alternate years, 1976–77

212. Studies in Renaissance Architecture from Brunelleschi to Palladio.
4 units, Win (Forster), given alternate years, 1976–77

213. Studies of Michelangelo and the Art of his Time.
4 units, Spr (Forster)

214A. Proseminar in Renaissance Art: Civic Patronage in Fifteenth Century Florence.
4 units, Aut (Forster)

214B. Seminar in Renaissance Art: Princely Patronage in Renaissance Mantua.
4 units, Win (Forster)

214C. Colloquium in Renaissance Art: Michelangelo.
4 units, Spr (Forster)

215A. Studies in Baroque Painting in Italy.
4 units, Win (Miller)

215B. Studies of Painting in the Low Countries and France during the Seventeenth Century.
4 units, Aut (Miller), given 1976–77

4 units, Spr (Miller)

217. Colloquium on Art in 18th Century European Culture—A study of some of the principal artifacts of 18th century artistic culture: the Garden, the Palace, 18th century collecting, practical aesthetics and fashions of taste.
4 units, Win (Miller)

218. Studies in the Age of Rembrandt in Dutch Painting.
4 units, Spr (Miller), given 1976–77

4 units, Aut, Win, Spr (Eitner, Elsen)

221. Seminar in Nineteenth Century Art.
4 units, Spr (Eitner)

221A. Studies in Twentieth Century Painting from 1900–1920.
4 units, Spr (Elsen), given alternate years, 1976–77

4 units, Win (Elsen), alternate years

4 units, Win (Elsen)

223. Seminar in Modern Sculpture.
4 units, Spr (Elsen)
223A. Studies in Modern Sculpture.
4 units, Spr (Elsen)

224. Colloquium on Picasso: His Life's Work in All Media.
4 units, Aut (Elsen)

4 units, Aut, Win, Spr (LaPlante)

226A. Studies in Chinese Art.
4 units, Win (Sullivan)

226B. Studies in Chinese Painting.
4 units, Spr (Sullivan)

226C. Studies in the Art of Japan.
4 units, Spr (Sullivan), given 1976–77

226E. Studies of Meeting of Eastern and Western Art.
4 units, Aut (Sullivan)

227A,B. Seminar in Chinese Art and Culture Between 200 and 600 A.D.
4 units, Aut, Win (Sullivan)

227C. Seminar in Far Eastern Art.
4 units, Spr (Sullivan)

228A. Seminar in Japanese Ceramics.
4 units, Aut (LaPlante)

228B. Seminar in Architecture of India and Farther India.
4 units, Win (LaPlante)

4 units, Aut (LaPlante) given 1976–77

229B. Seminar in Hindu Art and Iconography (India, Cambodia, and Java).
4 units, Win (LaPlante) given 1976–77

229C. Seminar in Ritual Bronze Vessels of Shang China—Technique and Style.
4 units, Spr (LaPlante) given 1776–77

230A,B. Studies in Nineteenth and Twentieth Century Painting in America.
4 units, Win, Aut (Frankenstein)

235. Proseminar in Art Historiography and Research Methods—Introduction to the major methods and approaches developed by modern schools of art historical research through discussion and comparative analysis of selected readings.
4 units, Win (Staff) given 1975–76

236. Colloquium: Art Historical Bibliography and Library Methods—An introduction to and survey of standard works and reference materials in art and architectural history. Subjects covered will include acquisition and research techniques, cataloging and library procedures, indexing and abstracting, the history of the book, papermaking, conservation as it relates to art history and museum practices, and career possibilities in the field of art. Competence in art historical research will be gained through bibliographical problems and the compilation of an annotated bibliography.
4 units, Win, Spr (Ross)

239. Colloquium: The Artist from Antiquity to the Present—Extensive readings and discussion of important developments in the history of the artist's profession. Enrollment restricted to twelve with approval of Instructor. Primarily for art history majors. Recommended prerequisites: Art 1 or Art 5 and 10.
4 units, Win (Elsen)

Any quarter (Staff) by arrangement

275A,B. Studies in Modern Architecture I, II.
4 units, Win, Spr (Turner)

4 units, Win (Turner)

278. Seminar on Twentieth Century Architecture.
4 units, Win (Turner), given 1976–77

279. Seminar on American Urbanism.
4 units, Spr (Turner)

Any quarter (Staff) by arrangement

Any quarter (Staff) by arrangement

Any quarter (Staff) by arrangement

RELATED COURSES
Classical Greek Sculpture and Painting—See Classics 102.
Hellenistic Greek Sculpture and Painting—See Classics 103.

Athenian Everyday Life — See Classics 105.

Art and Monuments of the Romans — See Classics 106.

Reading in German Art History—See German 112.

3 units, Spr (Snow)

INTERDEPARTMENTAL COURSE

Renaissance Society and Culture—See Art 109A,B, Humanities 109A,B or History 109 A,B (Art History credit given)

INTERDEPARTMENTAL SEMINAR

Art and the Law—See Law 235 (Art History credit given)

COURSES IN PRACTICE OF ART (STUDIO)

Students enrolled at the overseas campuses who wish to sign up for studio courses during advanced registration for the following quarter, must send notification to the Art Department detailing course number and section for the classes in which they wish to register.

BASIC COURSES

40. Basic Drawing — Basic drawing concepts introduced through charcoal, pencil, pen and ink, colored chalk, and opaque watercolor.

3 units, Aut, Win, Spr (Johnson)

50. Basic Sculpture—Introduction to sculpture through the use of clay, wire, wood construction, and plastic materials.

3 units, Aut, Win, Spr (Randell)

60. Basic Design — Introduction to visual language and media, and their applications to communication and environment. Two-and three-dimensional projects.

3 units, Aut, Win, Spr (Kahn, Molenkamp)

70. Basic Photography — Basic laboratory problems in developing and printing.

3 units, Aut, Win, Spr (Holub, Parker)

INTERMEDIATE COURSES

140. Drawing I — Intermediate drawing. Fundamentals of composition, and the color aspects of black and white approaches through drawing from still life and model. Prerequisite: 40 or equivalent, or consent of instructor. May be repeated for credit.

4 units, Aut, Win, Spr (Boyle)

141. Drawing II—Advanced drawing and composition. Prerequisite: 40 or equivalent, or consent of instructor. May be repeated for credit.

3 units, Aut, Win, Spr (Oliveira)

142. Drawing III—Advanced drawing. Emphasis on student initiative in respect to composition, color, and use of a variety of drawing materials. Work from imagination, still life, and model. Prerequisite: 40 or equivalent, or consent of instructor. May be repeated for credit.

3 or more units, Aut, Win, Spr (Lobdell)

145. Painting I — Introduction to painting procedure. Still life, landscape, and figure studies in oil and varied media. Prerequisite: 40 or equivalent, or consent of instructor. May be repeated for credit.

3 units, Aut, Win, Spr (Johnson)

146. Painting II—Beginning and intermediate painting. Extended problems in pictorial organization and content, with stress on oil painting. Prerequisite: 40 or equivalent, or consent of instructor. May be repeated for credit.

4 units, Aut, Win, Spr (Boyle)

147. Painting III—Advanced painting with emphasis on the individual point of view. Prerequisite: Three quarters of 145, 146, or equivalent, or consent of instructor.

3 or more units, Aut, Win, Spr (Lobdell)

148. Monoprint — Introduction to printmaking using monotype, a graphic art medium which was used by such artists as Blake, Degas, Gauguin, Pendergast, and many others. Visits to the Achenbach Foundation collection and the Editions Press in San Francisco, and the Stanford Museum will supplement this course. Prerequisite: 40 or equivalent. May be repeated for credit.

3 units, Aut, Win, Spr (Oliveira)

150. Sculpture I — Introduction to woodcarving and wood construction. Prerequisite: 50.

3 units, Aut, Win, Spr (Randell)

151. Sculpture II—Introduction to sculpture in metal. Gas and arc welding are principal techniques used. Prerequisite: 150.

3 units, Aut, Win, Spr (Randell)
160A,B. Design I — Comprehensive design experiences in a broad range of practical problem areas, with emphasis on fundamental design principles and methodology. Prerequisite: 60.
3 or more units, Aut, Win, Spr (Kahn, Molenkamp)

161. Design II—Introduction to Graphic Design—An introduction to the theory and practice of graphic design, including calligraphy, typography and the process of development of design concept. The course is designed mainly for undergraduates and is prerequisite for all further graphic design work. Prerequisite: Art 160 or equivalent.
3 units, Aut, Win (Molenkamp)

162. Design III—Typography, Type and Symbol Design—Perfecting the techniques and skills in typography acquired in 161. Emphasizes type and symbol design. Introduction to packaging and container design. Prerequisite: Art 161.
3 units, Win, Spr (Molenkamp)

166. Silkscreen Process/Textiles — Design problems in textiles, papers, and other surface materials with emphasis on the silkscreen printing process. Prerequisite: 160 or 161.
4 or more units, Aut (Kahn)

167. Metalsmithing — Design problems in jewelry and small utilitarian objects. Emphasis on craftsmanship in metal construction and lost wax casting. Prerequisite: 162.
4 or more units, Win (Kahn) given 1975-76

170. Intermediate Photography—Perfecting skills and techniques acquired in basic photography. Prerequisite: 70 or equivalent.
3 units, Aut, Win, Spr (Holub, Parker)

171. Photo Essay and Photo Silk-Screening — For serious students of photography. Prerequisites: 170 and consent of instructor.
3 units, Aut, Win, Spr (Holub, Parker)

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

241. Advanced Drawing and Painting Criticism I—Prerequisite: at least two quarters of painting or drawing.
Aut, Win, Spr (Oliveira) by arrangement

242. Advanced Drawing and Painting Criticism II—Prerequisite: at least two quarters of painting or drawing.
Aut, Win, Spr (Boyle) by arrangement

243. Advanced Drawing and Painting Criticism III.
Aut, Win, Spr (Lobdell) by arrangement

244. Individual Work: Drawing and Painting.
Any quarter (Staff) by arrangement

248. Advanced Lithography—Continuation of lithography, dealing with advanced technical and aesthetic problems in the medium. Prerequisite: 148.
Aut, Win, Spr (Oliveira) by arrangement

Any quarter (Staff) by arrangement

251. Metal Sculpture—Plastic construction, plastic forming. Prerequisite: 151.
3 units, Aut, Win, Spr (Randell)

252. Advanced Metal Sculpture—Welding aluminum and stainless steel. Prerequisite: 251.
3 units, Aut, Win, Spr (Randell)

Any quarter (Kahn, Molenkamp) by arrangement

261. Advanced Design I—Book Design/Design for Print—Introduction to book design and design for print. Includes experience in book design and production. Emphasizes the use of pictorial and typographical material. Prerequisite: Art 162 (148 or 70 with consent of instructor).
3 or more units, Spr (Molenkamp)

262. Advanced Design II—Graphic Organization—Design problems in graphic organization. Emphasizes the formulation of the problems and the appropriate approaches of design.
3 or more units, Win (Molenkamp)

263. Advanced Design III — Design Research Projects—Advanced design research projects in visual communication with emphasis on professional practice.
3 or more units, Spr (Molenkamp)

268. Design Synthesis—Mature semi-elective problems in composite and multi-media design areas. Prerequisite: any two design courses above 160.
3 or more units, Spr (Kahn)
269. Advanced Creative Studies—Seminar based upon elective design projects in areas of personal specialization.
   *Aut, Win, Spr (Kahn) by arrangement*

   *Aut, Win, Spr (Holub, Parker) by arrangement*

   *Aut, Win, Spr (Staff) by arrangement*

342. M.F.A. Project (Studio).
   *Any quarter (Staff) by arrangement*

360. Master's Project (Seminar): Design.
   *Aut, Win, Spr (Staff) by arrangement*

**RELATED COURSES**

Philosophy of Design—See Mechanical Engineering 214.

American Experimental Film—See Communications 210A.

**COURSES IN ART EDUCATION**

213. Foundations of Aesthetic Education—(Enroll in Education 213.)

219. The Artistic Development of the Child—(Enroll in Education 219.)

261A. Seminar for Doctoral Students in Art Education—(Enroll in Education 261A.)

380. Curriculum Development in the Visual Arts—(Enroll in Education 380.)

480. Directed Reading—(Enroll in Education 480.)

490. Directed Research—(Enroll in Education 490.)

**ASIAN LANGUAGES**

*Emeriti:* S. Wing Chan, Frederic Spiegelberg

*Professors:*

Chairman: Makoto Ueda

Professors: Albert E. Dien (on leave spring quarter 1975–76), James J. Y. Liu, David S. Nivison, Makoto Ueda

Associate Professors: Kung-yi Kao, William A. Lyell, John C. Y. Wang (on leave 1975–76)

Assistant Professors: Philip T. Harries, Susan K. Matisoff

*Lecturers:* Yin Chuang, Hiroyasu Kubota, Kimie Nebrig, Hiroshi Sakamoto, Dorothy Shou, Hei-Tak Wu

**Chinese-Japanese Language and Area Center**

*Director:* Albert E. Dien


*Assistant Professors:* Winston B. Davis, Harry Harding, Jr., Phillip T. Harries, John D. LaPlante, Jeffrey Mass (on leave 1975–76), Susan K. Matisoff, Stephen M. Olsen

*Lecturers:* Yin Chuang, James Cole, Hiroyasu Kubota, Kimie Nebrig, Hiroshi Sakamoto, Dorothy Shou, Hei-Tak Wu

**Offerings**

The Department of Asian Languages offers courses in the languages, cultures, and literatures of China and Japan. The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, and Doctor of Philosophy in Chinese or Japanese. It also gives a minor in Chinese or Japanese language and literature for the degree of Doctor of Philosophy.

**Programs of Study**

**Bachelor of Arts**

The degree of Bachelor of Arts is granted both in Chinese and in Japanese. The following courses must be completed:

1. Concentration in Chinese: AL92, C103, AL131, 132, 133, and two other content courses dealing with China at the 100 level, as approved by the Undergraduate Advisor.

2. Concentration in Japanese: AL92, J103, AL136, 137, 138, and two other content courses dealing with Japan at the 100 level, as approved by the Undergraduate Advisor.
ADMISSION TO GRADUATE STUDY

All students contemplating application for admission to graduate study must have a creditable undergraduate record at Stanford or elsewhere. The applicant need not have majored in Chinese or Japanese as an undergraduate, but must have had the equivalent of at least three years’ training in the language in which he or she intends to specialize, and must also demonstrate a command of English adequate for the pursuit of graduate study. Applicants should not wish merely to acquire or improve language skills but to pursue study in one of the following fields: Chinese history (premodern), Chinese linguistics, Chinese literature, Chinese philosophy, Japanese cultural history, Japanese literature.

MASTER OF ARTS

The degree of Master of Arts is granted in Chinese and in Japanese. The normal length of study for the degree is two years. Applicants who wish to obtain the A.M. only but do not intend to proceed to the Ph.D. will only be considered if no financial aid is requested.

Students who wish to spend their first year of graduate study at the Taipei or Tokyo Center must obtain departmental approval first.

Candidates for the degree must be in residence at Stanford in California during the final quarter of registration.

A thesis is not required for the A.M. degree. Instead, the candidate must prepare, in Chinese 299 or Japanese 299, an annotated translation of a text of suitable literary or historical worth. Under special circumstances, a paper approved by the Graduate Adviser may be substituted.

The University’s basic requirements for the Master’s degree are given in the section “Degrees” in this bulletin. Departmental requirements are set forth below.

Master of Arts: Chinese

The candidate must:

1. Meet the Department’s requirements for the Bachelor of Arts in Chinese or their equivalent.

2. Complete the following course work: 201, 202, 213, 223, 299; four courses in Chinese numbered between 241 and 292; and two courses on the upper division or graduate level in fields such as Chinese anthropology, art, history, philosophy, and politics, as approved by the Graduate Advisor in consultation with the student’s individual advisor. Students may be exempted from 211, 212, 213 and 221, 222, 223 by passing examinations to demonstrate that they have attained equivalent language competence.

Master of Arts: Japanese

The candidate must:

1. Meet the Department’s requirements for the Bachelor of Arts in Japanese or their equivalent.

2. Complete the following course work: 201, 202, 213, 248, 299; four courses in Japanese numbered between 256 and 297; and two courses in such fields as Japanese anthropology, history, politics, and religion, as approved by the Graduate Advisor in consultation with the student’s individual advisor. Students may be exempted from 211, 212, 213 and 246, 247, 248 by passing examinations to demonstrate that they have attained equivalent language competence.

DOCTOR OF PHILOSOPHY

The Doctor of Philosophy degree is granted in Chinese and in Japanese. Candidates for the degree are expected to acquire a thorough familiarity with Chinese or Japanese literature, an adequate command of both languages, and a comprehensive knowledge of East Asian history, social institutions, and thought. The University’s basic requirements for the doctorate are given in the section “Degrees” in this bulletin. Departmental requirements are set forth below.

Admission to candidacy—During a student’s second year of graduate study, the graduate faculty of his or her major field (Chinese or Japanese) will evaluate his or her progress on the basis of the A.M. Translation and course work, and decide whether the student should be admitted to candidacy for the Ph.D. or terminated. Such evaluation will take place no later than the Spring quarter of the student’s second year. In the case of a student who already has an A.M. when admitted to the department, the evaluation will be based on course work and written papers. If a student goes to the Tai-
pei or Tokyo Center during his or her first two years, the department will consider requesting the Dean of Graduate Studies for approval of an exception to the rule that qualification procedure must take place during the student's first two years.

A candidate must fulfill the following requirements for the Ph.D.

1. He or she must demonstrate a reading knowledge of French or German within a year after completing the A.M. degree.

2. He or she must complete two seminars at the 300 level. These seminars must be in different subjects.

3. He or she must pass an examination in the supporting Asian language. A candidate whose field is Chinese, will be examined on his ability to read modern Japanese works relevant to his or her field of study. This requirement may be met by completing Japanese 103. A candidate whose field is Japanese will be examined on ability to read Classical Chinese works relevant to his or her field of study. This requirement may be met either by completing Chinese 113 or by taking Japanese 250 and subsequently passing a test on the prescribed reading list in Kambun.

4. He or she must pass a set of four comprehensive written examinations. One of these will test the candidate's methodological competence in a discipline. The remaining three fields are to be chosen, with the approval of the Graduate Advisor in consultation with the student's individual advisor, from the following: Chinese literature, Chinese history, Chinese philosophy, Chinese linguistics, Chinese art, Japanese literature, Japanese history, Japanese religion, Japanese art.

University oral examination—General regulations governing the oral examination will be found in the section "Degrees" in this bulletin. The candidate will be examined on questions related to his or her dissertation, after acceptable parts thereof have been completed in draft form.

Dissertation—The candidate will write a dissertation demonstrating ability to undertake original research based on primary materials in Chinese or Japanese.

Minor for the Degree of Doctor of Philosophy—A student taking a minor in Asian languages shall complete at least 30 units of work within the Department to be chosen in consultation with a Departmental advisor.

He or she must elect either Chinese 201–202 or Japanese 201–202 unless the Department is satisfied that work done elsewhere has provided similar training. He or she must also pass a written examination in the Chinese or Japanese language.

Special Programs for the Degree of Doctor of Philosophy—Properly qualified students may plan special interdepartmental programs in the Asian field for the degree of Doctor of Philosophy. See the section "Graduate Division Special Programs" in this bulletin.

Special Opportunities for Study Abroad—Attention is called to the programs of the Inter-University Program for Chinese Language Study in Taipei and the Inter-University Center for Japanese Studies in Tokyo (both of which are administered by Stanford University). They are described elsewhere in this bulletin.

Summer Program of Intensive Language Courses—A ten-week program, which begins at the same time as the University's general summer program and continues two weeks beyond it, is held each summer. Intensive instruction is offered, on three different levels, in both Chinese and Japanese. The intensive courses provide the equivalent in instruction to regular academic-year courses. (See courses Chinese 5, 25, 105, Japanese 5, 25, and 105 as described below.) For detailed information about these and other aspects of the summer program, apply directly to the Department of Asian Languages, preferably before the end of the preceding autumn quarter.

COURSES NOT REQUIRING KNOWLEDGE OF AN ASIAN LANGUAGE

8. Languages of East Asia—A survey of East Asian languages, primarily Chinese and Japanese, discussing structure, literary forms, development of the script and prospects. This is meant to provide background information for the beginning language student but others may also enroll.

3 units, Aut (Staff) given 1976–77

46. Philosophical Chinese—Introduction to Classical Chinese and to Chinese philosophical concepts, through study of short philosophical texts; for students who have had no previous work in a Far Eastern language.
This course is intended for students who are not yet sure they wish to invest the time needed to learn to read and speak Chinese well, but who would like to learn something of the language of early Chinese philosophy, sufficient to enable them to read translations of Chinese philosophers, and books and articles in English about them, with some critical awareness of underlying language problems when a language radically unlike English is the medium of philosophical thinking. Significant Chinese texts will be examined and explicated as they are encountered, as quotations in articles or as problematic passages in translated works. Philosophers treated will include Confucius, Mencius, and Lao Tzu. This course is self-contained and does not assume that the student will do further work in the subject; a student taking the course may, however, continue study of classical Chinese by enrolling in 47 in the spring quarter and 101A the next year.

3 units, Win (Nivison) MWF10

47. Philosophical Chinese—Continuation of 46. Reading in Mencius and Han Fei Tzu.

3 units, Spr (Nivison) MWF10

91. Traditional East Asian Civilization — (Same as History 91 and Humanities 91.) An introduction to the development of civilization in China and Japan from earliest times to the spread of Buddhism. Lectures and discussions will cover political institutions, social and political ideas, religious currents, and artistic and literary trends. Intended for the nonspecialist.

5 units, Win (Duus, Lyell, Matisoff) MTWTh10

92. Traditional East Asian Civilization — (Same as History 92 and Humanities 92.) A continuation of History 91, or AL 91 covering the period down to 1700. Open only to students who have completed History or AL 91.

5 units, Spr (Duus, Lyell, Matisoff) MTWTh10

110 (257). Japanese-Western Literary and Cultural Interactions— (Same as Comparative Literature 110 and International Relations 110.) Discussion of cross-literary and cross-cultural topics, such as haiku in English, Marxism in Japanese prose fiction, and Zen in American literature. Graduate students may register under 257, in which case they will be required to do additional work.

4 units, Win (Ueda) M 2:15-4:05

131. Chinese Poetry and Drama in Translation—Readings in traditional Chinese poetry and drama with discussions on background, theme, and style.

4 units, Aut (Liu) MWF11

132. Chinese Fiction in Translation—A survey of Chinese prose fiction from early times to the late Ch'ing period, with emphasis on literary discussions of major representative works available in English translation.

4 units, Win (Staff) MWF11

133. Modern Chinese Literature in Translation—Readings in representative twentieth-century works of fiction, drama, and poetry in translation.

4 units, Spr (Lyell) MWF 1:15

136. Early Japanese Literature in Translation—An introduction to the major works of prose and poetry from the Nara through the Kamakura periods (c. 700–1300).

4 units, Aut (Harries) MWF 1:15

137. Japanese Literature in Translation—The Middle Period—An introduction to the major works in prose, poetry, and the theater from the Muromachi through the Tokugawa periods (1330–1868).

4 units, Win (Matisoff) MWF 1:15

138. Modern Japanese Literature in Translation—An introductory course in Japanese poetry, drama, and fiction since 1868. Authors considered will include Tanizaki, Kawabata, Mishima, and many others. Knowledge of pre-modern Japanese literature not required.

4 units, Spr (Ueda) MWF 1:15

143. The Philosophy of Wang Yang-ming (1472–1529)—(Same as Philosophy 123.)

4 units, Win (Nivison) given 1976–77

151. Chinese Historical Literature in Translation—(Same as History 196) A survey of the various modes of historical literature from earliest times, the development of historical consciousness and comparisons with other traditions.

4 units, Aut (Dien) MWF 1:15

152. Cultural History of Central Asia— (Same as History 195.) Central Asia as an arena of conflict between agricultural and nomadic societies and the traces of cultural diffusion.

4 units, Win (Dien) MWF 1:15 (plus one hour discussion to be arranged)

4 units, Spr (Wang) given 1976–77

179 (279). Classical Japanese Drama—The development of Japanese drama from pre-nō popular and ritual forms through nō, puppet theatre and kabuki. Particular emphasis will be given to the social significance of each genre and to the transition from drama as ritual to drama as theatrical entertainment. Graduate students may register under 279, in which case they will be required to do additional readings in Japanese.

4 units, Spr (Matisoff) M 2:15–4:05

184 (284). Murasaki Shikibu—The World’s First Woman Novelist—Study of the life and writing of one of the world’s greatest novelists, through detailed reading of her prose masterpiece, *The Tale of Genji*, and of her personal diary. Graduate students may register under 284, in which case they will be required to do additional readings in Japanese.

4 units, Spr (Harries) W 2:15–4:05

195 (295). Modern Intellectuals in Japanese Literature—A study of modern intellectuals described in Japanese prose fiction. Books to be discussed include Soseki’s *Kokoro*, Tanizaki’s *The Key*, Takeyama’s *Harp of Burma*, Mishima’s *Thirst for Love*, and Oe’s *A Personal Matter*. Graduate students may register under 295, in which case they will be required to do additional readings in Japanese.

4 units (Ueda) given 1976–77

197 (297). Images of Women in Modern Japanese Literature—A study of representative heroines in modern Japanese fiction. Novels to be discussed include Kawabata’s *Thousand Cranes*, Dazai’s *The Setting Sun*, Kafū’s *Geisha in Rivalry*, and Abe’s *The Woman in the Dunes*. Graduate students may register under 297, in which case they will be required to do additional readings in Japanese.

4 units, Win (Ueda) given 1976–77

255B. Chinese and Western Theories of Literature—(Same as Comparative Literature 255B.) Study of traditional Chinese theories of literature in comparison with Western ones. Seminar with limited enrollment. Graduate students in Chinese may enroll in this seminar in lieu of 361 and will be required to read original texts.

5 units, Spr (Liu) given 1976–77

I. COURSES IN CHINESE

1, 2, 3. First-Year Modern Chinese — Conversation, grammar, reading, elementary composition.

1. 5 units, Aut (Kao, Shou, Staff)
   Section 1 MTWThF 9
   Section 2 MTWThF 10
   Section 3 MTWThF 1:15

2. 5 units, Win (Kao, Shou, Staff)
   Section 1 MTWThF 9
   Section 2 MTWThF 9
   Section 3 MTWThF 1:15

3. 5 units, Spr (Kao, Shou, Staff)
   Section 1 MTWThF 9
   Section 2 MTWThF 9
   Section 3 MTWThF 9

5. Intensive First-Year Modern Chinese — Equivalent to 1, 2, and 3 combined.
   15 units, Sum (Staff) MTWThF 8–12

21, 22, 23. Second-Year Modern Chinese — Further study in grammar, reading, conversation, composition. Prerequisite: 3 or equiv.

21. 5 units, Aut (Chuang) MTWThF 9
22. 5 units, Win (Chuang) MTWThF 9
23. 5 units, Spr (Chuang) MTWThF 9

25. Intensive Second-Year Modern Chinese — Equivalent to 21, 22, 23 combined. Prerequisite: 3 or equivalent.
   15 units, Sum (Staff) MTWThF 8–12

51. Chinese Calligraphy—Practice in writing Chinese characters with a brush and learning different scripts. Prerequisite: Chinese 3, Japanese 3, or equivalent.
   1 to 2 units, Spr (Chuang) by arrangement

81, 82, 83. First-Year Cantonese—Conversation and grammar.
81. 5 units, Aut (Wu) by arrangement
82. 5 units, Win (Wu) by arrangement
83. 5 units, Spr (Wu) by arrangement

ADVANCED

101, 102, 103. Third-Year Chinese—Reading texts representative of various modern written styles; practice in using reference works; Introduction to Classical Chinese. Prerequisite: 23 or equivalent.
101. 5 units, Aut (Lyell) MTWThF 9
102. 5 units, Win (Lyell) MTWThF 9
103. 5 units, Spr (Lyell) MTWThF 9

101A, 102A, 103A. Introduction to Classical Chinese—This is the portion of third-year Chinese that deals with elementary classical Chinese. Enrollment limited to graduate students in Japanese, or by special permission of the department.
101A. 2 units, Aut (Lyell) TTh 9
102A. 2 units, Win (Lyell) TTh 9
103A. 2 units, Spr (Lyell) TTh 9

15 units, Sum (Staff) MTWThF 9–12

111. 5 units, Aut (Kao) MWF 11
112. 5 units, Win (Kao) MWF 11
113. 5 units, Spr (Kao) MWF 11

121, 122, 123. Advanced Conversation—Prerequisite: 23 or equivalent.
121. 2 units, Aut (Chuang) by arrangement
122. 2 units, Win (Chuang) by arrangement
123. 2 units, Spr (Chuang) by arrangement

199. Individual Reading in Chinese—(Asian Languages majors only). Prerequisite: 103 or consent of instructor.
4 units, Aut, Win, Spr (Staff) by arrangement

GRADUATE

200. Directed Reading in Chinese—Prerequisite: 103 or equivalent.
Number of units to be arranged, Aut, Win, Spr (Staff) by arrangement

201. 5 units, Aut (Dien) T 2:15–4:05
202. 5 units, Win (Dien) T 2:15–4:05

211, 212, 213. Modern Expository Chinese—Readings in contemporary Chinese scholarly and journalistic writings. Prerequisite: 103 or consent of instructor.
211. 5 units, Aut (Chuang) MTWThF 10
212. 5 units, Win (Chuang) MTWThF 10
213. 5 units, Spr (Chuang) MTWThF 10

221, 222, 223. Advanced Classical Chinese—Prerequisite: 113 or equivalent.
221. Historical Narration
4 units, Aut (Dien) MWF 9
222. Philosophical Texts
4 units, Win (Nivison) MWF 9
223. Literary Essays
4 units, Spr (Nivison) MWF 9

243. The Philosophy of Wang Yang-ming—
(Same as 143 with additional work requiring the knowledge of the language.)
4 units, Win (Nivison) given 1976–77

253. Local Histories—History of Chinese local historiography; survey of types of histories available; reading of sample texts of different kinds found in local histories. Prerequisite: 223 or consent of instructor.
4 units, Spr (Nivison) given 1976–77

261. Chinese Poetry—Selected readings in Han, Wei, and Six Dynasties Poetry (2nd century B.C.–6th century A.D.), with emphasis on critical analysis. Prerequisite: 223 or consent of instructor.
4 units, Aut (Liu) given 1976–77

262. Chinese Poetry—Selected readings in T'ang and Sung Poetry (7th–13th centuries A.D.), with emphasis on critical analysis. Prerequisite: 223 or consent of instructor.
4 units, Win (Liu) given 1976–77

263. T'ang and Sung Lyrics—Selected readings in the lyrics (tz'u) of the T'ang, Five Dynasties, and Sung periods (8th–13th centuries A.D.), with emphasis on critical analysis. Prerequisite: 262 or consent of instructor.
4 units, Aut (Liu) MWF 10

264. Yüan and Ming Songs—Selected readings in the songs (san-ch'ü) of the Yüan and Ming periods (13th–17th centuries A.D.), with emphasis on critical analysis. Prerequisite: 263 or consent of instructor.
4 units, Win (Liu) MWF 11
265. Chinese Critical Texts—Readings in traditional Chinese literary criticism. Prerequisite: 223 or consent of instructor.
4 units, Win (Liu) MWF 10

271, 272. Traditional Chinese Fiction—Selected readings in short stories and longer works of fiction from early times to late Ch'ing. Prerequisite: 113 or consent of instructor.
271. 4 units, Win (Staff) by arrangement
272. 4 units, Spr (Staff) by arrangement

273. Chinese Drama—Selected readings in dramatic works of the Yuan, Ming, and Ch'ing periods, with emphasis on literary rather than theatrical qualities. Prerequisite: 113 or consent of instructor.
4 units, Win (Wang) given 1976-77

274. Early Chinese Prose Literature—Selected readings in pre-Han prose texts with emphasis on their literary value in the study of later literature. Prerequisite: 223 or consent of instructor.
4 units, Spr (Wang) given 1976-77

281. Modern Chinese Literature—Short story and essay. Prerequisite: 213 or consent of instructor.
4 units, Aut (Lyell) TTh 1:15

291. The Structure of Modern Chinese—Prerequisite: 23 or equivalent. Recommended: a general introductory course in linguistics.
4 units, Spr (Kao) by arrangement

292. The Chinese Language and Current Linguistic Theories—Prerequisite: 103 or equivalent. Recommended: a general introductory course in linguistics.
4 units, Spr (Kao) given 1976-77

299. Translation.
A total of 5 units, which may be taken in one or more quarters, Aut, Win, Spr (Staff) by arrangement

321. Seminar on Mencius
5 units, Aut (Nivison) given 1976-77

5 units, Aut (Nivison) M 2:15-4:05

351. Seminar in Chinese Traditional Historiography—May be repeated for credit.
5 units, Spr (Dien) given 1976-77

361. Seminar in Chinese Literary Criticism—May be repeated for credit. Prerequisite: 265 or consent of instructor.
5 units, Spr (Liu) W 2:15-4:05

371. Seminar in Chinese Narrative—Thorough studies of individual texts with emphasis on theoretical applications. May be repeated for credit. Prerequisite: 272 or consent of instructor.
5 units, Aut (Wang) given 1976-77

(Staff) by arrangement

II. COURSES IN JAPANESE

1, 2, 3. First-Year Modern Japanese—Conversation, grammar, reading, elementary composition.
1. 5 units, Aut (Sakamoto, Nebrig)
   Section 1 MTWThF 9
   Section 2 MTWThF 11
   Section 3 MTWThF 2:15
2. 5 units, Win (Sakamoto, Nebrig)
   Section 1 MTWThF 9
   Section 2 MTWThF 11
   Section 3 MTWThF 2:15
3. 5 units, Spr (Sakamoto, Nebrig)
   Section 1 MTWThF 9
   Section 2 MTWThF 11
   Section 3 MTWThF 2:15

5. Intensive First-Year Modern Japanese—Equivalent to 1, 2, and 3 combined.
15 units, Sum (Staff) MTWThF 8-12

21, 22, 23. Second-Year Modern Japanese—Further instruction and practice in conversation, grammar, reading, and composition. Prerequisite: 3 or equivalent.
21. 5 units, Aut (Kubota) MTWThF 9
22. 5 units, Win (Kubota) MTWThF 9
23. 5 units, Spr (Kubota) MTWThF 9

25. Intensive Second-Year Modern Japanese—Equivalent to 21, 22, and 23 combined. Prerequisite: 3 or equivalent.
15 units, Sum (Staff) MTWThF 8-12

27, 28, 29. Intermediate Conversation—Prerequisite: 3 or equivalent.
27. 2 units, Aut (Sakamoto) TTh 1:15
28. 2 units, Win (Sakamoto) TTh 1:15
29. 2 units, Spr (Sakamoto) TTh 1:15
ADVANCED

101, 102, 103. Modern Written Japanese—Reading texts representative of various modern written styles. Prerequisite: 23 or equivalent.

101. 5 units, Aut (Kubota) MTWThF 11
102. 5 units, Win (Kubota) MTWThF 11
103. 5 units, Spr (Kubota) MTWThF 11

105. Intensive Modern Written Japanese—Equivalent to 101, 102, and 103 combined. Prerequisite: 23 or equivalent.

15 units, Sum (Staff) MTWThF 9–12

121, 122, 123. Advanced Conversation —Prerequisite: 23 or equivalent.

121. 2 units, Aut (Kubota) TTh 1:15
122. 2 units, Win (Kubota) TTh 1:15
123. 2 units, Spr (Kubota) TTh 1:15

199. Individual Reading in Japanese—(Asian Languages majors only.) Prerequisite: 103 or consent of instructor.

4 units, Aut, Win, Spr (Staff) by arrangement

GRADUATE

200. Directed Reading in Japanese — Prerequisite: 103 or equivalent.

Number of units to be arranged, Aut, Win, Spr (Staff) by arrangement


201. 5 units, Aut (Matisoff) W 2:15–4:05
202. 5 units, Win (Harries) W 2:15–4:05


211. 5 units, Aut (Matisoff) MW 11–12:15
212. 5 units, Win (Matisoff) MW 11–12:15
213. 5 units, Spr (Matisoff) MW 11–12:15

246, 247, 248. Introduction to Classical Japanese—The basic principles of the classical literary language. The first quarter concentrates on basic grammar and vocabulary, while the subsequent quarters involve reading in progressively more difficult texts from the Heian and Kamakura periods. Prerequisite: 103 or equivalent.

246. 4 units, Aut (Harries) TTh 2:15–4:05
247. 4 units, Win (Harries) TTh 2:15–4:05
248. 4 units, Spr (Harries) TTh 2:15–4:05

249. Japanese Historical Texts: An Introduction to Komonjo—(Same as History 494.) A course on early and medieval documents; where to find them, how to read them, and the ways they can contribute to an understanding of Japanese history. Emphasis will be on the Kamakura period. Prerequisite: 3 years of Japanese and at least one course in Japanese history.

5 units, Spr (Mass) given 1976–77

250. Introduction to Kambun — Prerequisite: Chinese 103A or consent of instructor.

4 units, Aut (Matisoff) given 1976–77

257. Japanese-Western Literary and Cultural Interactions—(Same as 110 with additional work requiring knowledge of the language.)

4 units, Win (Ueda) M 2:15–4:05

258. Major Haiku Poets—Reading and discussion of selected haiku by Bashō, Buson, Issa, and others. May be repeated for credit.

4 units, Aut (Ueda) TTh 10:00–11:30

259. Readings in Japanese Criticism —Selected readings of modern Japanese literary scholars, as an introduction to Japanese critical method and idiom. Prerequisite: 103 or equivalent.

4 units, Win (Harries) given 1976–77

276. Readings in Medieval Prose—Readings from the major prose texts of the Kamakura-Muromachi periods. Emphasis on episodes from Heike monogatari and Konjaku monogatari which exemplify popular cultural traditions and inspire later writers. Prerequisite: 248 or equivalent.

4 units, Spr (Matisoff) given 1976–77

278. Japanese Poetry from Manyōshū to Renga—Prerequisite: 247 or equivalent.

4 units, Spr (Harries) given 1976–77

279. Classical Japanese Drama—(Same as 179 with additional work requiring knowledge of the language. Prerequisite: 246 or equivalent.)

4 units, Spr (Matisoff) M 2:15–4:05

284. Murasaki Shikibu—(Same as 184 with selected readings of the Genji Monogatari in the original. Prerequisite: 247 or equivalent.

4 units, Spr (Harries) W 2:15–4:05
295. Modern Intellectuals in Japanese Literature—(Same as 195 with additional work requiring knowledge of modern Japanese.) 4 units, Win (Ueda) given 1976–77

299. Translation.
A total of 5 units, which may be taken in one or more quarters, Aut, Win, Spr (Staff) by arrangement

369. Seminar in Classical Japanese Literature—Students intending to enroll in the seminar are required to consult the instructor at the beginning of the preceding quarter.
5 units, Spr (Ueda) W 2:15–4:05

396. Seminar in Modern Japanese Literature—May be repeated for credit. Students intending to enroll in the seminar are required to consult the instructor at the beginning of the preceding winter quarter.
5 units, Spr (Ueda) given 1976–77

399. Dissertation.
(Staff) by arrangement

ADDITIONAL INFORMATION
For information concerning other opportunities for study in the Asian field, see listings under the following departmental headings: Anthropology, Art and Architecture, Economics, Graduate Division Special Programs, History, Humanities Special Programs, Philosophy, Political Science, Social Sciences (Special Program), Sociology. For additional offerings in literature, see Comparative Literature.

BIOLOGICAL SCIENCES
Emeriti: Lawrence R. Blinks, Arthur C. Giese, George S. Myers, Cornelis B. van Niel, Joseph F. Oliphant, Ira L. Wiggins (Professors); Roxana S. Ferris (Curator). By Courtesy: C. Stacy French

Acting Chairman: Allan McC. Campbell
Director of Undergraduate Studies: John H. Thomas
Director of Graduate Studies: Paul R. Ehrlich


Assistant Professors: Peter A. Getting, H. Craig Heller, Peter K. Hepler, Jonathan Roughgarden, Robert D. Simoni. By Courtesy: Joseph A. Berry

Adjunct Professors: Naomi C. Franklin, Donald H. Perkel, Evelyn Shaw

Lecturers: Marcia K. Allen, Charles H. Baxter, Elizabeth M. Center

Directors of Systematic Collections: Paul R. Ehrlich (Entomological Collections), John H. Thomas (Dudley Herbarium)

OFFERINGS AND FACILITIES
The Department of Biological Sciences comprises facilities and personnel housed in Herrin Laboratories and Herrin Hall, the Museum Building on the campus, and in the Hopkins Marine Station in Pacific Grove on Monterey Bay.

The Department provides: (1) courses designed for the general student, (2) a major program leading to the degree of Bachelor of Science, (3) programs of graduate study and research leading to the degree of Doctor of Philosophy, and (4) a program of study leading to the Master of Science degree designed for students not intending to proceed to the Ph.D. degree at Stanford. The Department also administers a graduate program leading to the Ph.D. in Biophysics.

The Jasper Ridge Biological Preserve Area near the Stanford Campus provides a 960-acre reserve on the campus for physiological, ecological and population studies. Special laboratory facilities for marine research are described in the Hopkins Marine Station Bulletin.

The Dudley Herbarium, named in honor of Professor William Russel Dudley, a distinguished member of the original faculty of Stanford University, is especially rich in material of vascular plants from western North America from Alaska to Central America. Representative collections from other parts
of the world, especially the Mediterranean region, furnish authentic comparative material. The collections in the Dudley Herbarium now number about 750,000 sheets and constitute one of the most important resources in existence for critical systematic and distributional studies of the vascular plants of North America. It is housed in the south wing of the Stanford Museum Building.

Entomological collections, restricted to those being used in particular research projects, are housed in the Herrin Laboratories. No general collections are maintained except for teaching purposes. Most of the entomological collections formerly housed at Stanford are now to be found either at the California Academy of Sciences, the Los Angeles County Museum, or at the Berkeley and Davis campuses of the University of California.

The Department formerly maintained large collections of fishes, reptiles, and amphibians, as well as smaller collections of birds, mammals, and invertebrates. These are now housed at the California Academy of Sciences in San Francisco, where they, as well as the other extensive collections of the Academy, are available for those interested in the systematics of these groups.

The Falconer Biology Library in Herrin Hall and its two branches contain over 1200 current subscriptions and back sets of journals, and an extensive collection of monographs and reference works. Smaller specialized libraries serve the needs of the Hopkins Marine Station and the botanical collections of the Dudley Herbarium.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

UNDERGRADUATE ADVISING

Most members of the biology faculty are available for advising. The Student Affairs Office maintains a current list of faculty advisors, their advising schedule, and relevant guidelines.

The Student Affairs Office is prepared to answer questions on administrative matters, such as requirements for the major, eligibility of courses as electives, necessity for petition, and the like. Academic advising is provided by members of the Faculty, on such matters as choice of courses and career plans.

Each declared major in biology is expected to select a regular advisor at an early date. The resultant continuity of academic advice is likely to be particularly advantageous to students who anticipate applying to medical school or graduate school, enrolling in the honors or coterminal program, taking courses at Hopkins Marine Station, or attending one of the overseas campuses.

COURSE REQUIREMENTS

Candidates for the degree of Bachelor of Science must complete:

(1) Core Courses

<table>
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<th>Course</th>
<th>Units</th>
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<tr>
<td>Biology 1</td>
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<tr>
<td>Biology 21</td>
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<td>Biology 22</td>
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</tr>
<tr>
<td>Biology 24YZ</td>
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<td>Total</td>
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(2) Elective Courses

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<tr>
<th>Course</th>
<th>Units</th>
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<tr>
<td>Electives</td>
<td>18</td>
</tr>
<tr>
<td>Total Core and Electives</td>
<td>40</td>
</tr>
</tbody>
</table>

Elective courses may be selected from the offerings in the Department of Biological Sciences or from a list of courses in other departments. This list may be obtained from the Student Affairs Office. In completing the elective course requirement, a biology major must take approved elective courses from at least three faculty members (this does not apply to students in the class of 1973 or 1974).

Not more than 10 units from a single faculty member or in a single specialized field from "in-depth" courses, such as 169, 175H, 178, 198, 199, 199H, 245, 253, may be applied toward the total number (40) of required biology units.

(3) Cognate Courses

Required courses in cognate fields include:

- Introductory, organic, and physical chemistry, with laboratory.
- A half year (two quarters) of General Physics Mathematics through Calculus

It is expected that many students will meet a portion of these requirements by advanced placement on the basis of their high school education. The following Stanford courses fulfill these requirements:

- Chemistry 31, 33
- Chemistry 35, 36, 131, 132, and 135
- Mathematics 5, 6, 7 or 10, 11, 21 or 41, 42
- Physics 21, 23 or 51, 53, 55
Physics 29 is not required by this department because it overlaps required courses in chemistry. Students should be aware, however, that many graduate schools and professional schools (e.g. Medicine and Education) have a requirement for a “year of general physics with laboratory.” Biology majors are therefore strongly urged to take the year-long Physics sequence Physics 21, 23, 29 (or Physics 51, 53, 54, 55, 56, 57, 58). It is strongly recommended that students intending to do graduate work in Biological Sciences acquire reading ability in an appropriate modern foreign language.

It is also recommended that such students complete the mathematics requirement with Mathematics 10, 11, 21 or 41, 42 and take at least one additional course in statistics and probability.

**Typical Schedule for a Four-Year Minimum Program**

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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</thead>
<tbody>
<tr>
<td>Chem. 31, 33, 35, 36. Introductory Chemistry</td>
<td>4</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Biology 1. Introductory Biology</td>
<td>—</td>
<td>—</td>
<td>5</td>
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</tr>
<tr>
<td>Math. 10, 11, 12. Calculus and Probability</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
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<td><strong>Totals</strong></td>
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**Second Year**

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<td>Biology 22. Principles of Biology</td>
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<td>Biology 23. Principles of Biology</td>
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<tr>
<td>Biology 24. Experimental Biology</td>
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<td>3</td>
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<tr>
<td>Chem. 131, 132, 135. Organic &amp; Physical Chemistry</td>
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<td>3</td>
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<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
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<td>9</td>
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**Third Year**

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<th>Subject</th>
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<th>W</th>
<th>Sp</th>
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<tbody>
<tr>
<td>Physics 21, 23, Introductory Physics</td>
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</tr>
<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
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<tr>
<td><strong>Totals</strong></td>
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**Fourth Year**

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<th>Course No.</th>
<th>Subject</th>
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<th>W</th>
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<td>Electives</td>
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<td><strong>Totals</strong></td>
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</table>

**Honors Program in Biological Sciences**

An Honors Program in Biology is open to a limited number of qualified undergraduate majors. The aim of the program is to aid students to gain independence of thought and a more professional approach to biological problems. Emphasis will be placed on the importance of original ideas in research rather than on the mastery of established facts. Satisfactory completion of the program by the end of winter quarter preceding June Commencement, as well as completion of all requirements for the B.S. in Biological Sciences, leads to graduation “with Departmental Honors.” This designation appears on the student’s transcript and in the Commencement Program. An Honors Certificate is awarded. (See Biology 198 under “Courses.”)

**Premedical, Predental, and Preparamedical Requirements**

It is recommended that premedical, predental, and preparamedical students who are not biology majors take at least the following courses in biology: 1, 21, 22, 23, 24YZ, 110, 110L and (for those students applying to medical schools which explicitly require a course in embryology or developmental biology) 107 or 108, and such additions or substitutes as may be recommended by Stanford’s Premedical Advising Office (Academic Information Center, Old Union.)

**Transfer Students**

Transfer students should be aware that the curricula in biology and chemistry differ in important respects from those at many other institutions. For example, a year-long course in general biology may be equivalent to only a portion or more of the core curriculum in biology. Only rarely does a transfer student have the equivalent of Biology 24YZ. With respect to chemistry, after a year’s course in general chemistry at most institutions, a student is required to complete Chemistry 33, 35, 131, 132, and 135 at Stanford. After a year’s course in general chemistry plus a year’s course in organic chemistry, Chemistry 132 and 135 are required. Transfer units are not lost, but are applied to other requirements than core curriculum and cognate course requirements.

**Teaching Credentials**

For information concerning the requirements for teaching credentials, consult the School of Education section of this bulletin or address inquiry to the Credential Secretary, School of Education.
MASTER OF ARTS IN TEACHING

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section or may be obtained from the Credential Secretary, School of Education.

MASTER OF SCIENCE

The Department of Biological Sciences at Stanford University offers a program leading to the Master's degree. The program is designed for those students whose professional goals will be forwarded by advanced study in biology in an experimentally oriented department. Requirements for the degree include one year (three academic quarters) of registration, during which 45 units of credit are earned. Thirty of those units must be in advanced courses in biology; fifteen units of cognate course work is required in subjects such as statistics, biochemistry, behavioral psychology, and various courses in the Stanford Medical School. No financial support derived from Stanford University funds is available for either tuition or living expenses associated with the Master's program. Appropriate application materials for the program can be obtained from the Graduate Admissions Office.

DOCTOR OF PHILOSOPHY

Preparation for graduate study—Students seeking entrance to graduate study in biology ordinarily will have the equivalent of an undergraduate major in biology at Stanford (see above). However, we encourage students from other disciplines, particularly the physical sciences, to apply for graduate work in the Biological Sciences. Such students will be advised at the time of initial registration as to how they should complete their background training during the first year of graduate study. In addition to the usual basic undergraduate courses in biology, it is recommended that preparation for graduate work include courses in chemistry through organic chemistry, general physics, and mathematics through calculus.

Application, Admission, and Financial Aid

Prospective graduate students should apply formally through the Graduate Admissions Office, which will submit their names to the Department for approval when application requirements are completed. The deadline for receipt of applications with all supporting materials is January 15.

An applicant must file a report of scores on the aptitude tests and the advanced biology test of the Graduate Record Examination as part of the application. It is strongly recommended that the GRE be taken in October so that scores will be available when applications are evaluated.

It should be noted that, due to a high level of applications to graduate study, competition for admission has become keen and that in recent years it has been possible to act favorably upon less than ten per cent of applications received. For that reason it seems prudent to advise that only well-qualified students apply for admission. All admitted students are normally offered financial support in the form of Biology Fellowships or Graduate Research Assistantships. Such awards are for one year and are renewable as funds permit, assuming continuing excellent performance. It is current policy not to offer financial support from University-derived funds beyond the fourth year of graduate study. Qualified applicants are urged to take the initiative in applying for predoctoral national fellowships in open competition, especially those from the National Science Foundation, and to consult their Financial Aid Officers for information and applications.

Students who have had their undergraduate training in biology at Stanford are ordinarily encouraged to undertake graduate study elsewhere to ensure breadth of experience. Printed information regarding choice of a graduate school can be obtained from the Student Affairs Office of the Department.

It should be noted that graduate programs in specialized areas of biology are offered in other departments on the campus, e.g., Genetics, Physiology, Psychology, Medical Microbiology, Pharmacology, Anatomy, Biochemistry, Neurological Sciences. Students interested in these areas should contact the appropriate department. A Biophysics Program is offered in this Department.

An admitted applicant is required to conform to the requirements of the University as outlined in the section "Degrees" in this
Courses required of all Ph.D. candidates — Each student must take at least three units of work as a graduate under each of four or more Stanford faculty members. Course work to be taken in preparation for the qualifying examination will be determined in consultation with the graduate advisor.

Teaching Experience and Training are part of the graduate curriculum. Each student assists in teaching eight sections, usually during the first year in residence. This normally involves two afternoons a week for four quarters and assignments are made in consultation with the student. Graduate students with departmental support are called upon to teach one-fourth time (2 units per year) in each of the 2nd, 3rd, and 4th years. Students on non-University fellowships or grants are not required to carry out this additional teaching.

Graduate Seminars, devoted to the discussion of current literature and research in particular fields of biology, are an important means of attaining professional perspective and competence. These seminars are presented under individual course listings or as announced by the various research groups. The Biology Seminar meets on most Monday afternoons at 4:15. Topics of current biological interest are presented by speakers from Stanford and from other institutions, and are announced in the weekly Campus Report. Graduate students are expected to attend.

The Ph.D. Qualifying Examination — At the time of graduate admissions, each incoming graduate student is assigned an advising committee, consisting of three faculty members, one of whom will be as close as possible to the student's stated area of interest. The purpose of the advising committee is threefold: (1) to counsel first-year students on course work and research opportunities, (2) to evaluate progress toward qualification, and (3) to assist in organization of the dissertation committee.

As the Department requires its Ph.D.'s to have breadth of knowledge in diverse areas of biology as well as expertise in a specialized area, the advising committee is primarily responsible for assistance in assuring breadth of knowledge. The means used to judge breadth consist of (1) review of undergraduate training, (2) performance on a prescriptive examination (given before beginning of the first fall quarter), and (3) personal contact with students during the entire first year. If deficiencies are present, the advising committee may advise particular course work, directed reading, or other remedial work. Students are strongly urged to take advantage of this opportunity for continuous interaction with the faculty, not only to get feedback on progress but, equally important, to become acquainted with the opportunities of the Department.

At the end of the first year, the advising committee will evaluate student progress and recommend to the departmental faculty that the student deserves qualification to the Ph.D. program. If in the opinion of the advising committee and the student a delay in qualification is appropriate, qualification may be postponed until no later than the end of the next fall quarter.

The third function of the advising committee is to assist students in the organization of the dissertation committee, which is primarily responsible for advancement to candidacy and assistance in future training. No later than the end of the winter quarter of the second year, the student, in consultation with the dissertation committee, submits a dissertation proposal describing the area of specialization and a general outline of proposed research. The student then takes an oral examination from the dissertation committee on the proposed dissertation and on the area of specialization. Passing the oral examination, normally not to exceed two hours, automatically leads to departmental certification of candidacy. If the oral examination is not passed, it may be retaken no later than five days before the end of the next spring quarter (second year). The dissertation committee will remain active for advice and guidance during the remainder of a student's graduate training, including the period of dissertation preparation and oral defense. Work should be planned so as to complete the entire Ph.D. program within four years.

Language Requirement — A foreign language may be required by the major professor but is not required by the Department.

Residency Requirement — A minimum of three years (nine quarters) of full-time graduate registration is required of each candidate. The Department normally accepts only
full-time students for study leading to the Ph.D. However, it recognizes that because of family and child-bearing responsibilities, military or alternative service obligations, or other personal reasons, students may wish at various times to interrupt their graduate education or to pursue their studies on a half-time basis. The Department is willing to undertake such arrangements, which can include partial stipends if the student is being supported from departmental funds.

Dissertation — A contribution to knowledge which is the result of independent work, expressed in satisfactory form. Abstracts of Ph.D. theses are published in Dissertation Abstracts.

The Oral Examination — This consists of a formal seminar open to the public, followed by a closed session of questioning. This examination is taken after the dissertation is completed in draft form and approved by all members of the Reading Committee.

COURSES

Additional courses not listed here are frequently offered in the areas of their special research competence by selected postdoctoral or terminal Ph.D. personnel. These are listed in the quarterly time schedules, and course descriptions are circulated in advance.

INTRODUCTORY COURSES

1. Introductory Biology — A consideration of three major unifying themes in biology, namely: the cell theory and some of its chemical ramifications, the principles and mechanisms of Mendelian heredity, and Darwin’s principle of natural selection. Serves as introductory quarter of the Biological Sciences major core sequence; also open to non-majors interested in a first course in biology. Some previous experience with chemistry is strongly recommended.

5 units, Spr (Watt) TWThF 11;
   discussions (Staff) (1) M 1:15–3:05,
   (2) M 3:15–5:05, (3) T 1:15–3:05,
   (4) T 3:15–5:05, (5) W 1:15–3:05,
   (6) W 3:15–5:05, (7) Th 1:15–3:05,
   (8) Th 3:15–5:05, (9) T 7:30–9:30 p.m.
   (10) Th 7:30–9:30 p.m.


3 units, Win (Ehrlich, Holm) TTh 11
   alternate years, given 1975–76

21, 22, 23. Principles of Biology—A comprehensive study of the principles of modern biology from the molecular to the population level of organization, including cellular and organismal biology. These courses must be taken in sequence, although not necessarily in the same year. Prerequisites: 1, and Chemistry 31, 33, 35. Required cognate courses in calculus may be taken concurrently.

21. 4 units, Aut (Allen, Yanofsky, Simoni) MTWTh 11
22. 4 units, Win (Heller, Green) MTWTh 9
23. 3 units, Spr (Roughgarden) MWF 9

24. Experimental Biology—Introduction to experimental methods and experimental analysis of problems in the major areas of biology. A two-quarter course designed to be taken concurrently with or subsequent to Biology 21, 22, and 23. Prerequisites: 1, and Chemistry 31, 33, 35, 36.

24Y. 3 units, Win (Allen, Center)
   labs. and discussion
   (1) T 1:15–3:05, Th 1:15–5:05;
   (2) T 3:15–5:05, Th 1:15–5:05;
   (3) T 1:15–3:05, Th 1:15–3:05;
   (4) T 1:15–5:05, Th 3:15–5:05;
   (5) W 1:15–3:05, F 1:15–5:05;
   (7) W 1:15–3:05, F 1:15–3:05;
   (9) W 1:15–5:05, Th 7:00–9:00;
   (11) T 2:15–5:05, Th 3:15–5:05;
   (12) T 7:00–9:00, Th 2:15–6:05

24Z. 3 units, Spr (Allen, Center)
   labs. and discussion
   (1) T 1:15–3:05, Th 1:15–5:05;
   (2) T 3:15–5:05, Th 1:15–5:05;
   (3) T 1:15–5:05, Th 1:15–3:05;
   (4) T 1:15–5:05, Th 3:15–5:05;
   (5) W 1:15–3:05, F 1:15–5:05;
   (7) W 1:15–5:05, F 1:15–3:05;
   (9) W 1:15–5:05, Th 7:00–9:00;
   (11) T 2:15–5:05, Th 3:15–5:05;
   (12) T 7:00–9:00, Th 2:15–6:05

24S. 6 units, Sum (Staff) by application only. Fulfills the requirement of 24Y and Z for Stanford Biology majors. For further information, see Summer Bulletin.
95. Practical Plant Biology—Experience in phenomena and techniques of food crop growth by participation in field garden project accompanied by reading and discussion of pertinent botanical background.

3 units, Spr (Ray) TTh 10 plus 6 hours per week by arrangement

UPPER DIVISION COURSES

100H. Marine Algae—See Hopkins Marine Station.

106. Cell Biology—A correlation of the substructure of cells to biochemical and developmental processes. Included will be the following: the cell theory, organization and transport in membranes, cellular energetics, form and function of the organelles and inclusions of the cell, and an introduction to cell development. Prerequisite: 21 or Human Biology 2A.

3 units, Win (Hepler) MWF 10

107. Cell Development and Morphogenesis—A study of those controls which account for the progression of a cell through the cell cycle and into the differentiated state. Current theories for the generation of pattern and form will also be covered. Prerequisites: 21 and 22 or Human Biology 2A and 3A, college math, some physics is involved in the analysis.

3 units, Spr (Green) MWF 10

108. Organismal Development—A study of those processes responsible for development of multicellular organisms. Morphogenesis, cytodifferentiation, growth control, and regulatory phenomena will be discussed. Prerequisite: 110.

3 units, Win (Wessells) MWF 9, given 1976–77

110. Vertebrate Biology—Structure, function, behavior, and evolution of vertebrates. Prerequisites: 1, 21, 22, 23; or Human Biology 1, 2A, 3A, 4A.

3 units, Aut (Sweet) MWF 9

110L. Vertebrate Biology Laboratory—Dissection of selected vertebrates. Pass/No Credit only. Discussion sections to be arranged. Prerequisites: same as for 110.

2 units, Aut (Center) labs T, W, Th, or F 1:15–5:05

111H. Marine Invertebrates—See Hopkins Marine Station.
systems. Prerequisite: 23, or Human Biology 4A.

4 units, Win (Mooney) WF 11; field trips by arrangement, alternate years, given 1976–77

126. Topics in Plant Ecology — Readings and discussions in selected topics in plant ecology. The theme varies each quarter, and the course may be repeated for credit. Prerequisite: consent of instructor.

2 units, Win, Spr (Mooney) Th 4:15

127. Plants and the Fossil Record — History of plant life from the earliest known identifiable organisms of nearly three billion years ago up to the Ice Age. A major portion of the course will be devoted to tracing the emergence and development of the major groups of vascular plants and changing vegetational patterns in time and space.

3 units, Win (Page) WF 10–12

128. Systematics and Ecology of Vascular Plants — Lectures, laboratory, field studies. Prerequisite: consent of instructor.

4 or 5 units, Spr (Thomas) WF 1:15; lab. WF 2:15–5:05; field trips by arrangement

130. Algae and Fungi — These lower plants are studied in selected habitats: a pond, an ocean cove, and a wet forest slope, as well as in the laboratory. Field recognition of several score of the most common genera is involved. Pertinent ecological theory is presented. Students develop talks/projects using these organisms in the analysis of questions of ecology and development. Lectures, laboratory, and field trips (one to Hopkins Marine Station). Prerequisites: 22 and 23.

4 units, Win MWF 9 lab. T 1:15–4:05

131. Mosses and Ferns — Structure, development, evolutionary relationships of mosses and ferns. Lectures, laboratories, and field trips. Prerequisite: consent of instructor.

5 units, Aut (Thomas) WF 2:15–5:05; given 1976–77

132. Seed Plants — Structure, development, evolutionary relationships of seed plants. Lectures, laboratories, and field trips. Prerequisites: 22 and 23.

5 units, Spr (Holm) TTh 1:15–5:05

134. Seminar on Replication of Nucleic Acids — Modes of replication and their control in prokaryotic and eukaryotic systems. Critical review of current literature. Prerequisite: 21 and/or consent of instructor.

3 units, Spr (Hanawalt) by arrangement

135. Seminar on Developmental Genetics — Genetic expression and its developmental basis, especially in such representative organisms as Drosophila, mice and men. Prerequisites: 1 and 22 or consent of instructor.

3 units, Spr (Center) Th 2:15–4:05

138. Topics in Mathematical Biology — Levels of mathematical modeling in biology. Readings and discussion of selected areas, including growth equations, population interactions, models of neural systems, and the uses and abuses of computers. Term projects in students' fields of special interest. Prerequisites: calculus, basics of computer programming, either probability or statistics, and consent of instructor.

3 units, Win (Perkel) TTh 10–11:30

140. Highlights in Photobiology — Basic principles of the action of light upon biological systems. Lectures and student reports on special topics including: photosynthesis, photoperiodism, phototropism, vision, photoactivation and recovery. Prerequisites: 21, and 22.

3 units, Win (Briggs and Hanawalt) TTh 11

141. Biostatistics — An introduction to the statistical analysis of biological data. Lectures, discussion and student exercises.

3 units, Win (Feldman) TWF 4:15–5:05

146. Cell Differentiation — Lectures and discussions for graduate and advanced undergraduate students covering the original literature of selected problems in the cellular and molecular biology of cell differentiation. Prerequisites: 21, and 22 or consent of instructor.

3 units, Spr (Stockdale) by arrangement

147H. Comparative Embryology — See Hopkins Marine Station.

151. Evolutionary Genetics — Application of genetics to study of evolution. Prerequisite: a knowledge of basic genetics.

3 units, Spr (Regnery) TTh 10, alternate years, given 1975–76

152. Neurophysiology — Electrical properties of excitable membranes; physiology of receptors, muscles, and synapses; operations of simple networks of neurons relevant to
behavior. The approach to neuronal systems will be comparative and developmental. (This course may be taken after Psychology 107; it treats the cellular material in substantially greater depth. It also serves as the basis for the 160 series of behavior courses in biology.) Prerequisites: 21, 22, 23 or Psychology 107.

3 units, Win (Getting, Kennedy) MWF 8

156. Plant Physiology—Principal functions of green plants, including photosynthesis, gas exchange, water and nutrient transport, mineral metabolism, growth, and environmental responses. Prerequisites: 21 and 22 or equivalent, and Chemistry 121 and 123 or Biochemistry 200 and 201 or equivalent.

3 units, Aut (Ray) MWF 10

158. Introduction to Behavior Genetics—(Same as Psychology 158.) Designed for students of anthropology, biology, and psychology. Principles and methods of animal and human behavior genetics research. Discussion of the social implications of gene-behavior relationships. Prerequisites: Psychology 1 and Genetics 201 or Human Biology 130 or their equivalents.

4 units, Win (Kessler) TTh 1:15

162. Biogeography—Survey of major principles of ecological and historical geography of plants and animals. Prerequisite: 23.

3 units, Aut (Holm) TTh 11, alternate years, given 1975–76

163. Animal Behavior: Developmental Aspects—Theories of behavioral development; naive behaviors, critical periods, imprinting; early experiences; parental-young interactions; processes of socialization; development of perceptual capacities; causal mechanisms. Emphasis on experiments. This course is intended to be part of a sequence of behavior courses, 163, 164, 165, which may be taken in any order. Prerequisites: 22 and 23, or consent of instructor.

3 units, Aut (Shaw) MWF 11

164. Animal Behavior: Neurobiological Aspects—(Same as Psychology 147) Ethological viewpoints of behavior will be presented, with an emphasis on recent advances in understanding their physiological substrates. This course is intended to be part of a sequence of behavior courses, 163, 164, 165, which may be taken in any order. Prerequisite: 22, or Human Biology 2A, or Psychology 107, or 108, or 109 is recommended.

4 units, Win (Wine) by arrangement

165. Animal Behavior: Ecological and Evolutionary Aspects—A comparative survey of principles and patterns of animal behavior stressing their evolution and adaptive significance. Emphasis will be placed on vertebrates. Lecture and discussion. This course is intended to be part of a sequence of behavior courses, 163, 164, 165, which may be taken in any order. Prerequisites: 1 and 22.

3 units, Spr (Heller) MWF 11

166. Genetics (Eukaryotes) — The principles of genetics as developed in and applied to studies of eukaryotic organisms. Emphasis will be placed on the transmission of genetic factors. Prerequisite: 1 or consent of instructor.

3 units, Win (Regnery) MWF 11

167. Genetics (Prokaryotes) — Continuation of 166 with emphasis on prokaryotes. Basic genetic principles applied to bacteria and viruses. Methods of genetic mapping; correlation of genetic and physical structure; mechanism of recombination. Prerequisite: 166.

3 units, Spr (Campbell) MWF 11

168. Vegetation and Fire—An examination of the past and present role of fire in the evolution and maintenance of vegetation types, with particular reference to the diverse California flora. Prerequisite: consent of instructor.

3 units, Win (Thomas) W 2:15–4:05; field trips by arrangement, alternate years, given 1976–77

169. Advanced Cellular and Molecular Biology Laboratory—This laboratory will be offered autumn and/or winter quarters for 3 to 15 units of credit. Individual research projects will be carried out at differing levels commensurate with student’s background, experience and choice. A wide range of experiments can be dealt with, limited only by expense and availability of equipment. See unit limitation under “Bachelor of Science Course Requirements.” Prerequisite: 24Y.

3 to 15 units, Aut, Win (Woodward) by arrangement, given 1976–77

175H. Problems in Marine Biology — See Hopkins Marine Station.
178. Biology of Natural Populations — Introduction to independent study of natural populations. Jasper Ridge serves as an outdoor laboratory for course. Prerequisite: consent of instructor; preparatory study in 199 during previous quarter recommended.

10 units, Spr (Mooney) by arrangement

181. Darwin — A seminar dealing with the contributions of Charles Darwin to the Biological Sciences and the impact of this work upon society. Prerequisite: consent of the instructor.

3 units, Win (Thomas) W 2:15–4:05, alternate years, given 1975–76

184. Biology of Insects — An introduction to the functional biology of insects. Insect anatomy, biochemistry, behavior, ecology, physiology and systematics will be considered, as well as more specialized topics intended to illustrate or emphasize unusual features of insects which make them attractive as objects of research. Lab sometimes meets for the full time as a lab or field exercise, and at other times only for the first hour as a lecture-discussion. Much of the laboratory work will take the form of individual projects. Prerequisites: 1, 21, 22, and 23, or consent of instructor.

4 units, Win (Watt) MTh 2:15; lab. T 1:15–5:05; alternate years, given 1975–76

185. Coevolution — Evolutionary interactions among different kinds of organisms — plants and herbivores, models and mimics, predators and prey, parasites and hosts, etc. Emphasis will be on the importance of these interactions in understanding problems of community structure and human ecology. Lectures, discussion and library research. Prerequisites: 23 or Human Biology 4A and consent of instructor.

3 units, Spr (Ehrlich) MWF 10, alternate years, given 1975–76

186. Advanced Topics in Geographical Ecology — Will deal in depth with the biogeography and ecology of specific regions or special habitats. The subject matter will vary from year to year and the course may be repeated for credit. Prerequisite: 23 or Human Biology 4A.

3 units, Spr (Ehrlich, Holm) M 2:15–4:05, alternate years, given 1976–77

187. Topics in Epizootiology — Lectures, discussions, and readings on the effects of particular diseases on infra-human animal populations. Prerequisite: 23 or consent of instructor.

3 units, Spr (Regnery) TTh 10, alternate years, given 1976–77

189. Introduction to Visible and Electron Optical Methods in Biology — After study of the appropriate elementary theory, the student employs the following sequence of light optical techniques on biological material: light microscopy, still and time-lapse photography, phase, fluorescence, polarized light, Nomarski, and interference microscopy. Two hours of lecture, one three-hour laboratory. Prerequisites: 21 and 22; 24A and 24B (or 24Y instead of A and B); high school physics.

3 units, Aut (Green, Hepler) lee. TTh 1:15; lab. T 2:15–5:05 or Th 2:15–5:05

197. Student Seminars — Intensive study of specific areas of the biological literature by means of oral presentation by the students, discussion, and term papers. Topics covered will vary from year to year. Prerequisites: 21 and 23.

3 units, Win (Campbell) W 2:15–4:05, given 1975–76

198. Honors Program — Research in some phase of biology of special interest to the individual. Successful completion of a minimum of 10 units of 198 is required for graduation with Departmental Honors. Units taken in another numbered research course in biology may be counted toward this minimum by arrangement between the student and the course instructor and with approval of the Committee on Undergraduate Studies upon written recommendation by the instructor to the Committee on a form provided. Biology 198 may be taken with an out-of-department faculty member only with the prior approval of the Committee on Undergraduate Studies by petition. An essay based on the research in each course taken for Honors must be presented to, and accepted by, both the research director and the Department. The essay, to be submitted in duplicate, will be deposited in the Department Library and in the University Archives. See unit limitation under “Bachelor of Science Course Requirements.”

(Staff) by arrangement

199. Special Problems — Individual study or research undertaken by arrangement with
instructor (out-of-Department instructor arrangement only for Biology majors). See unit limitation under "Bachelor of Science Course Requirements."
(Staff) by arrangement

199H. Special Problems—See Hopkins Marine Station.

GRADUATE COURSES

200. Seminar in Animal Communication—(Same as Hearing and Speech Sciences 281 and Psychology 228.) A general survey of the communicative aspects of social behavior of animals including man. Emphasis will be placed upon diversity of signal systems and the contrasts between these systems and human linguistic behavior. Prerequisite: consent of instructor.

4 units, Win (Dewson) by arrangement

201. Biological Effects of Radiation—(Same as Radiology 201.) Basic physical and chemical events, vulnerable biochemical pathways and molecules, repair of radiation lesions, factors governing cellular radiosensitivity, dose modifiers, tissue and organ effects, carcinogenesis and radiation hazards, and permissible dose standards. Prerequisite: Biochemistry 200, or consent of instructor.

2 units, Win (Kallman and Staff) by arrangement

204. Bacterial Genetics—(Same as Medical Microbiology 204.) Lectures, optional demonstrations, minilab on inheritance in bacteria. Prerequisite: Medical Microbiology 101 or equivalent.

3 to 4 units, Win (Stocker) MWF 9

208. Advanced Topics in Genetics — Will deal in depth with topics of current interest. The subject matter will vary from year to year, and the course may be repeated for credit. The general theme in 1974–75 will be the origin, behavior, and significance of duplications. Prerequisites: 166, 167 or equivalent, and consent of instructor.

2 units, Aut (Perkins) by arrangement, given 1976–77

210. Membrane Molecular Biology — The structural organization and properties of lipids and proteins in artificial and biological membranes, membrane isolation techniques, physical techniques for studying lipid and membrane structure, membrane transport, assembly of membranes and organelles, and cell surface interactions of viruses, anti-bodies, and hormones and cells. Prerequisites: 21, Biochemistry 200 recommended.

3 units, Spr (Simoni) TTh 11–12, given 1975–76

213. Viruses — Principles of virus growth, genetics, architecture and assembly. Relation of temperate viruses and other episomes to the host cell. Prerequisite: 21.

3 units, Aut (Campbell) MWF 11

215. Advanced Topics in Evolution—Current methods of approach to such evolutionary subjects as tempo and mode, origin of major categories, cytogenetics, hybridization. Prerequisites: 22, 23.

3 units, Aut (Holm) TTh 11, alternate years, given 1976–77

221. Advanced Topics in Plant Physiology and Development—Will consider in depth currently important aspects of plant physiology such as growth and its hormonal regulation, transport phenomena, and environmental responses. Topic will vary from year to year and the course may be repeated for credit with consent of instructor. Prerequisites: 156, Biochemistry 200, or equivalents, and consent of instructor.

3 units, Spr (Ray, Green, Helper) MW 1:15–3:15

245. Laboratory in Biological Clocks—Individual or group experiments on circadian clocks in organisms ranging from single cells, fungi and green plants to insects and vertebrates. Whenever possible, the experimental work consists of genuine research projects. Limited to students taking 259 or by consent of instructor.

3 to 15 units, Aut, Win (Pittendrigh) by arrangement; minimum of two quarters' work. Given 1976–77

247. Protein Synthesis and Degradation in Eukaryotes—A lecture and student discussion course on various aspects of the regulation of protein synthesis and degradation in higher organisms, with special emphasis on molecular mechanisms involved in developmental processes and actions of hormones. Prerequisites: 252 desirable but not necessary; Biochemistry 201 and 202.

3 units, Spr (Schimke) TTh 4:15, given 1976–77

249. Cytogenetics—(Same as Genetics 249.) Principles and modern biochemical methods of chromosome analysis. The structure, func-
tion, and replication of pro and eukaryotic chromosomes. The influence of chromosomal changes in development and evolution of organisms. Human chromosomes and their behavior in hybrid cell cultures. Prerequisites: 21, 22, and 23; knowledge of genetics and biochemistry.

3 units, Aut (Ganesan) MWF 10, given 1976–77

250. Molecular Biophysics — Physical biochemistry and physical approaches to biological problems at the molecular level. Lectures include discussion of macromolecular structure and intermolecular interactions, physical methods for characterizing proteins and nucleic acids, the interaction of electromagnetic radiation with biological molecules, isotopic tracer techniques, and classical physics of cellular processes. Open to qualified advanced students upon consent of instructor.

4 units, Win (Hanawalt) TTh 10 and T 7:15–10:00 p.m., alternate years, given 1975–76


4 units, Spr (Yanojfsky) TTh 9–10:50

253. Laboratory in Neurophysiology—Experimental approaches to the electrical properties of neurons, muscle cells, and receptors, and to the organization of central nervous systems. Enrollment limited to students considering careers in neurobiology.

4 to 15 units, Spr (Kennedy, Getting) by arrangement

255. Advanced Topics in Neurobiology: Biophysics of Excitable Membranes—Extensive coverage of current problems in neurobiology. The subject material will vary from year to year, and the course may be repeated for credit. Subject material for 1974–75: biophysical approaches to unit properties of excitable membranes, neurons, and synapses. Prerequisites: 153 or equivalent and elementary calculus.

3 units, Aut (Getting) by arrangement

257. Molecular Photobiology — Fundamentals of photochemistry, photon effects on biological macromolecules, photoinactivation of biological systems, cellular recovery from radiation damage, photodynamic action, and comparisons with ionizing radiations. Prerequisite: consent of instructor.

3 units, Spr (Hanawalt, K. Smith) TTh 1:15, alternate years, given 1976–77

258. Physiological Basis of Adaptation — Lectures, reading, and discussion on recent research concerning biochemical and physiological bases of evolutionary adaptations to environment. Subjects covered will include invertebrate and vertebrate thermal biology, biochemical population genetics, respiratory physiology, and other topics. Prerequisites: biology core and cognates.

3 units, Aut (Watt, Heller) TTh 8:30–10:00, alternate years, given 1976–77

259. Biological Clocks—Innate oscillations in physiological systems that measure environmental time. The phenomena considered will range from biochemical to behavioral, and the time periods from daily to annual. Lectures and discussion. Prerequisites: 21 and consent of instructor.

3 units, Win (Pittendrigh) TWTh 4:15–5:05, given 1976–77

260. The Physiology and Behavior of Thermoregulation — Lectures and student presentations of recent research and literature reviews. Topics will range from the central nervous system regulation of body temperature to the ecology of thermoregulation. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Heller) Th 12–1

261H. Comparative Biochemistry of Marine Microorganisms—See Hopkins Marine Station.

265. Field Studies in Animal Behavior — The sociobiology of insects, fish, amphibians, birds, and mammals, free-ranging and in captivity. Individual research projects dealing with courtship, parental care, development, social organization, and ecology. Field station on campus. Prerequisite: consent of instructor. Enrollment limited.

5–15 units, Spr (Shaw) by arrangement

266. Field Studies in Animal Behavior—as above. Prerequisite: 265.

5–15 units, Sum (Shaw) by arrangement

269H. Ecological Physiology—See Hopkins Marine Station.

277. Theory and Models of Biological Processes—Formulation and solution of difference and differential equations from popula-
tion biology mass transfer, reaction kinetics, morphogenesis, elements of probability, stochastic processes and linear algebra as applied to population genetics, neural systems, and epidemiology. Guest lecturers will present examples from their specialties. Prerequisites: elementary calculus, probability or statistics, and consent of instructor.

3 units, Aut (Feldman) MWF 1:15, alternate years, given 1976–77

280. Mathematical Modeling of Biological Systems — Formulation of quantitative descriptions of the dynamics of living systems, including both deterministic and stochastic models. Digital-computer techniques for numerical prediction and comparison with experiment. The roles of mathematical models in biology. Term projects will be chosen from students' fields of special interest. Prerequisites: intermediate calculus, probability or statistics, basics of computer programming, and consent of instructor.

3 units, Spr (Perkel and Staff) TTh 10–11:30, alternate years, given 1975–76

282H. Marine and Amphibian Toxins—See Hopkins Marine Station.

283. Theoretical Population Genetics — A detailed survey of models in population genetics to include aspects of selection, random drift, gene linkage, migration, and inbreeding. The influence of these on evolution of gene frequencies and chromosome structure is analyzed and some data evaluated. Prerequisite: consent of instructor.

3 units, Aut (Feldman) MWF 3:15, alternate years, given 1975–76

286. Theoretical Population Ecology — An examination of papers on current issues, including r and K-selection, niche theory, life history and foraging strategies, the spatial structure of populations, and systems ecology. Term paper required which develops a mathematical or computer model of some ecological problem. Prerequisites: 23 and consent of instructor.

3 units, Win (Roughgarden) TTh 11, alternate years, given 1975–76

287. The Testing of Ecological Theory—An examination of the natural history of several groups of organisms with a view toward testing ecological theory and finding topics for further theoretical work. Term paper required which tests some element of ecological theory using existing data from the literature or using new data obtained from local populations such as those in the Jasper Ridge Preserve. Prerequisites: 23 and consent of instructor.

3 units, Aut (Roughgarden) TTh 10, alternate years, given 1976–77

290. Teaching of Biological Science—Practical experience in teaching laboratory biology or serving as a course assistant in a lecture course. Open to upper division and graduate students.

Aut, Win, Spr (Staff) by arrangement

300. Research.

(Staff) by arrangement

300H. Research—See Hopkins Marine Station.

325. Seminar in Evolutionary Mechanisms — Presentation and discussion of current research results and literature dealing with mechanistic studies of evolutionary adaptation. Prerequisite: consent of instructor.

1 to 3 units, Aut, Win, Spr (Watt) F 12:00–1:15

345. Seminar in Genetics and Molecular Biology—Enrollment limited to graduate students directly associated with departmental research groups in genetics or molecular biology.

1 to 3 units, Aut, Win, Spr (Campbell, Hanawalt, Perkins, Simoni, Woodward, Yanofsky) by arrangement

346. Seminar in Regulatory Biology—Literature review of elected topics in eukaryote regulatory biology. Prerequisite: consent of instructor.

1 to 3 units, Aut, Win, Spr (Schimke) T 12–1, given 1976–77

347. Seminar in Photoperiodic Time-Measurement—An analysis of current literature on the diverse mechanism involved in recognizing season by the measurement of daylength. Prerequisite: 259 or consent of instructor.

3 units, Win (Pittendrigh) by arrangement, given 1976–77

348. Graduate Seminar in Population Ecology—Prerequisite: consent of instructor.

1 unit, Aut, Win, Spr (Ehrlich) by arrangement
351. Seminar in Neurobiology—Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Kennedy, Perkel, Getting) MT 12:00-1:15
352. Seminar in Developmental Biology—Literature and research review of selected topics in development. Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Wessells, Green, Hepler, Ray) by arrangement
353. Seminar in Plant Physiology—Presentation of current research projects and topical literature by faculty, graduate students, and visiting speakers. Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Ray, Briggs, Green, Hepler) W 3:30-5:00
354. Seminar in Population Biology—Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Ehrlich, Feldman, Holm, Mooney, Roughgarden, Thomas, Watt) by arrangement
383. Seminar in Population Genetics—Literature review and research discussion of current problems in the theory and practice of population genetics. Student participation required. Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Feldman) by arrangement

**BIOPHYSICS PROGRAM**

**Committee on Biophysics:**
Philip C. Hanawalt, *Professor of Biological Sciences*, Chairman; Donald Kennedy, *Professor of Biological Sciences*; Harden M. McConnell, *Professor of Chemistry*; David A. Clayton, *Assistant Professor of Pathology*; Donald H. Perkel, *Adjunct Professor, Biological Sciences*; one student member elected annually by the students from the group.

The Biophysics Program offers instruction and research opportunities leading to the Ph.D. in biophysics. Students admitted to the Program may perform their graduate research in the Department of Biological Sciences or, through special arrangements, in other University departments.

**PROGRAM OF STUDY**

A small number of highly qualified applicants will be admitted to the Program each year. Applicants should present strong undergraduate backgrounds in the physical sciences and mathematics. The graduate course program, beyond the stated requirements, will be worked out for each student individually with the help of appropriate advisers from the Committee on Biophysics.

The requirements for the Ph.D. degree include the following:

1. Training in physics equivalent to that of an undergraduate physics major at Stanford.
2. A graduate minor in physics, chemistry, or biology (or in a related field). Consult appropriate Departmental announcements for minor requirements.
3. Completion of the following courses (or their equivalents):
   a) Biology 250; and 252 or 153, depending upon interest.
   b) Biochemistry 200, 201.
   c) Chemistry 121, 171, 173 and 175.
   d) Additional courses as required for the individually tailored program.
4. Proficiency in one or more foreign languages and/or a computer language may be required at the discretion of the major professor.
5. The completion of eight sections of teaching apprenticeship during the first nine quarters.
6. Successful passing of a comprehensive qualifying examination in biophysics is required for admission to Ph.D. candidacy. This examination is normally taken early in the second year of study and it emphasizes the area of specialization in biophysics.
7. Preparation of a Dissertation Proposal defining the research to be undertaken, including methods of procedure. This proposal should be submitted by Spring Quarter of the second year and it must be approved by a committee of at least three members including the principal research adviser and at least one member from the Committee on Biophysics. The candidate may be called upon to defend the dissertation proposal in an oral examination. The dissertation reading committee will normally evolve from the dissertation proposal review committee.
8. The presentation of a Ph.D. thesis as the result of independent investigation and
expressing a contribution to knowledge in the area of biophysics.

9. The successful passing of the University oral examination which is to be taken only after the student has substantially completed the research. The examination will be preceded by a public seminar in which the research will be presented by the candidate.

Courses of interest to biophysics students:

- Biol. 152. The Physiological Basis of Behavior.
- Biol. 201. Biological Effects of Radiation.
- Biol. 249. Cytogenetics.
- Biochem. 200 and 201. Biochemistry Lectures.
- Biochem. 213. The Arrangement of Information in Chromosomes.
- Chem. 171, 173, and 175. Physical Chemistry.
- Chem. 221. Advanced Organic Chemistry.
- Chem. 271, 273, and 275. Advanced Physical Chemistry.
- Computation Center 1. Introduction to a Programming Language.
- Engr. 177. Radio-activation Analysis.
- Genetics 216. Selected Topics in Neurobiology.

**DIVISION OF MARINE BIOLOGY**

**HOPKINS MARINE STATION**

*Emeriti:* Lawrence R. Blinks, Arthur C. Giese, Cornelis B. van Niel (*Professors*)

*Acting Director:* Allan McC. Campbell

*Associate Director:* Donald P. Abbott


*Lecturers:* Charles A. Baxter, Robin D. Burnett

*Affiliated Faculty:* Frederick A. Fuhrman (*Physiology*)

The Hopkins Marine Station is situated at Pacific Grove, on the south side of Monterey Bay, 90 miles from the main University campus at Palo Alto. The ground area comprises about eleven acres, consisting of the main portion of Cabrillo Point, and including a sheltered landing place and storage for small boats. Buildings include the “Marinostat,” the Alexander Agassiz Laboratory and the Jacques Loeb Laboratory. The 15,000 volume library subscribes to approximately 450 journals, and its collections are particularly good in marine biology, oceanography, microbiology, and embryology.

The Station is open during the entire year and maintains a permanent staff of resident investigators and technical assistants; this staff is increased by visiting faculty members, especially during the summer. There are facilities for visiting investigators and for elementary and advanced instruction in biology. For further information, see the *Hopkins Marine Station Bulletin* issued in February, or write Hopkins Marine Station, Pacific Grove, Ca. 93950.

**AUTUMN, WINTER, AND SPRING QUARTER COURSES**

Although few formal courses will be offered, the staff will welcome the opportunity to direct work of graduate and undergraduate students in the fields indicated. Owing to superior conditions of tides and weather, the autumn and spring quarters are especially recommended for research involving marine organisms.

**114H. Marine Biology**—A broad survey of the biology of marine forms focusing on local organisms and habitats. Topics treated will include classification, basic body plan, group diversity, and relationships. Within this framework the course will concentrate on aspects of adaptation for life in specific habitats, and consider in some detail the physiology and behavior of local forms. The organization of the course will be lecture, discussion, lab, and field trips, and each person will explore several areas of interest with individual or small group projects. Prerequisite: consent of instructor. By application only.

15 units, Win (Baxter, Burnett) MTWThF

**175H. Problems in Marine Biology**—Lectures, laboratory work, field studies, and individual problems. The course is designed primarily to give advanced undergraduates an opportunity to engage in research. Students will spend the entire spring quarter in residence at the Marine Station, Pacific Grove. For further description see *Hopkins Marine Station Bulletin*. Prerequisites: junior or senior standing in biology and permission of instructors.


**199H. Special Problems**—Properly qualified undergraduate students may undertake
individual work in the fields indicated under course 300H, listed immediately below. Such studies are intended to give the serious student experience in biological research. Preference is given to Stanford students who have already completed Biology 175H and wish to continue their studies, and to Stanford biology students enrolled in the C-terminal M.S. Program. Arrangements must be made by consultation or correspondence.

(Staff) by arrangement 300H. Research—Graduate study involving original work may be undertaken with members of the staff in the fields indicated below.


R. Burnett: Invertebrate Biology—Field and laboratory investigations of marine invertebrates, especially crustaceans.

F. Fuhrman: Physiology and Pharmacology—Toxins from marine organisms and comparative pharmacology.


**SUMMER QUARTER COURSES**

The summer program is open to all advanced undergraduate, graduate, postdoctoral students and teachers whose biological background, teaching or research activities can benefit from a summer’s study of marine life. Application blanks may be obtained by writing directly to the Academic Secretary, Hopkins Marine Station, Pacific Grove, Ca. 93950. Completed applications should be submitted by March 31. Applications received later are considered if space is still available in classes.

The summer quarter is divided into two terms of five weeks each. Those courses requiring the lower tides of early summer are scheduled in the first term. It is possible to register for either term, or for the full quarter.

Most classes meet regularly, all day, on three alternate days each week, and some activities may be scheduled on the days in between. Registration for more than six units (one course) each term is not ordinarily recommended, owing to the intensive work schedule.

**First Term**

100H. Marine Algae—Lectures, laboratory, and field work on the various classes of algae. Particular attention will be given to the benthic marine algae of the Pacific Coast. Prerequisite: elementary botany or general biology.

6 units (I. Abbott) TThS

111H. Marine Invertebrates—Survey of the lower marine invertebrates, echinoderms, and protostomes. Emphasis is placed on basic body plan, functional anatomy, pattern of development, higher classification, and phylogenetic relationships, rather than on detailed morphology and species identification. Prerequisite: at least two courses in zoology. Preference is given to students registering for both 111H and 112H.

6 units (D. Abbott) TThS

113H. Introduction to Oceanic Biology—Introduction to the ocean as an environment; to its major categories of inhabitants, producer and consumer, benthic and pelagic, invertebrate and vertebrate; and to the functioning of the oceanic ecosystem. Prerequisite: introductory biology or general zoology.

6 units (Staff) MWF

115H. Subtidal Ecology—Group and individual studies on the structure and function of a selected subtidal community. All participants must be certified SCUBA divers and have their own diving equipment (including wet suit and buoyancy vest). Background which would be appropriate are courses in organismic biology, ecology, statistics, and ocean diving experience.

6 units (Baxter) MWF

199H. Special Problems—(See above, autumn, winter, and spring quarters.)

282H. Marine and Amphibian Toxins—(Same as Physiology 282.) Lectures, laboratory work, and discussion on the biology, chemistry, and mechanism of action of toxins from marine plants and animals and from amphibians. Special emphasis will be given to neurotoxins such as tetrodotoxin, saxitoxin, and batrachotoxin. The course will include discussion of the basic principles of
evaluation and mode of action of toxic substances in general, and a systematic presentation of various aspects of marine and amphibian toxins.

6 units (Fuhrman) MWF

300H. Research—(See above, autumn, winter, and spring quarters.)

Second Term

112H. Marine Invertebrates—Continuation of 111H, covering the molluscs, annelids, arthropods, and allied lesser phyla. While the two courses form a continuous sequence, either half may be taken separately when space permits. Prerequisite: same as for 111H, preferably also 111H.

6 units (D. Abbott) TThS

118H. Phytoplankton — Lectures, laboratory, and field work. Prerequisite: one year of biological science at the college level.

6 units (Staff) MWF

147H. Comparative Embryology—Lectures and laboratory studies integrating principles and concepts of developmental biology with studies of gametogenesis, cleavage, differentiation, morphogenesis, larval forms, metamorphosis and overall reproductive strategies of a variety of marine invertebrates. Prerequisites: at least two biology courses.

6 units (Staff) MWF

199H. Special Problems — (See above, autumn, winter, and spring quarters.)

269H. Ecological Physiology — Physiological responses of animals to variations in environmental factors and to organisms. Most of the work will deal with marine invertebrates. Prerequisites: general zoology or organismic biology and general chemistry.

6 units (Staff) MWF

300H. Research—(See above, autumn, winter, and spring quarters.)

Chemistry

Emeriti: Paul J. Flory, Philip A. Leighton, J. Murray Luck, Carl R. Noller, Linus C. Pauling (Professors)
Chairman: Eugene E. van Tamelen
Vice Chairman: Douglas A. Skoog

* The curriculum leading to the B.S. degree in Chemical Engineering is described elsewhere in this bulletin.


Associate Professors: Hans C. Andersen, Robert Pecora
Assistant Professors: Michael D. Fayer, Keith O. Hodgson, Bruce S. Hudson, Wray Huestis, Frank A. Weinhold
Lecturer: Suzanne Hudson

Entrance Preparation

Students who intend to major in chemistry are expected to offer entrance credit in the preparatory subjects of chemistry, physics, and mathematics (including algebra and plane trigonometry). Those who do not have entrance credit or equivalent training in the foregoing subjects, particularly mathematics, may experience some difficulty in meeting the Department requirements for graduation in four years, especially if they expect to pursue a program leading to professional certification by the American Chemical Society or to the B.S. degree with Honors. A year or more of secondary school preparation in German is desirable.

Advanced placement in chemistry courses, based on the College Board Advanced Placement Examination, is not available.

Programs of Study

Minimum Requirements for the Bachelor of Science Degree

University writing and distribution requirement; Mathematics 10, 11, 21, 22, 23, or 41, 42, 43; Physics 51, 53, 54, 55, 56, 57, 58; Chemistry 31, 33, 35, 36, 131, 132, 132B, 133, 134, 137, 171, 173, 174, 175, 176. In addition, a reading knowledge of scientific German is strongly recommended. Premedical students majoring in chemistry may substitute Physics 21, 23, 29 for Physics 51–53 provided they also complete Biology 1, 21, 22, 23. Students interested in attending overseas campuses should consult their advisers as early as possible in order to avoid scheduling problems. Note that it is particularly convenient to attend an overseas campus
during spring and summer of the second year, since the courses listed in these quarters may be delayed to subsequent years without disadvantage. No required course may be taken on a pass/no credit basis.

**AMERICAN CHEMICAL SOCIETY CERTIFICATION**

Students who wish to be certified as having met the minimum requirements of the American Chemical Society for professional training must complete, in addition to the above requirements, at least six units from Chemistry 136, or 190; and at least three additional units from one of the following: Chemistry 136, any chemistry course numbered above 200 for which permission to register has been granted by the instructor; Biochemistry 200; or an advanced course in mathematics or physics. A reading knowledge of scientific German or Russian is required. This requirement may be fulfilled by completing one year of college level courses or by passing the graduate language examination.

**HONORS PROGRAM IN CHEMISTRY**

A limited number of undergraduates may be admitted to the Chemistry Honors Program at the beginning of the senior year. Those completing the program satisfactorily will receive the degree of Bachelor of Science in Chemistry with Honors.

To be admitted to the program, the student must have a grade average of at least B in all course work in the University. In addition to the minimum requirements for the B.S. degree, the student must complete nine units of Chemistry 190 to be taken three units per quarter for three quarters; and nine additional units from Chemistry 221, 223, 225, 227, 251, 253, 255, 271, 273, 275, Biochemistry 200, 201, Mathematics 130, 131, 132, physics lecture courses numbered 100 and higher, or other advanced courses approved by the student's adviser and by the supervisor of his work in Chemistry 190.

Students who wish to be admitted to the Honors Program but who do not meet all of the above formal requirements, may petition the Department for admission.

**TYPICAL SCHEDULE FOR FOUR-YEAR PROGRAM**

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 31.</td>
<td>Chemical Principles</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Chem. 33.</td>
<td>Structure and Reactivity</td>
<td>—</td>
<td>4</td>
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**Second Year**

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<thead>
<tr>
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<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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</thead>
<tbody>
<tr>
<td>Chem. 131.</td>
<td>Chemical Synthesis and Properties</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Chem. 132B.</td>
<td>Theory and Practice of Identifications</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Chem. 133.</td>
<td>Special Topics in Organic Chemistry</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Chem. 134.</td>
<td>Theory and Practice of Quantitative Chemistry</td>
<td>—</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Chem. 136.</td>
<td>Synthesis Laboratory</td>
<td>—</td>
<td>3</td>
<td>—</td>
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<tr>
<td>Chem. 137.</td>
<td>Inorganic Chemistry</td>
<td>—</td>
<td>3</td>
<td>—</td>
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<tr>
<td>Math. 22, 23.</td>
<td>Analytic Geometry and Calculus</td>
<td>3</td>
<td>3</td>
<td>—</td>
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<tr>
<td>Physics 51, 53, 54.</td>
<td>Mechanics, Sound, Electricity</td>
<td>4</td>
<td>5</td>
<td>—</td>
</tr>
<tr>
<td>Electives (see Note 1)</td>
<td>5</td>
<td>3</td>
<td>4</td>
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**Third Year**

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<tr>
<th>Course No.</th>
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<th>A</th>
<th>W</th>
<th>Sp</th>
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</thead>
<tbody>
<tr>
<td>Chem. 171, 173, 175.</td>
<td>Physical Chemistry</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 174, 176.</td>
<td>Physical Chemistry Laboratory</td>
<td>—</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 55, 56, 57, 58.</td>
<td>Light, Heat, Atomic Physics</td>
<td>5</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Electives (see Note 1)</td>
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<td>5</td>
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**Fourth Year**

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<th>Subject</th>
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<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electives (see Note 1)</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td></td>
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</tbody>
</table>

**Note 1.** — Elective courses must be used to complete the University Writing and Distribution Requirement. They may also be used to broaden the student's background in science and non-science areas and to provide an opportunity for advanced study in chemistry. Courses offered by other departments that may be of interest to chemistry majors include: Chem. Engr. 20, 120, 130; Econ. 1; English 191; Math 44, 106, 113, 130, 131, 132; Physics 110, 111, 112; Stat. 40, 110, 116; Geol. 1; Engg. 50; Appl. Earth Sci. 105; Mat. Sci. and Engr. 50; Med. Micro. 101; Biol. Sci. 1, 21, 22, 23; Biochem. 200, 201; Comp. Sci. 106, 135; Civil Engr. 170, 175, 276A.

**TEACHING CREDENTIALS**

The requirements for certification to teach chemistry in the secondary schools and ju-
SCHOOL OF HUMANITIES AND SCIENCES

Senior colleges of California may be ascertained by consulting the section on credentials under "School of Education" in this bulletin and the Credential Secretary of the School of Education.

ADVANCED DEGREES IN CHEMISTRY

General Requirements

Qualifying examinations are given prior to the first week of the autumn quarter and in the first week of the winter quarter. Each new graduate student must take these examinations on entrance. Satisfactory performance is required for permission to begin thesis research and to continue work for an advanced degree. Students who do not complete the remaining requirements for an advanced degree within six years after entrance as a graduate student must repeat and pass the qualifying examinations and must meet any other requirements established by the faculty before the degree will be granted.

Candidates for advanced degrees must have a minimum grade average of B for all chemistry lecture courses as well as for all courses taken during graduate study. Required courses may not be taken under the pass/no credit option. All students are expected to give full time to their graduate work once they have begun thesis research. All prospective Ph.D. candidates, regardless of the source of their financial support, will be expected to gain teaching experience as an integral part of their graduate training. During the period in which a thesis is being read by members of the staff, candidates must be available for personal consultation until the thesis has had final Departmental approval. In addition to Departmental requirements, candidates for advanced degrees must meet the general University regulations as stated in the section "Degrees" in this bulletin.

Qualifying Examinations

These examinations will consist of four written exams of two hours duration each in the fields of analytical, inorganic, organic, and physical chemistry, and will cover such material as ordinarily is given in a rigorous one-year undergraduate course in each of these subjects. Students who fail to pass these examinations in the autumn will be advised to repeat them during the first week of the winter quarter. All qualifying examinations will be given during the period September 26, 27, 1975, and all must be taken at this time.

Master of Science

All applicants for the degree of Master of Science in Chemistry are required to complete, in addition to the requirements for the Bachelor's degree, a minimum of 39 units of work. Of the 39 units approximately two-thirds must be in the Department and must include at least 12 units of advanced course work in chemistry exclusive of the thesis. Of the 12 units, at least three units must be from Chemistry 221, 223, 225, 251, 253, 255, 271, 273, or 275.

Master of Arts in Teaching (Chemistry)

In cooperation with the School of Education, the Department offers a program leading to a degree, Master of Arts in Teaching (Chemistry). This degree is intended for candidates who have a teaching credential and who wish to strengthen further their academic preparation. Detailed requirements are outlined in this bulletin under "School of Education, the Master of Arts in Teaching."

Doctor of Philosophy

The graduate student does not become a formal candidate for the Ph.D. degree until he has passed the Department qualifying and language examinations and has been admitted to candidacy by the University Committee on the Graduate Division. Doctorate candidates will be considered responsible for an integrated knowledge of their field of specialization, which will not be limited to the content of related advanced courses offered by the Department. Normally they will register for at least 30 units of advanced lecture courses, exclusive of research. The foreign language requirement for the Ph.D. in organic chemistry ordinarily will be met in German and in French or Russian. The foreign language requirement in physical or inorganic chemistry ordinarily will be met in either German or Russian. Proposals to substitute for French or Russian another language or a program of course work will be considered by the Department on petition by the candidate. Candidates for the Ph.D. degree are required to participate continually in the Department seminar (Chemistry 300), and in the division seminar of the major sub-
ject. In addition, continuous enrollment in Chemistry 301 is expected after the student has passed the qualifying examinations and chosen a research supervisor.

All students majoring in inorganic chemistry are required to take (1) Chemistry 271, 273, and 275 (or be exempted therefrom by passing special examinations administered by the professors in charge of these courses); (2) two courses from Chemistry 251, 253, or 255; (3) Chemistry 221 or 223 or 225; (4) six additional units of approved advanced lecture courses.

All students majoring in organic chemistry are required to (1) take Chemistry 221, 223 and 225 during the first year, irrespective of background; those who fail to make a grade average of at least B in these three courses may not become candidates for the Ph.D. degree in organic chemistry; (2) take Chemistry 271 (or be exempted therefrom by passing a special examination administered by the professor in charge of this course); (3) take Chemistry 233 in the second and third year (3 units); (4) take six units of advanced lecture courses outside of the field of organic chemistry.

All students majoring in physical chemistry are required to take (1) Chemistry 271, 273, and 275 (or be exempted therefrom by passing special examinations administered by the professors in charge of these courses) during the first year, irrespective of background; those who fail to make a grade average of at least B in these three courses may not become candidates for the Ph.D. degree in physical chemistry; (2) six units of advanced lecture courses in physical chemistry, biophysical chemistry, or inorganic chemistry; (3) Chemistry 221, or 223, or 225; (4) six additional units of advanced lecture courses outside of the fields of biophysical chemistry, physical chemistry, and inorganic chemistry.

Students with an exceptionally strong background in physics and mathematics may, upon special arrangements, pursue a program of studies in chemical physics.

Before a candidate may request scheduling of the University oral examination, clearance must be obtained from the major Professor and the chairman of the Department Graduate Study Committee. Conditions that must be fulfilled before clearance is granted vary with the different divisions of the Department and may be ascertained by consulting the chairman of the Committee.

It is the policy of the Department to encourage and support in every possible way the pursuit of research and of other work along advanced lines by qualified students. Information concerning staff members with lists of their recent research publications will be found in the Directory of Graduate Research published by the American Chemical Society.

Minor in Chemistry—Candidates for the degree of Doctor of Philosophy in other departments who wish to minor in chemistry must complete with a grade average of B or better, at least 12 units of chemistry courses more advanced than those that meet the minimum requirements for the Bachelor's degree in chemistry. At least 3 units must be from Chemistry 221, 223, 225, 251, 253, 255, 271, or 273.

Fellowships and Scholarships

In addition to the University fellowships and scholarships that are open to properly qualified students, there are at present several Departmental fellowships in chemistry. The Edward Curtis Franklin Fellowship, James W. McBain Memorial Fellowship, Frederick P. Whitaker Fellowship, William H. and Myrtle B. Sloan Scholarship, David L. and Lavinia E. Sloan Memorial Scholarship, John Maxon Stillman Scholarship, and the Robert M. and Katherine F. Loeser Scholarship are granted only to graduate students. The William H. Nichols Scholarships are open to graduates and undergraduates; the Frank Card Scholarship is available to undergraduates only.

There also are teaching assistantships and research assistantships open to advanced students. Application forms for fellowships, scholarships, and teaching assistantships may be obtained from the office of the Department of Chemistry.

Courses

Note — Deposits required in laboratory courses, against which charges are made for breakage are from $10 to $30 per quarter.

UNDERGRADUATE COURSES

1. The Nature of Chemistry—For non-science majors. This course will present, in non-mathematical terms, modern views of chem-
istry regarding chemical bonding; the structure of organic molecules; macromolecules; synthetic fibers; and materials of biochemical importance. There will be some discussion of the impact of chemistry on national and international economics and policies. The growth of modern understanding from earlier views will be emphasized, so that the history of chemistry will be dealt with in some detail, and there will be discussion of the importance of symbolic representation. No prerequisites.

3 units, Win (Hutchinson) by arrangement

31. Chemical Principles — Preparation for chemistry, chemical engineering, medicine, biochemistry, biology, and related fields. Atomic and molecular orbital theory, periodicity, bonding, properties of matter, stoichiometry. Prerequisite: high school algebra; high school chemistry and physics desirable.

3 units, Win (Hutchinson) by arrangement


3 units, Win (S. Brauman, Collman, Eastman, Bonner) lecture and recitation sections same as 31

35. Functional Groups and Stereochemistry — Organic Chemistry, carbonyl compounds, bifunctional molecules, stereochemistry, carbohydrates. Prerequisite: 33 or 41, 43.

3 units, Spr (Eastman, Mosher, Huestis) lecs. (1 and 2) MWF 8, lec. (3) MWF 9, lec. (4) MWF 10; one recitation by arrangement

36. Theory and Practice of Separations—The course will deal with techniques for separations of compounds including distillation, crystallization, extraction, and various chromatographic procedures. The lecture will treat the theory of these processes while the laboratory will provide practice in their use. Prerequisites: 33 and concurrent or previous enrollment in 35.

3 units, Spr (Hodgson) lec. M or W or F 1:15; lab. M, T, W, Th or F 2:15-5:05

130A,B. Biosocial Aspects of Birth Control — (Same as Human Biology 150A,B — see there for fuller description.) The courses will deal with a critical evaluation of the practical and logistic aspects of human fertility control. After a first quarter devoted mainly to lecture, task forces of 5 to 8 students each will develop a series of position papers dealing with new birth control procedures suitable for populations of different cultural and socioeconomic backgrounds. Prerequisites: at least junior standing, registration for both quarters and completion, prior to Autumn quarter, of preregistration questionnaire available from Human Biology Office. Limited to 40 students.

5 units, Aut, Win (Djerassi) MW 2:15–4:05, alternate years, given 1975–76

131. Chemical Synthesis and Properties—Polymers, heterocyclic compounds, natural products, dyes, purines, pyrimidines, DNA, RNA. Prerequisite: 35.

3 units, Aut (Hodgson, Bonner, Johnson) lec. (1) MWF 11, (2) TTh 11:00-12:15, (3) MWF 12

132A. Theory and Practice of Identification —The course will deal with the theory and practice of identification of compounds. A part of the lecture will be devoted to the interpretation of infrared, mass, and nmr spectroscopy; the remainder will cover elementary theory of absorption spectroscopy as well as instruments for measurement of spectra. The laboratory work will be devoted to the synthesis and identification of compounds. Prerequisite: 35, 36 and concurrent enrollment in 131. Chemistry majors and prospective majors should register for 132B.

3 units, Aut (Huestis, Eastman) lec. (1) TTh 9; lec. (2) TTh 10; lab. M, T, W, Th or F 1:15–4:05 or M, T, W or Th 6:30–9:05 p.m.

132B. Theory and Practice of Identification —The course is similar to 132A, involves an additional unit of laboratory work, and is required for but not limited to chemistry majors. Prerequisite: 35, 36 and concurrent enrollment in 131.

4 units, Aut (Staff) lab. MW 1:15–4:05 or MW 6:30–9:05 p.m. or TTh 2:15–5:05


3 units, Win (van Tameken, Staff) MWF 11

134. Theory and Practice of Quantitative Chemistry—The course will deal with the
theory and practice of quantitative analysis. Methods considered will include gravimetric, volumetric, spectrophotometric, and electrometric. Prerequisite: 132 or 5.

4 units, Win (Skoog) lec. (1) TTh 10, lab. MW 1:15-4:05 or TTh 1:15-4:05

135. Physical Chemical Principles—Terminal physical chemistry for non-chemistry majors. Emphasis is on those portions of physical chemistry most useful for students of the life sciences. Introduction to chemical thermodynamics, heterogeneous equilibria, thermodynamics of solutions, electrolytes, chemical kinetics, macromolecular solutions and colloidal dispersions. Prerequisites: 31 and calculus.

3 units, Win (S. Hudson, Pecora) lec. (1) MWF 11, lec. (2) TTh 8:30-9:45


3 units, Spr (Bonner) by arrangement, given 1975-76

137. Inorganic Chemistry—Intended for undergraduates. Systematic survey of the chemistry of inorganic substances. Classification, bonding, structures, and reactivities. Prerequisite: 171 or 131.

3 units, Spr (Taube) MWF 10

171. Physical Chemistry—Chemical thermodynamics: fundamental principles, Gibbsian equations, equilibrium conditions, phase rule, systematic deduction of equations, gases, solutions. Prerequisites: 35, Mathematics 10, 11, 21 (or equivalent) and Physics 51, 53, 54 and previous or concurrent registration in Physics 55 (or Physics 21, 23, 29 in the case of premedical students majoring in chemistry; see under “Minimum Requirements”).

3 units, Aut (Hutchinson) MWF 11

173. Physical Chemistry—Quantum Chemistry, molecular structure and spectroscopy including atomic spectroscopy, molecular rotation, molecular vibration and infrared spectroscopy, electronic states of molecules and magnetic resonance spectroscopy. Prerequisite: 171.

3 units, Win (Weinhold) MWF 11

174. Physical Chemistry Laboratory—Use of modern chemical instrumentation to study fundamental areas of physical chemical concern—kinetics, spectroscopy, and properties of molecules. Experiments include X-ray powder diffraction, dipole moment determination, determination of polymer molecular weight by light scattering and viscosity; rotational-vibrational, microwave, laser raman, and nuclear quadrupole resonance spectroscopy; enzyme kinetics, gas phase ion-molecule kinetics, and solution kinetics studied with electron paramagnetic resonance (EPR) and nuclear magnetic resonance (NMR). Prerequisite: concurrent enrollment in 173.

3 units, Win (Fayer) lec. TTh 10; lab. T 1:15-4:05 or W 1:15-4:05


3 units, Spr (Golden) TTh 8:30-9:45

176. Physical Chemistry Laboratory—(Continuation of Chemistry 174.) Prerequisites: 174 and previous or concurrent enrollment in 175.

3 units, Spr (Fayer) lec. TTh 10; lab. T 1:15-4:05 or W 1:15-4:05

GRADUATE COURSES

Undergraduates may register for chemistry courses numbered 200 and above only if admitted to the Honors Program or if special permission has been granted by the instructor in the course.

221. Advanced Organic Chemistry—Introduction to physical organic chemistry. Basic M. O. theory and application. Methods of determining organic reaction mechanisms from a theoretical and experimental point of view. Prerequisites: 133 and 175.

3 units, Aut (Brauman) MWF 9

223. Advanced Organic Chemistry—Continuation of 221 with emphasis on stereochemistry. Prerequisite: 221 or consent of instructor.

3 units, Win (Brauman) MWF 9

225. Advanced Organic Chemistry—Continuation of 223: Organic reactions, new synthetic methods, conformational analysis, and exercises in the syntheses of complex mole-
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cules. Prerequisite: 223 or consent of instructor.

3 units, Spr (Johnson) MWF 9

227. Selected Topics in Organic Chemistry
— May be repeated for credit. Possible topics include synthetic organic chemistry, photochemistry, inorganic-organic chemistry, biorganic chemistry, reaction mechanisms, structural chemistry of organic and biological molecules. Prerequisite: 225 or consent of instructor.

3 units, Aut, or Win, or Spr (Staff) MWF 10

229. Organic Chemistry Seminar — Attendance is required of all graduate students majoring in organic chemistry.

1 unit, Aut, Win, Spr (Staff) Th 4

233. Creativity in Organic Chemistry — The art of formulating, writing, and orally defending a research progress report will be practiced and criticized with the student using his own research as a vehicle. Required of all 2nd year Ph.D. candidates. Winter and spring: the art of formulating, writing, and orally defending an original research proposal will be practiced and criticized.

1 unit, Aut, Win, Spr (Eastman, Bonner, Mosher) by arrangement

251. Selected Topics in Advanced Inorganic Chemistry — May be repeated for credit. Prerequisite: one year of physical chemistry.

3 units, Aut, or Win, or Spr (Staff) TTh 11

253. Advanced Inorganic Chemistry — Introduction to stereochemical and electronic principles of transition metal compounds; ligand field and molecular orbital theories, electronic spectra and magnetism.

3 units, Win (Holm) TTh 11, alternate years, given 1975–76


3 units, Spr (Collman) TTh 10–12

257. Research Proposals in Inorganic Chemistry — Research progress reports (fall quarter) and research proposals (winter and spring quarters) will be presented in oral and written form. Writing ability and oral defense will be criticized as well as scientific content. Required of all second-year inorganic students.

1 unit, Aut, Win, Spr (Collman, Hodgson, Holm, Taube) by arrangement

271. Advanced Physical Chemistry — Principles of quantum mechanics. General formulation, mathematical methods, and elementary applications of quantum theory to the structure of atoms and molecules, including variational procedures, perturbation theory, operator and matrix methods, theory of angular momentum, and elements of the electronic structure of atoms. Prerequisite: 175.

3 units, Aut (Weinhold) MWF 11

273. Advanced Physical Chemistry — Molecular spectroscopy and molecular structure. Examination of the experimental and theoretical basis for various models of molecular structure: review of quantum theory of atomic and molecular structure, Born-Oppenheimer approximation, molecular energy levels, interaction of radiation with matter, microwave, infrared, and ultraviolet spectroscopy of molecules. Also, special topics to be chosen according to the interests of the students and instructor; for example, scattering of light by fluids, correlation function methods, spectra of molecules in solution, Mossbauer spectroscopy, magnetic resonance, Raman spectroscopy. Prerequisite: 271.

3 units, Win (B. Hudson) MWF 11

275. Advanced Physical Chemistry — Basic principles and methods of statistical mechanics from the ensemble point of view, statistical thermodynamics, heat capacities of solids and polyatomic gases, chemical equilibria, equations of state of fluids, phase transitions. Prerequisite: 271.

3 units, Spr (S. Hudson) MWF 11

277. Selected Topics in Physical Chemistry — May be repeated for credit. Possible topics include structure elucidation using diffraction techniques, advanced statistical mechanics, crystal field theory, advanced quantum mechanics, magnetic relaxation, advanced thermodynamics, chemical applications of group theory. Prerequisite: 275 or consent of instructor.

3 units, Aut, or Win, or Spr (Pecora) MWF 10
283. Research Proposals in Physical Chemistry—Students will present research proposals and progress reports on their research in physical chemistry, using oral and written forms. Topics may be drawn from the student’s research or a related area in physical chemistry. Written form, oral presentation and scientific merit will be evaluated. May be required of 2nd- and 3rd-year graduate students at the discretion of the research advisor.

1 unit, Aut, Win, Spr (B. Hudson, Pecora, Weinhold) by arrangement

287. Biophysical Chemistry—Covers theoretical and experimental aspects of biophysical phenomena, with emphasis on magnetic resonance methods, and problems in membrane biology. Special lectures on x-ray diffraction, low-angle scattering and electron microscopy will also be included. Minimal prerequisites are previous or concurrent registration in Chemistry 173, or the equivalent.

3 units, Aut (McConnell) MWF 9, alternate years, given 1975–76

289. Biophysical Chemistry—(Continuation of Chemistry 287.)

3 units, Win (McConnell) MWF 9, alternate years, given 1975–76

291. Biophysical Chemistry—(Continuation of Chemistry 289.)

3 units, Spr (McConnell) MWF 9, alternate years, given 1975–76

300. Department Seminar—Attendance is required of all graduate students, and all undergraduates registered for 190.

1 unit, Aut, Win, Spr (Staff) M 4

301. Research in Chemistry—Seminars and directed reading dealing with newly developing areas in chemistry and experimental techniques. Open to qualified graduate students with the consent of the instructor. May be repeated for credit. Registration required of all graduate students who have passed the qualifying examination.

2 units, Aut, Win, Spr, Sum (Staff) sec. 2 through 30, W 7:30–9:30 or by arrangement

RESEARCH AND SPECIAL ADVANCED WORK

190. Introduction to Methods of Investigation—For general character and scope, see 200, below. Limited to undergraduate students admitted under the Honors Program or by special arrangement with a member of the teaching staff. Concurrent attendance in 300 required.

(Staff) by arrangement, register for sec. 2–30 according to professor

200. Research and Special Advanced Work—Properly qualified students are encouraged to undertake work of research, or other advanced laboratory work along lines not covered by courses already listed, under direction of any member of teaching staff with whom arrangement is made. For all such research and special work, students will register for 200 (or 190 if in undergraduate standing), giving name of staff member under whom arrangement is made. Prerequisite for 190 or 200 in organic chemistry: previous or concurrent registration in 134.

(Staff) by arrangement, register for sec. 2–30 according to professor

CLASSICS

Emeriti: Hermann F. Fränkel, Lionel Pearson (Professors)

Acting Chairman: Mark W. Edwards

Professors: Mark W. Edwards, Edwin M. Good (Religious Studies and, by courtesy, Classics), Antony E. Raubitschek, Michael Grant (Visiting, Win)

Associate Professors: N. Gregson Davis, Andrew Devine, Michael Wigodsky

Assistant Professors: John Nicols. Acting: Carolyn J. Dewald, Helene P. Foley

Lecturers: Dorothea A. Frede, Robert Hamerton-Kelly (Classics and Religious Studies), Stella Miller (Aut, Win), Edward W. Spofford

The Department of Classics offers work in the Greek and Latin languages and literatures (both in the original languages and in translations), in Greek and Roman History, and in Classical Art and Archaeology. It affords an opportunity for the student to develop three things: a competence in the classical languages, an appreciation, comprehension, and enjoyment of classical literature, and an understanding of the history and culture of the ancient world. The Department is interested both in students who wish to do their major work in Classics and in students...
who wish to relate Classics to work in such other departments as English, Philosophy, History, and the Modern Languages.

Study of the Classics is a very important part of a liberal education and should be undertaken with that thought in mind. The Department hopes that some students who make it their major subject will devote themselves to teaching Latin and Greek in high schools or colleges.

**ADMISSION TO THE DEPARTMENT**

Those who are considering a major in Classics (Latin and Greek) should enroll in the Department as early as possible, since at least three years of work in Latin or Greek or both will generally be required of them, and those with no previous knowledge of Latin (or Greek) should begin the study of the language in their freshman year, or as early as possible in their sophomore year. Prospective majors in Classical Studies should normally enroll not later than the beginning of their junior year, but are urged to discuss their plans with a member of the department at an earlier stage if possible.

**PROGRAMS OF STUDY**

**BACHELOR OF ARTS IN CLASSICS**

The Degree of Bachelor of Arts with a Major in Classics may be taken in the following alternative ways:

1. Greek and Latin.
2. Greek or Latin.
3. Greek or Latin with a related Minor, e.g., Latin, Greek, Art, English, History, Philosophy, or one of the Modern Languages.
4. A Combined Major, with emphasis divided equally between Classics (Greek or Latin) and another subject, e.g. English, History, French, etc.
5. An Extended Major, which requires work in Classics, combined with work in two other subjects in different departments.

More detailed descriptions of the requirements follow. All major students will be assigned a departmental adviser, who will help them prepare a program of study; they should discuss their program with him at regular intervals.

1. Greek and Latin. Six or more courses in Greek numbered 100 or higher and an equal number in Latin. Credit towards the Major for Second-Year courses (101, 102, 103) will be accepted only with the approval of the Undergraduate Studies Committee. So far as possible, students should follow the sequence of Greek and Latin courses, 111, 112, 113, 151, 152, 153 (in alternate years 161, 162, 163), so as to acquire an acquaintance with the major authors in both languages. In addition, as recommended by their adviser, they may do some work in Greek and Latin Composition, one of the Senior Undergraduate Seminars, or some work in Graduate Courses. Some work will also be expected in Ancient History or Art or some other aspect of Classical Civilization.

This is the most exacting course of study in the department, preparing students to go on to graduate work in Classics, and involves between 50 and 60 units in departmental courses and directed reading. It is particularly recommended for students with good preparation in secondary school, but it is within the range of those who have had no previous training in one of the languages (Greek or Latin), if the elementary work is completed in freshman or sophomore year, thus leaving time for the six courses at the level of 100 or above.

2. Greek or Latin

a) Latin: 30 units in Latin courses, all at the 100 level or higher (including, if recommended by the student’s adviser, some work in Latin Composition); two courses in Ancient History; some work in Greek, or two related courses, acceptable to the department, in Ancient Art and Archaeology, Classical Civilization, or the Humanities program. (See note 1)

b) Greek: 30 units in Greek courses, all at the 100 level or higher (including, if recommended by the student’s adviser, some work in Greek Composition); two courses in Ancient History; some work in Latin, or two related courses, acceptable to the department, in Ancient Art and Archaeology, Classical Civilization, or the Humanities program. (See note 1)

3. Greek or Latin with a related Minor. Courses in Greek or Latin, Ancient History, and other subjects as in 2), with an
additional Minor program of 20 units in any field acceptable to the department.

4. Combined Major. A student may divide the time equally between work in Classics and work in another department, e.g. English, Philosophy, History, or one of the Modern Language departments, with the consent of the Chairmen of both departments concerned. Interested students should consult the departmental chairmen for details of requirements. They may be formally enrolled as major students either in the Classics department or in the other department. The Classics Department will require about two-thirds of one of its major programs, 1) or 2) above, and a comparable demand may be expected from the other department.

5. Extended Major. This is similar to 4), except that two other departments besides Classics are concerned. Further details may be obtained from department chairmen. The student may be enrolled as a major student either in Classics or in one of the other departments; he or she will arrange his or her program of study with the departmental adviser where he or she is enrolled. This program may be particularly attractive to a student who has a broader interest in History and Literature, and wishes, for example, to combine the study of a classical language and its literature with the study of another literature, history, and civilization. If Greek or Latin is one of the subjects chosen, the student will be expected to reach a standard similar to what is expected in 4) above.

A high degree of flexibility is possible in this Major, but the total of units demanded will be quite high, and the student must be prepared to restrict the number of his or her elective courses.

6. Classical Studies. This major is recommended for students who wish to study the classical civilization in depth as part of their general educational experience, but do not have the time or the desire to study the languages to the extent required by the major in Classics. The required minor is intended to assist students in relating their work in Classics to particular aspects of modern civilization. This major is suitable for students who think of proceeding to Law, Business, or Medical School, or to graduate work in History, Archaeology or Comparative Literature. It is not suitable for those who may wish to teach Latin or Greek in high school or college, as the language work is insufficient for this purpose. Additional language work would be necessary before entering graduate school in Classics.

Requirement: 40 units in the major, including (a) at least two courses in Latin or Greek at the 100 level or higher; or one course in one of the languages at the 100 level or higher, plus the 1, 2, 3 or 51, 52 series in the other language; (b) at least one course in the Department from each of the following groups: Literature; Philosophy and Political Theory; Ancient History; Religion and Mythology; Art and Archaeology. Students are required to take not less than 15 units in a relevant minor field outside the Department; such fields might include not only other humanities subjects but also anthropology, psychology, sociology, or political science.

Note 1. University units earned by placement tests or advanced placement work in secondary school will not be counted towards any major program in the department and work done in other universities or colleges will be subject to departmental evaluation.

Note 2. Students who are contemplating graduate work in Classics, or a professional career as teachers of Greek and Latin, might suitably follow any of the first three programs, 1), 2), or 3), provided they do some work in both languages. Programs 4) and 5) cover a wider field, and may be recommended particularly to students who look towards graduate work in other humanistic subjects, e.g., History, Philosophy, or some field of literature other than the classical.

MINORS

For an Undergraduate Minor in Classics (Greek or Latin) the Department recommends the following: 20 units in Greek or Latin courses at the 100 level or above, including at least one of the More Advanced Courses, and an additional 4 units in related courses (Ancient History, Ancient Art and Archaeology).

HONORS PROGRAM IN HUMANITIES

For acceptable majors in Classics an Honors Program in Humanities is offered, a de-
scription of which will be found under "Humanities Special Programs."

**TEACHING CREDENTIALS**

For information concerning the requirements for teaching credentials, consult the "School of Education" section of this bulletin and the Credential Secretary, School of Education.

**ROME CLASSICAL CENTER**

Classics majors are strongly urged to attend the Intercollegiate Classical Center at Rome. The program in Rome is specially designed for classical undergraduates. The Center is managed by Stanford University for 53 constituent colleges and universities including Stanford. It is open to Stanford majors in Classics and Art History (see the Center brochure) and all courses given in the Center receive full credit at Stanford and count toward a Stanford major in Classics.

All students interested in this program should consult the Chairman of the Department.

**STANFORD IN GREECE**

The Classics Department is operating a program of summer study in Greece, in which students take a preparatory course in Greek art and archaeology at Stanford in the Spring Quarter and then spend a period of direct study of the monuments in Greece during the summer. Students who are not Classics or Art majors are eligible, but should have some previous study of Greek history, language or art. Those interested should see the Chairman of the Classics Department early in the academic year.

**ADVANCED DEGREES**

**MASTER OF ARTS**

Students who have completed an undergraduate major in Classics (Latin and/or Greek) or its equivalent may be accepted as candidates for the degree of Master of Arts, and expect to complete the program in one year. Students without an undergraduate major in Classics may also be accepted as candidates, though they may require a longer period of study before completing the requirements for the degree. These requirements are:

1. Satisfactory demonstration of competence in Greek and/or Latin composition.
2. Attainment of a standard of scholarship such as would normally be reached by three quarters of study in the Department after fulfilling the requirements for an undergraduate major in the Department. This would normally mean the completion of at least 18 units of graduate courses and 18 units of work at the 150 or 170 levels.
3. The satisfactory completion of one Greek course at the 100 level (if the undergraduate major has been Latin) or one Latin course at the 100 level (if the undergraduate major has been Greek).
4. The passing of an examination testing the candidate's ability to translate into English from a selected list of Greek or Latin authors.
5. The writing of a thesis, or the passing of an examination on a particular author or topic.
6. A reading knowledge of French or German.

Students who are candidates for the Ph.D. degree may also (on the recommendation of the Department) become candidates for the A.M. degree. In their case requirement 5 above will be waived provided that they have completed some work beyond the course requirements listed under 2 and 3 above.

**DOCTOR OF PHILOSOPHY**

University regulations regarding admission and application for candidacy are discussed in the section "Degrees" of this Bulletin.

All candidates for the Ph.D. degree in Classics must fulfill the following requirements:

1. They must complete at least three years (nine quarters) of full-time work, or equivalent, in study beyond the Bachelor's degree. At least 72 approved units in graduate courses or seminars at 200 level or above must be completed in addition to the doctoral dissertation. At least three consecutive quarters of graduate work and the final units of credit in the program must be taken at Stanford. More detailed information on the Advanced Degree Program is available in mimeographed form in the Classics Department Office.
2. Candidates will be required to pass examinations as follows:
   a) Reading examinations in French and German. In some circumstances Italian may be substituted for French.
   b) Examinations in translation into English from Greek and Latin authors included in an approved list (drawn up by the Department and available from the Departmental secretary).
   c) Final written examinations in two classical authors (one Greek and one Latin) and in two fields, one of which must be historical. Each student must submit a syllabus for each author and each field. The examinations will be drawn up on the basis of this syllabus after it has been approved by the Department.
   d) An oral examination on the candidate’s dissertation subject and on two or more special topics, such as selected authors or selected aspects of Greek or Roman literature, history, archaeology, philosophy, epigraphy or palaeography.
   e) Candidates must pass examinations in the reading and writing of Greek and Latin unless they receive a satisfactory grade in Greek 205 and Latin 205.

3. The examinations in translation from Greek and Latin authors will normally be taken in the autumn term of the second year of graduate work, the final written examinations in the spring term of the second year and the autumn term of the following year, the oral examination in the spring following. The period between the translation and final written examinations will be devoted largely to an intensive preparation for the latter examination, during the course of which candidates will be expected to make full use of relevant secondary material in modern languages. They should therefore plan to satisfy the requirements in composition and French and German as soon as possible, preferably before the time of the translation examination. Except in very special circumstances they will not be allowed to take the final written examination until the other three sets of examinations have been successfully completed.

4. Each candidate (not later than the end of the quarter in which the final written examination is taken) must submit to the Chairman of the Department a statement of his or her dissertation topic as approved by his or her dissertation committee. This committee will normally be appointed (for each candidate) by the Chairman of the Department at least one quarter before the student’s dissertation topic is due to be submitted. At the same time or earlier a senior member of the Department will be appointed as the candidate’s adviser who will thereafter supervise the candidate’s writing of the dissertation. An acceptable dissertation must be a genuine contribution to classical scholarship and should be written in an acceptable style. All theses must be written in English.

Minor for the Degree of Doctor of Philosophy—The Department recommends for a graduate minor at least 18 units in Latin or Greek at the 100 level or above, and at least one course at the graduate (200) level.

Graduate Program in Indo-European Studies

This program is administered by the Classics Department. It involves work in general Indo-European and a language of specialization. Interested students should contact Professor Devine of the Classics Department.

Graduate Program in Humanities

The Department of Classics participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Classics and Humanities. For a description of that program see the section “Humanities Special Programs” in this bulletin.

Comparative Literature

The Classics Department cooperates closely with the Graduate Program in Comparative Literature. Interested students should consult the Chairman of the Department.

Courses in Greek

First- and Second-Year Courses

Students with no previous experience may begin the study of Greek with either Greek 1 or Greek 51. The series 1, 2, 3 begins in Autumn quarter (4 units a quarter), the series 51–52 in Winter quarter (5 units a quarter), and is intended to cover the same
ground at a more rapid pace, so that the series 101, 102, 103 forms a sequel equally to Greek 3 and Greek 52. During the first year some Xenophon or Plato will be read, so as to prepare the student in the following year for further reading of Plato, Homer, and Euripides. These courses all form part of a series, but qualified students may be admitted to the class in winter or spring by consent of the instructor.

Students who have done previous work in Greek elsewhere should consult a member of the department to determine for what course they are qualified.

Students whose major work is in another department and who wish to fulfill a departmental language requirement by taking Greek should consult their departmental advisers to determine what courses will be required, but most departments will be satisfied if part of the series 101, 102, 103 is completed.

1. First-Year Greek—For beginners.
   4 units, Aut (Foley) MTWTh 9
2. First-Year Greek—Continuation of 1.
   4 units, Win (Foley) MTWTh 9
3. First-Year Greek—Continuation of 2.
   4 units, Spr (Foley) MTWTh 9
51. First-Year Greek—Accelerated course.
   5 units, Win (Dewald) MTWThF 1:15
52. First-Year Greek—Continuation of 51.
   5 units, Spr (Dewald) MTWThF 1:15
101. Second-Year Greek—Reading of Plato, Apology, and other selections.
   4 units, Aut (Frede) MWF 10:00
102. Second-Year Greek—Homer, Odyssey.
   4 units, Win (Raubitschek)
103. Second-Year Greek—Euripides, one play.
   4 units, Spr (Raubitschek)
   2 units, Win (Kelly) by arrangement

The intensive Greek course (Greek 10) offered in summer quarter should prepare students to enter Greek 101 in autumn quarter.

THIRD- AND FOURTH-YEAR COURSES

The series 111–113 is offered every year. 151–153 and 161–163 are offered in alternate years and may be taken in succession.

111. Sophocles, one or more plays.
   4 units, Aut (Dewald) MWF 10
112. Euripides.
   4 units, Win (Staff)
113. Attic Prose.
   4 units, Spr (Staff)
151. Euripides and Greek Lyric.
   4 units, Aut (Edwards)
152. Homer.
   4 units, Win (Edwards)
153. Aristophanes.
   4 units, Spr (Foley)
160. Individual Work.
   By arrangement
161. Plato.
   4 units, Aut, given 1976–77
162. Aeschylus.
   4 units, Win (Foley) given 1976–77
163. Herodotus.
   4 units, Spr (Raubitschek) given 1976–77

The sequence of authors in undergraduate courses is intended to provide an initial acquaintance with the best of classical literature and to meet each student's level of competence in the language. Modifications may be made to suit the needs and interest of each class.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

175. Greek Composition.
   2 units, Aut (Frede)

GRADUATE COURSES

202. Tutorial in Greek Literature.
   2 units, Aut, Win, Spr (Staff)
205. Greek Language and Style.
   2 units, Win, Spr (Edwards)

The above courses are offered every year. Other courses alternate or vary from year to year. In 1974–75 there were courses in the following authors or topics: Aeschylus, Thucydides, Greek Lyric Poetry, Plato. The following courses will be offered in 1975–76:

222. Plato.
   4 units, Spr (Frede)
225. The Sophists.
   4 units, Win (Raubitschek)
235. The Heracles Myth in Sophocles and Euripides.  
4 units, Spr (Foley)

250. Greek Epigrams.  
4 units, Spr (Raubitschek)

252. Homer.  
4 units, Aut (Edwards)

254. Homeric Archaeology.  
4 units, Aut (Miller)

260. Directed Reading.  
By arrangement

270. Greek Prose or Verse Composition.  

Note: Some of the courses listed above may be continued in the following quarter when arrangement is made with the instructor. This will usually require the writing of a research paper based on work directly related to the course.


COURSES IN LATIN
FIRST-YEAR COURSES

Students with no previous experience may begin the study of Latin with either Latin 1 or Latin 51. The series 1, 2, 3 begins in autumn quarter (4 units a quarter), the series 51, 52 in winter quarter (5 units a quarter) and is intended to cover the same ground at a more rapid pace, so that the series 101, 102, 103 forms a sequel equally to Latin 3 and Latin 52. During the first year some Caesar or other simple Latin prose will be read so as to prepare the students in the following year for Cicero, Virgil, and Ovid. These courses all form part of a series, but qualified students may be admitted to the class in winter or spring quarters by consent of the instructor.

Students whose major work is in another department and who wish to fulfill a departmental foreign language requirement by taking Latin should consult their departmental advisers to determine what courses will be required, but most departments will be satisfied if part of the series 101, 102, 103 is completed.

1. First-Year Latin—for beginners.  
4 units, Aut (Spofford) MWThF 9

2. First-Year Latin—Continuation of 1.  
4 units, Win (Spofford) MWThF 9

3. First-Year Latin—Continuation of 2.  
4 units, Spr (Spofford) MWThF 9

51. Accelerated Beginners’ Course.  
5 units, Win (Devine) MTWThF 1:15

52. Accelerated Beginners’ Course — Continuation of 51.  
5 units, Spr (Devine) MTWThF 1:15

The intensive Latin course (Latin 10) offered in summer quarter should prepare students to enter Latin 101 in the autumn quarter.

INTERMEDIATE COURSES

Students will be admitted to these courses by completing Latin 3 or Latin 52 or on the basis of previous work done in high school or elsewhere. Usually two years of high school Latin qualifies a student for 101, three or four years for 111. New students should determine for which course they are best fitted by writing the Latin placement examination, which is set every autumn in orientation week, or by consultation with a member of the Department. These courses form two consecutive series, but students may be admitted to the class in the winter or spring quarters by consent of the instructor.

101. Second-Year Latin (Sequel to Latin 3 or 52)—Latin Poetry. Ovid, Catullus.  
4 units, Aut (Dewald) MWThF 9

4 units, Win (Nicol)

103. Second-Year Latin—Latin Poetry. Virgil, Aeneid. One or more books will be studied.  
4 units, Spr (Staff)

104. Christian or Medieval Latin Authors.  
5 spr, by arrangement

111. Horace, Odes.  
4 units, Aut (Davis) MTWThF 1:15

112. Virgil, Eclogues and Georgics.  
4 units, Win (Staff)

113. Livy, Elegy.  
4 units, Spr (Nicol)

MORE ADVANCED COURSES

The series 141—143, 151—153, and 161—163 are all at the third- or fourth-year level and will be offered in successive years.
   4 units, Spr (Dewald)
   4 units, Aut (Nicol's)
143. Virgil, Aeneid.
   4 units, Win (Wigodsky)
151. Roman Comedy.
   4 units, Aut (Staff) given 1976–77
152. The Roman Novel: Petronius, Apuleius.
   4 units, Win (Staff) given 1976–77
   4 units, Spr (Wigodsky) given 1976–77
160. Individual Work.
   By arrangement
161. Tacitus.
   4 units, Aut (Staff) given 1977–78
162. Roman Elegy.
   4 units, Win (Davis) given 1977–78
163. Lucretius.
   4 units, Spr (Wigodsky) given 1977–78

The sequence of authors in undergraduate courses is intended to provide an initial acquaintance with the best of classical literature, and to meet each student’s level of competence in the language. Modification may be made to suit the needs and interest of each class.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

175. Latin Composition.
   2 units, Aut (Davis)

GRADUATE COURSES

   2 units, Aut, Win, Spr (Staff)
205. Latin Language and Style.
   2 units, Win, Spr (Wigodsky)
   by arrangement

The above courses are offered every year. Other courses alternate or vary from year to year. In 1974–75 there were courses in the following authors or topics: Petronius, Horace, Odes, The Twelve Caesars, Roman Historiography. The following courses will be offered 1975–76:

208. Post-Classical Latin—(Same as English 208 and Comparative Literature 208.) Careful reading of Latin texts of graded difficulty, beginning with the Vulgate Bible, working through various patristic writings and medieval literature toward Latin of the Renaissance. Intended primarily for students not in classics. Prerequisite: two years high school Latin or equivalent.
   5 units, Win (Damon) MTWTh 10:00

220. Roman Numismatics.
   4 units, Win (Grant)
223. Vulgar Latin.
   4 units, Aut (Devine) W 2:15–4:05
225. Pastoral Poetry.
   4 units, Win (Spofford)
260. Directed Reading.
   By arrangement
263. Lucretius.
   4 units, Spr (Wigodsky)
270. Latin Prose or Verse Composition.
   By arrangement

Note: Some of the above courses may be continued in the following quarter by arrangement with the instructor. This will usually require the writing of a research paper based on work directly related to the course.


COURSES IN HEBREW

For courses in Hebrew, see Religious Studies.

COURSES IN CLASSICAL STUDIES

No knowledge of Greek or Latin is required for these courses.

COURSES FOR FRESHMEN

Topics in Classical Civilization

In this program a number of courses are offered specifically intended to acquaint first-year students with certain ways of looking at the ancient world which will be of use to them in their general educational experience in the university. They introduce the student to the value of classical learning as a means of rapidly widening one’s knowledge and experience, and as an opportunity to observe how the universal problems of human nature, human society, and the circumstances of human life were viewed and
grappled with by the brilliant civilizations of Greece and Rome.

2. The World of Greece and Rome — This course is designed to give a general picture of the civilization of Greece and Rome, by comparing certain aspects of the two cultures. In turn, epic poetry, the use of audial and visual media to propagate ideas, drama, poetic theory, and philosophy will be studied—comparing in each case the Greek element with the Roman—in order to produce a general picture which may form the background for further study of other cultures.

3 units, Win (Grant) TTh 11

4. Ancient Poets and Philosophers on the World and Society — A study of some ancient poets and philosophers with emphasis on their understanding of their own abilities; their attention to gods, justice, and work; and their sense of the wholeness of the world of which all men are part.

3 units, Aut (Spofford) TTh 11:00

7. Rome and the Romans in the Age of Augustus — The course will deal with various aspects of public and private life in ancient Rome: the family, religion, the arts, politics, housing, commerce, leisure activities. Attention will be paid to the city plan and architecture of ancient Rome, in an attempt to relate the everyday life of the Romans to their physical environment.

3 units, Aut (Nicols) TTh 10


3 units, Win (Raubitschek) TTh 10

9. Women in the Ancient World — The course will identify the image of the female in ancient myth and religion, and discuss the actual status of women at various periods of antiquity. In addition to ancient literature, readings will include some modern psychological studies.

3 units, Aut (Foley) TTh 11

GENERAL COURSES

121. Satire and the Novel — This course will focus on the themes, rhetoric and moral values of the major Roman satirists, Horace and Juvenal. We shall also consider satirical aspects of the ancient Roman novel as represented by Petronius’ Satyricon and Apuleius’ Golden Ass. Our discussion of works in these two genres—satire and the novel—will pay some attention to internal structure and literary conventions. All works will be read in modern English translations.

3 to 4 units, Spr (Davis)

160. Individual Work.

By arrangement

161. The Classical Epic — A comparative study of the heroic epics of Homer, Apollonius, and Virgil, with allusion to oral and written epics in other cultures.

3 to 4 units, Aut (Edwards)

162. Greek Tragedy: Aeschylus, Sophocles, Euripides — A study of the history, social function, and development of ancient tragedy.

3 to 4 units, Win (Foley)

172. Classical Influences in Modern Literature — Themes from classical myth and history in selected Renaissance and later writers; parallel readings from ancient literature.

3 to 4 units, Win (Wigodsky) given 1976–77

Philosophy and Political Theory

164. Plato — The meaning of Plato’s thought will be discovered in the dramatic form of selected dialogues as well as in direct philosophical statement.

3 to 4 units, Win (Frede)

165. Hellenistic Philosophy — Epicurus, Stoics and minor schools, their relation to earlier Greek thought, and their influence in the Roman Empire.

3 to 4 units, Spr (Wigodsky) given 1976–77

173. Classical Political Theory — Ancient political ideas (Plato, Aristotle, Polybius, Cicero) and their impact on modern theory.

3 to 4 units, Win (Raubitschek) given 1976–77

Ancient History

These courses are accepted by the History Department for credit toward a major in History.
INTRODUCTORY COURSES

102. History of Greece — A survey of the history of ancient Greece from the Bronze Age through the Age of Pericles down to the death of Alexander the Great (323 B.C.).

4 to 5 units, Aut (Raubitschek)

MTWTh 2:15

103. History of Rome — A survey of the history of the Roman people from the founding of Rome (c. 753 B.C.) to the fall of the Roman Empire in the West (476 A.D.).

4 to 5 units, Win (Nicob) MTWTh 2:15

MORE SPECIALIZED COURSES

115. Historiography and Ancient History — An examination of the nature and purpose of history as well as the aims and methods of historians. Reading and discussion will focus on historians of antiquity (Thucydides, Herodotus, Polybius, Livy, Tacitus) and a modern historian of Rome (Gibbon).

3 to 4 units, Spr (Nicols)

See also Religion 132, Religion in the Ancient Near East.

160. Individual Work in Ancient History.
By arrangement

174. Roman Law and Political Institutions — An introductory study of Roman private and public law; the family, the administration of justice, the practice of government.

3 to 4 units, Spr, given 1976–77

261. Individual Work in Greek History.
By arrangement

262. Individual Work in Roman History.
By arrangement

Religion and Mythology

163. Comparative Mythology: Topics from Greek and Roman, Near-Eastern and African Culture — (Same as Comparative Literature 163.)

3 to 4 units, Spr (Davis)

Art and Archaeology

101. Archaic Greek Sculpture and Painting.
2 to 3 units, Aut (Miller) given 1976–77

102. Classical Greek Sculpture and Painting.
2 to 3 units, Win (Miller) given 1976–77

104. Greek Vase Painting.
3 units, Win (Miller)

106. Art and Monuments of the Romans.
4 units, Spr (Wigodsky)

108. Topography and Monuments of Greece.
3–4 units, Aut, Spr (Raubitschek)

See also Art 100 A, B, C, and 103.

Other Courses

153. Introduction to Indo-European Linguistics — (Same as 253.) Suitable for undergraduate majors or minors in Classics. Prerequisite: Latin 103, Greek 103, or equivalent.

4 units, Spr (Devine)

201. Introduction to Classical Scholarship.
1 unit, Aut, Win, Spr (Staff)

253. Introduction to Indo-European Linguistics — (Same as Linguistics 253.) This course is recommended for students in Classics as an introduction to the scientific study of language, especially topics such as the relationship of writing to speech and the common origins of Latin, Greek, and English.

4 units, Spr (Devine)

3 units, Aut, Win (Devine)

COMMUNICATION

Emeriti: Wilbur Schramm, Clifford F. Weigle (Professors)

Chairman: Lyle M. Nelson

Director, Institute for Communication Research: Nathan Maccoby

Director, Professional Journalism Fellowship Program: Lyle M. Nelson. Managing Director: Harry N. Press


Associate Professors: Henry S. Breitrose, William J. Paisley

Assistant Professors: Don Dodson, Robert C. Hornik, Steven Kovács, John K. Mayo, Emile McAnany, Donald F. Roberts, Edward J. Sondik. Acting: David B. Jones, Diana Tillinghast, Charles D. Whitney
Lecturers: Richard C. Block, Jules Dundes, Marion Lewenstein, Arthur C. Mayer, Matilda Butler-Paisley, Harry Press

The Department of Communication engages in research in communication and offers curricula leading to the A.B., A.M. and Ph.D. degrees. The Master of Arts degree prepares students for careers in journalism or documentary film, or in evaluation research for mass media projects in developing countries. The Ph.D. degree leads to careers in teaching and research or other related specialties.

The Institute for Communication Research is the research arm of the Department and offers research experience to advanced students.

The Professional Journalism Fellowship Program brings promising young journalists to study at the University in a non-degree course of study under a program which is sponsored by The National Endowment for the Humanities.

ADMISSION

All prospective undergraduate students should write the University's Office of Admissions.

All prospective graduate students should write to the Graduate Admissions Office, Stanford University, Stanford, California 94305.

The Department requires that applicants for graduate admission include verbal and quantitative scores from the Graduate Record Examination (area scores are optional). Applicants who hope to work toward a Ph.D. are also required to submit scores from the Miller Analogies Test. These test requirements may be waived after written petition to the Department only in exceptional circumstances where the applicant is prevented from taking the tests.

Preference is given to those applicants for the Master of Arts in Journalism who have not had extensive media experience or courses in journalism.

PROGRAMS OF STUDY

BACHELOR OF ARTS

Undergraduate students must complete Communication 1 before they are accepted as a major. They normally should enroll in the department during either their sophomore or junior years.

A student planning a major in Communication is strongly urged, in consultation with his adviser, to select courses in humanities, social sciences, and sciences. Most commonly, majors take elective courses in psychology, sociology, anthropology, political science, history, economics, and English, and in such interdepartmental studies as Urban Affairs, Human Biology, and African and Afro-American Studies.

One Department degree program is offered with the opportunity to concentrate in (a) the general study of communication and the mass media, (b) preprofessional study in journalism or (c) preprofessional study in film and broadcasting. The undergraduate major is considered a preprofessional program and is designed to provide a variety of offerings within the Department combined with a flexible program of breadth and depth in courses outside the Department. Burden of program development rests with the student in consultation with his or her advisor.

To be recommended for the Bachelor of Arts degree in communication, the student must take at least 30 and not more than 40 units within the department except with the prior written consent of his advisor. The student must also meet University distribution requirements and complete a unified program of advanced courses (100 level or above), totaling at least 20 units, in another department, an interdepartmental program, an interdisciplinary honors program, or a second major.

As part of the 30 to 40 units a student takes within the department, he or she must complete Communication 1 and one of the following sequences:

1. Students concentrating in the social science sequence must complete:
   a. Communication 70
   b. Communication 100–102 or Communication 90
   c. Psychology 60 or Statistics 60
   d. Any two of the following Communication courses: 126, 127, 128, 131, 135 or 192

2. Students concentrating in the film and broadcast sequence must complete:
   a. Communication 142
   b. Communication 101 and 180 (133 and 134 are recommended but not required
and may be used to fulfill this requirement)

3. Students concentrating in the journalism sequence must complete:
   a. Communication 100–102
   b. Communication 107
   c. Communication 175

An alternative degree is a Bachelor of Arts degree in Social Science (Communication). Requirements for this degree are a total of 30 units in Communication courses as specified in (1) above and 20 units of advanced courses in one or more other social science departments. Students electing Communication as a secondary major must declare with the department.

**MASTER OF ARTS**

The Master of Arts degree is awarded by the Department in the fields of Journalism, Film and Broadcasting, and Communication Media and Social Change. Requirements are as follows:

1. The candidate must earn at least 45 units in graduate residence at Stanford; he must be enrolled as a major in the Department for at least two quarters; he must maintain a high academic performance during his entire program of study. At least 20 of the 45 units must be in courses numbered 200 or higher, and the other units in courses numbered 100 to 199. An independent project (on occasion a thesis) under the direction of a major professor must be undertaken. Three to six hours of credit in independent study may be applied to this requirement. A report of the project must be made to the professor directing the independent study. Completion of the entire program normally takes three to five quarters depending on the nature of the independent project. Tuition usually is charged only for the quarters of regular class attendance.

2. A unified program of advanced course work is to be arranged with the approval of the adviser. This includes appropriate grounding in research methodology and communication theory and training in one or more communication media. Students with insufficient undergraduate background in the appropriate social sciences will be required to take Communication 203 or another Communication Theory or Methods course.

3. Typically, students concentrating in film will take Communication 206A,B,C and Communication 223A,B,C, together with additional work in film aesthetics, history, criticism, and such other courses in the social sciences and humanities as would be useful to them. The graduate seminar 203A,B,C is required. Students having an interest in broadcasting will also take 242 and 242A. The rest of the curriculum will be worked out in consultation with his or her advisor.

4. Students in the Journalism A.M. program with neither undergraduate journalism instruction nor professional experience are required to take: Communication 100, 102, 107, 150 or 175 or 241, 203, 220, 149 or two quarters of 225 or Political Science 273, and 309. The remainder of the program is to be a cohesive group of at least two or three courses outside the Department. Students with undergraduate journalism training or media experience should check with their advisers to determine which of the above departmental courses will be required and which can be replaced with electives.

5. The Master's program in Communication Media and Social Change is designed primarily for students from Asia, Africa, and Latin America. It will entail a two-year commitment on the part of most students and include course work in Communication and development theory (255, 256), research methods (207, 257) and statistics. Much of a student's second year will be spent in the design, implementation, and write-up of a field research project.

**DOCTOR OF PHILOSOPHY**

The Department offers the Doctor of Philosophy in Communication Theory and Research with emphases in Attitude Formation and Change, Communication Behavior Through the Life Cycle, Communication Media and Social Change, Information Sciences, and Public Affairs Communication. Regardless of the area of specialization, the Ph.D. program is designed primarily for persons interested in teaching and research careers or policy formation positions.

The Ph.D. program is designed to encompass four years of graduate study (subsequent to completion of the A.B. degree) during which, in addition to fulfilling University residence requirements, Ph.D. candidates are required to:

1. Satisfactorily complete all departmental course requirements.
2. Pass general preliminary examinations by the beginning of the second academic year of study and specialization examinations by the completion of the third academic year of study.

3. Demonstrate proficiency in tools required in area of specialization. Chosen with the advice of the faculty, such tools may include foreign languages, statistics, computer programming, etc.

4. Complete both a Master’s research project (first-year project) and a pre-dissertation research project (second-year project).

5. Teach or assist in teaching at least two courses.

6. Have at least one year of work experience in the mass media or in another activity relevant to the area of specialization, prior to writing the dissertation.

7. Complete a dissertation satisfactory to an advisory committee of three or more members and to the University Committee on the Graduate Division.

8. Pass the University oral examination, which may be either a comprehensive examination covering the same area as the written specialization examination or a defense of the dissertation.

Because the multidisciplinary nature of the Department makes it possible for the Ph.D. student to emphasize one of several areas of communication study, there tend to be several “typical” programs of course work followed by various students depending on their area of specialization. Generally, the variation in course programs tends to occur after the first year of graduate study, the first year primarily being devoted to basic “core” courses required of all students.

The department requires that all students, regardless of their area of specialization, fulfill the following course requirements:

Communication 211: Theory of Communication
Communication 213: Computer Analysis of Communication Research Data
Communication 218: Communication Research Methods I
Communication 219: Communication Research Methods II
Communication 309: First-year Research Project
Communication 319: Pre-dissertation Research Project

Depending on the area of Communication study the student chooses to emphasize, additional courses are selected, with the assistance of the advisor, from within the Department’s offerings and from other University departments. Requirements vary depending on the area emphasized.

Ph.D. candidacy expires five years after admission to candidacy by the University Committee on the Graduate Division. Reapplication will require reexamination.

Other programs leading toward the Ph.D. and involving communication may be pursued in the Graduate Division Special Programs. These are individually planned for unusually well-qualified students.

Minor for the Degree of Doctor of Philosophy—Candidates for the degree of Doctor of Philosophy in other departments who elect a minor in Communication will be required to complete a minimum of 20 units of graduate courses in the Communication Department, including a total of three theory or research methods courses. The balance among communication theory, methods, and applications courses will be determined by the candidate and his senior advisor. Communication 211, 218, and 219, together with advanced theory and methodology courses, are often chosen to satisfy the minor requirement.

THE INSTITUTE FOR COMMUNICATION RESEARCH

The Institute for Communication Research operates as an office of project research for the faculties of the Department of Communication and other departments, on grants from foundations, communication media, and other agencies, on government grants and contracts, and on its own funds. A few research assistantships are available to qualified graduate students. Among the qualifications which will be highly valued in applicants are high scholarship, training in
the behavioral sciences (preferably psychology and sociology, including training in statistics and research methodology), and training for or experience with the mass media. For further information write to the Director.

**COURSES OPEN TO UNDERGRADUATES AND GRADUATES**

**GENERAL**


   *5 units, Win (Dodson, Roberts) MWF 10 and Sections T or Th 10*

2. Introduction to Survey Research — An introductory course in survey research methods. Formulation of problems, study design, sampling, interviewing, data processing and analysis, and writing of reports of public opinion surveys. Designed primarily for undergraduate non-majors. Prerequisite: Psychology 60 or equivalent.

   *3 units, Spr (Maccoby) W 3:15-5:05*

3. Images, Media, and the Construction of Reality—Images of women and men, racial groups, politics and government, other nations, the future, etc., help to structure individual reality. Media and interpersonal channels convey and color these images. The course emphasizes wide reading in the literature of images.

   *4 units, Spr (Butler-Paisley) F 3:15-5:05*

4. Communication and Children—How children come to use the mass media, what information they obtain from the media, and how their behavior is influenced by the media. Prerequisite: Communication 1 or equivalent.

   *3 units, Spr (Roberts) by arrangement*

5. General Systems Theory and Communication Research—Introduction to general systems theory through readings, discussion, and papers. Systems approaches to communication — theory building and research problems. Applications of systems theoretic principles to problems of communication in organizations, international development. Prerequisite: Consent of instructor.

   *4 units, Aut (Richards)*

149. Communication Law (Same as Law 149)—This course introduces non-law students to the issues surrounding government regulations of the mass media. These issues emerge in virtually every aspect of the operation in print or broadcast media — getting permission from the FCC to begin broadcasting; what media may do to obtain desired information; regulate controls on what media may publish — or must publish; constraints on demonstration on the vital productions. Major attention will be given to decisions of the Supreme Court involving first amendment issues. May not be offered 1976-77.

   *5 units, Spr (Franklin) TTh 8:30-9:50*


199. Individual Work—Major students with high academic standing are permitted to undertake individual work.

   *1 to 4 units, any quarter (Staff) by arrangement*

**JOURNALISM**

100. Editorial Techniques I — A writing course emphasizing various forms of journalism: news, interpretation, features, opinion. Detailed criticism of writing. Communication 102 must be taken concurrently.

   *4 units, Aut (Staff) TTh 11 Win (Staff) by arrangement Spr (Staff) by arrangement*

102. Editorial Techniques I Laboratory — Practice in journalistic writing. Must be taken concurrently with Communication 100. Open to non-majors. Prerequisite: typing speed of 35 words a minute.

   *1 unit, Aut (Staff) by arrangement Win (Staff) by arrangement Spr (Staff) by arrangement*

107. Editorial Techniques II — Copy editing, headline writing, news display, illustration, typography, printing processes. With laboratory that includes editing daily teleprinter reports of Associated Press, news evaluation and page make-up. Prerequisites: 100 and 102.

   *4 units, Win (Staff) MW 2:15-4:05 4 units, Spr (Staff)*

140. History of American Journalism—Evolution of the democratic mass media in their social, political, economic, technological and
professional aspects, with special attention to significant trends and personalities. Enrollment preference given to senior and graduate majors. Consent of instructor.

4 units, Aut (Stewart) MWF 3:15-4:05

150. Magazine Writing—Practice in writing magazine articles, with emphasis on marketing manuscripts. Conferences. Prerequisites: 100 and 102.

4 units, Spr (Lewenstein) TTh

152. Magazine Editing — Planning, writing, production studied with local magazine editors, correspondents. Prerequisite: 150.

3 units, Spr (——) W 1:15-3:05

175. Reporting of Public Affairs — Local, state, federal courts; municipal, state, federal administration in the local community. Prerequisites: 100 and 102 and junior or graduate standing.

4 units, Aut (Lewenstein) MWF 10

Spr (Whitney) MW 10

176. Grass Roots Reporting—Field work in a census tract. Students will write journalistic articles on community life through the use of participant observation, interviewing, and documentary sources such as census data.

4 units, Win (Dodson) by arrangement

185. Internship Experience — Professional journalism experience in the print media. Open only to Communication majors.

0 units (for graduate students) 1 to 4 units (for undergraduate students)

Aut, Win, Spr, Sum (Dodson) by arrangement

225A. Problems of the Mass Media—Visiting lecturer series. Prerequisite: any other Communication course. May be repeated once for credit.

1 unit, Aut (Nelson, Tillinghast)

T 4:15-5:15

225B. Problems of the Mass Media — Continuation of 225A. Prerequisite: 225A. May be repeated once for credit.

1 unit, Win (Nelson, Tillinghast)

T 4:15-5:15

232. Public Policy Toward the Mass Media (Same as Political Science 194C.)—Seminar is an examination of the policy processes relating to the mass media: how technological and regulatory developments will affect the future of mass media; an effort to define a more coherent public policy toward communications and society.

4 units, Spr (Cater) M 4:15-5:30

241. The New Journalism—Analysis of the “New Journalism” with individual practice in writing. Prerequisite: A.M. candidates only.

4 units, Aut (Dodson) MW 2:15-4:05

FILM AND BROADCASTING

90. Introduction to Film and Video—A basic introduction to the theory and technique of film and television mediated communication, including production exercises in video, film, and sound, and consideration of the fundamentals of script research and writing, and production management. The course is designed mainly for undergraduates, and is a prerequisite for all further film production course work.

4 units, Aut, Win (Crowley) TTh 4:15-5:30 and tutorials by arrangement

101. Film Aesthetics—A theoretical, historical examination of the nature of the film medium. Attention is given to the problems of aesthetics and communication from the viewpoints of the practitioner, the critic, and the audience.

4 units, Aut (Kovdcs) MWF 10; evening screenings by arrangement

133. Visual and Aural Communication Techniques—An investigation of the techniques of cinematography and sound from the standpoint of the communication of ideas. Students will produce short exercises and a short film. The course is designed mainly for undergraduates. Prerequisites: 90 and consent of instructor. Concurrent registration in 134.

5 units, Win, Spr (Alexander) Sum (Staff) TTh 2:15-4:05 and tutorials by arrangement

134. Writing for the Visual Media—Script writing techniques for film and television. Emphasis is placed on conceptualizing and executing ideas for the films made jointly with 133, as well as on preproduction preparation for those films. The course is designed mainly for undergraduates with preprofessional concerns. Prerequisite: 90 and consent of instructor for winter and spring, con-
sent of instructor only for summer. Concurrent registration in 133.

4 units, Win, Spr (Jones, D. B.)
Sum (Staff) MW 2:15-4:05 and screenings by arrangement

141. History of Film — Studies in the development of the motion picture as an art form and a means of communication. Lab.: screenings of films announced in class.

4 units, Win (Mayer) MWF 9; evening screenings by arrangement

142. Broadcast Communication — The development of American broadcasting and its contemporary problems. (Graduate students register for 242.)

4 units, Aut (Dundes) MWF 11

142B. Broadcast News — Writing, delivery and direction of radio and TV news. Prerequisites: 100, 102, 142, and consent of the instructor.

4 units, Aut (Staff) MW 11 and lab by arrangement

180. Broadcasting and Film Criticism — An attempt to develop a critical view of film. Readings and discussion will consider models of artistic and literary criticism as points of comparison. The student will be introduced to journalistic, psychoanalytical, Marxist, structuralist, and semiological approaches. Weekly reviews will stress the meaning of the films and a lucid writing style. Prerequisites: 101, 141, or 142.

4 units, Spr (Kovács) MW 9

205A. Television Production I — Production and direction of news and documentary television programs. Prerequisite: consent of instructor.

4 units, Sum (——)

206A. Film Production I — The first quarter of a three-quarter continuing sequence designed for professional training in all phases of the production of motion pictures. The emphasis in production is largely on non-dramatic and documentary forms. Each student will be required to complete a series of exercises and a very short film. Prerequisite: admission to the film A.M. program, and concurrent registration in 223A.

5 units, Aut (Alexander and Jones, D. B.)
MW 2:15-4:05 and tutorials by arrangement

206B. Film Production II — The second quarter of a three-quarter continuing sequence for training in the production of motion pictures. During this term and finishing in the third quarter, each student will be expected to produce a film approximately ten minutes in length. Prerequisite: successful completion of 206A and concurrent registration in 223B.

5 units, Win (Alexander and Jones, D. B.)
MW 2:15-4:05

206C. Film Production III — Continuing 206B. Prerequisite: successful completion of 206B, consent of instructor, and concurrent registration in 223C.

5 units, Spr (Alexander and Jones, D. B.)
MW 2:15-4:05

208A. Seminar in Film and Broadcasting I — Limited to Film and Broadcasting A.M. students.

1 to 2 units, Aut (Breitrose) M 4:15-5:30

208B. Seminar in Film and Broadcasting II — Limited to Film and Broadcasting A.M. students.

1 to 2 units, Win (Breitrose) M 4:15-5:30

208C. Seminar in Film and Broadcasting III — Limited to Film and Broadcasting A.M. students.

1 to 2 units, Spr (Breitrose) M 4:15-5:30

210A, B, C. Topics in Film Study — Each quarter during the academic year a different aspect of film history, criticism, aesthetics, and institutional development will be examined in detail. Admission is by consent of the instructor. Topics for the academic year 1974-75 are the following:

210A. Contemporary Eastern European Film — The evolution of Eastern European cinema from the dogma of socialist realism. Readings will focus on the role of the arts in Communist society as articulated by Hegel, Marx, Engels, Lenin, Stalin, Mao, Trotsky, Lukács and others. An attempt will be made to establish the tenets of socialist realism and examine its dialectical relationship to recent developments in Soviet, Polish, Hungarian, Czech, and Yugoslav cinema. Weekly screenings will feature highlights from the works of contemporary Eastern European directors.

4 units, Aut (Kovács) MW 1:15-2:05

210B. Japanese Cinema — A survey of Japanese film, including the work of Mizoguchi, Kurosawa, Ozu, Hani, Oshima, and Ichikawa. Through a selection of films and read-
ings the course will attempt to explore the significance of Japanese films in terms of their social and cultural background. Weekly screenings.

4 units, Win (Kovács) by arrangement

210C. Five American Directors—The work of John Ford, Howard Hawks, Orson Welles, Alfred Hitchcock and Stanley Kubrick will be examined in light of the auteur theory. Weekly screenings.

4 units, Spr (Kovács) by arrangement

216. The Broadcast Editorial—Analyses of radio and television editorials. Students will research, write, deliver and direct their own editorials. Prerequisite: 142 and consent of instructor.

3 units, Aut (Dundes) MW 2:15-4:05

223A. Writing for Film I — Techniques of writing for the visual media. Emphasis is placed on conceptualizing and executing ideas for the production work done jointly with 206A as well as on pre-production for that work. The course will include some introductory writing assignments. To be taken concurrently with 206A. Open to graduates only.

4 units, Aut (Alexander and Jones, D. B.) TTh 2:15-4:05

223B. Writing for Film II—Form and style in the construction of fiction and non-fiction scripts. Much attention will be given to script for the film to be made jointly with 206B and 206C. Writing assignments will aim at preparing the student for a full script to be written for 223C. To be taken concurrently with 206B. Prerequisite: 223A.

5 units, Win (Alexander and Jones, D. B.) TTh 2:15-4:05

223C. Writing for Film III—Course divided between seminar in more advanced writing and individual work with instructor on student’s script. Time will also be devoted to problems revealed by work on productions for 206C. To be taken concurrently with 206C. Prerequisite: consent of instructor.

5 units, Spr (Alexander and Jones, D. B.) TTh 2:15-4:05

242A. Seminar in Government, Industry and Consumer Relations in Broadcasting—The legal, economic and societal factors in both commercial and noncommercial broadcasting today. Prerequisites: 142 and consent of the instructor.

4 units, Win (Dundes) MW 1:15-2:05

242B. Broadcast News Techniques and Production—Writing, delivery and direction of radio and TV news. Prerequisites: 100, 102, 142, and consent of the instructor.

4 units, Win (Dundes) MW 11 plus lab by arrangement

242C. Seminar in Broadcast Management—An advanced examination of the managerial aspects of commercial and public broadcasting. Prerequisites: 142 or concurrent registration in the School of Law or Graduate School of Business.

4 units, Spr (Block) by arrangement

Summer Film and Broadcasting Institute

(See the 1976 Summer Session Bulletin, available in February, 1976.)

COURSES FOR GRADUATES


3 units, Win (Maccoby)

207. Introduction to Communication Research Methods—Formulation of research problems, research design, sampling, data collection and analysis. Examples will be drawn from the communication and national development literature. Designed primarily for students in the Communication and Social Change M.A. program. Prerequisite: Psychology 60 or equivalent.

5 units, Win (Hornik) TTh 1:15-3:05

211. Theory of Communication—Approaches to communication theory, seminar and tutorial meetings; extensive reading and papers. Required of all Communication doctoral students; others by consent of instructor.

4 to 5 units, Aut (Maccoby) TTh 3:15-5:05

212. Persuasive Communication — Seminar on campaigns designed to change information attitudes and behavior with particular reference to health. Designed for Ph.D. students in Communication. For others, consent of instructor.

4 units, Win (Maccoby) by arrangement

213. Computer Analysis of Communication Research Data — An introduction to computer programming and data analysis in Communication research. Includes an introduction to the Stanford computer facilities,
interactive text editing, statistical programming in BASIC and FORTRAN, and use of statistical packages such as BMD and SPSS. Prerequisite: consent of instructor.

0 to 3 units, Aut, by arrangement

214. Advanced Analysis of Communication Research Data — Advanced statistical programming for data analysis. Emphasis on algorithms and statistical programming in FORTRAN. Prerequisite: successful completion of 213 and consent of instructor.

0 to 3 units, Win, by arrangement

218. Communication Research Methods I — Methods of research in mediated and interpersonal communication. Application of scientific method to communication research. Logic of inquiry, conceptualization of variables, design of experiments. Prerequisite: elementary statistics.

4 units, Aut (Paisley) MW 4:15-5:30


4 units, Spr (Hornik) MW 4:15-5:30

220. Mass Communications in Society — The nature and social responsibilities of the media, the structure of the industry, problems of regulation, management, educational and commercial interests. For A.M. students.

4 units, Spr (Tillinghast) by arrangement

222. Documentary Film — Analysis of the techniques and strategies of films designed to effect attitudinal and behavioral change. Prerequisite: consent of instructor.

4 units, Spr (Breitrose) 10:00

226. Images, Media, and the Construction of Reality — Same as 126, but graduate students are expected to complete an independent project of "potentially publishable" quality.

4 units, Spr (Butler-Paisley) F 3:15-5:05

231. Developmental Communication I — Changes with age in how people use the mass media, what information they obtain from the media, and how they are influenced by the media. Particular emphasis on children and the media. Prerequisite: consent of instructor.

4 units, Spr (Roberts) by arrangement

238. Social Effects of the Mass Media Among Adults — Survey and critique of the research literature in the varied sub-areas of this field. Emphasis on useful directions for future research. Prerequisite: 211 or consent of the instructor.

4 units, Spr (Hornik) T 2:15-4:05

240. Mass Media History — Review of the literature and research in the historical development of newspapers, magazines, broadcasting and film.

4 units, Spr (Staff) by arrangement

242. Broadcast Communication — See 142. 

252. Research Seminar — Discussions of research projects — research design, field work, problems, etc. — led by Communication teachers and advanced graduate students who are conducting research. Prerequisite: graduate standing.

1 unit, Win (Staff) T 12-1

255. Communication Theory and Social Change — This is a seminar for students in the Communication Media and Social Change A.M. program and for other students with the instructor's consent. Various theoretical approaches to the communication process and its effects are examined. Student papers, exercises and tutorial meetings supplement the weekly seminar meetings.

4 units, Aut (Mayo) F 2:15-4:05

256. Communication Media and Social Change — Seminar on the communication problems of economic and social development, and on the uses of the mass media for national integration, social change, and education in the developing countries. Special uses and difficulties of communication research in these countries. Case studies and planning exercises.

3 to 5 units, Win (Mayo and McAnany) T 2:15-4:05

257. Evaluative Research Methods for Mass Media Projects in Developing Countries (Same as Education 214) — Nature of evaluation and evaluation design, problems of field work, construction of instruments. During the quarter each student will prepare a complete evaluation design for a project using mass media in a developing country. Prerequisites: Basic statistics, Comm. 207 (or equivalents), Comm. 256.

4 units, Spr (McAnany and Hornik) F 1:15-3:05
260. Introduction to Information Science—
Techniques for describing the organization, utilization, and growth of data collections whether stored in the mind, in society, or in computers.

3 units, Aut (Staff) by arrangement

263. Computer Information Systems—Analysis of computer systems and techniques for information retrieval, library automation, and specialized applications such as medical information systems.

3 units, Win (Staff) by arrangement

265. Information Technology and Society—
The social history of information technology will be used as background against which to examine the social, economic and public policy implications of current and potential changes in information technology and in the institutions controlling that technology. Policy options associated with cable television, communication satellites and computer information systems will be discussed.

3 units, Spr (Staff) by arrangement

270. Advanced Communication Theory and Method Seminar I—May be repeated for credit. Topic and instructor change each year. Prerequisites: 211 and 219.

3 units, Aut (Staff) by arrangement

271. Advanced Communication Theory and Method Seminar II—May be repeated for credit. Topic and instructor change each year. Prerequisites: 211 and 219.

3 units, Win (Staff) by arrangement

272. Advanced Communication Theory and Method Seminar III—May be repeated for credit. Topic and instructor change each year. Prerequisites: 211 and 219.

3 units, Spr (Staff) by arrangement

274. Application of Communication Theory and Research to Persuasive Campaign Strategies—Seminar designed to bring together the theory and research of communication with the problems and techniques of mass communication, advertising and marketing. How the behavioral findings can actually be used to deal with problems in mass communication strategy for products, services, candidates, and causes will be explored. The focus of the course will be on application; students will be required to use behavioral knowledge to develop persuasive campaigns of various types.

4 units, Spr (Ray) by arrangement

280. Telecommunications Systems and Public Policy—(Same as Engineering-Economic Systems 280.) Structure of the U.S. and international communications industry. Regulation of common carriers, TV and radio broadcasters, and users of the frequency spectrum. Analysis of social consequences and public policy issues arising out of the rapidly changing technology in this field. Case studies of international satellite communications systems, cable television systems, land-mobile radio systems, and computer-based teleprocessing systems.

3 units, Spr (Parker, Dunn)

296. Comparative Literature

300. Thesis.

6 to 10 units, (Staff) by arrangement


3 to 6 units, (Staff) by arrangement

319. Pre-Dissertation Research Project—Advanced research for Ph.D. candidates.

3 to 6 units, (Staff) by arrangement

330. Public Affairs Thesis Seminar—For Public Affairs Ph.D. candidates only.

1 to 6 units, Aut, Win, Spr (Rivers) W 12

331. Public Affairs Comprehensive Review—For Public Affairs Ph.D. candidates only.

1 to 6 units, Aut, Win, Spr (Rivers) Th 12

347. Management of Marketing Communications. Enroll in Graduate School of Business.

449A. Consumer Behavior. Enroll in Graduate School of Business.
parative Literature), Gerald Gillespie (German Studies and Comparative Literature), Herbert Lindenberger (Comparative Literature and English) (on leave 1975–76), Charles R. Lyons (Drama and Comparative Literature), N. Scott Momaday (English and Comparative Literature), Makoto Ueda (Japanese and Comparative Literature)

Associate Professors: N. Gregson Davis (Classics and Comparative Literature), David G. Halliburton (English, Comparative Literature, and Modern Thought and Literature)

Assistant Professor: John B. Foster (English and Comparative Literature)

The interdepartmental program in Comparative Literature admits students for the Ph.D. It also supervises a minor program for students working toward the Ph.D. in individual language departments and, in conjunction with the Humanities Honors Program, offers a concentration in Comparative Literature for undergraduates.

UNDERGRADUATE HONORS PROGRAM

The undergraduate program is designed for students who combine a strong commitment to literary study with the drive and the ability to master foreign languages. Students planning to concentrate in Comparative Literature must apply for admission to the Humanities Honors Program and for graduation with Honors in Humanities.

Freshmen and sophomores interested in the program must first consult with the Director or the Associate Director of the Humanities Honors Program. Because of the strong language requirements, the consultation should take place at the earliest opportunity, preferably during the freshman year. Students who have not started their second foreign language by the sophomore year have little chance of fulfilling the program requirements on schedule. No student may declare a major later than two weeks after the start of the junior year. After admission to the program, the student will be assigned an adviser representing the Committee on Comparative Literature.

Students in the program do not need to complete a formal major in another field but, in order to satisfy the final requirement listed below, they will normally have a major, or the equivalent of a major, in a single national literature. Requirements are as follows:

1. Western Thought and Literature — Humanities 61 or 62. Completion of the full Humanities 61, 62, 63 series is strongly recommended.

2. Two seminars drawn from the series Humanities 191–196, of which one must be Humanities 194.

3. At least three literature courses in a foreign language and at least one advanced course—preferably a literature course—in a second foreign language.

4. One literature course—not necessarily in the original language—drawn from a cultural tradition distant from that of the student's main areas of interest.

5. Two additional literature courses drawn from the following:
   a) Courses listed under Comparative Literature.
   b) Courses offered in translation by the foreign language departments in languages outside the student’s two languages.
   c) Advanced literature courses offered at the overseas campuses.

6. Honors essay—an essay in literary criticism (2 units, spring, junior year; 5 units, autumn, 5 units, winter, senior year). A grade of at least B is required on the essay for graduation with Honors in Humanities.

7. Two courses related to the student's total program, but drawn from disciplines outside literature.

8. Course distribution should be designed in such a way that students develop an extensive background (about six courses covering a large range of periods) in a single national literature read in the original language. Students may fulfill this requirement through work either in the English Department or in one of the language departments.

GRADUATE PROGRAM

The Ph.D. program is designed for a small group of students whose linguistic background, breadth of interest in literature, and curiosity about the problems of literary
scholarship and theory (including the relation of literature to other disciplines) make this program more appropriate to their needs than the Ph.D. in one of the individual literatures. Students will take courses in at least three literatures (one of which may be English), to be studied in the original languages. The program is designed to encourage familiarity with the major approaches to literary study prevailing today.

A considerable part of a student's work will consist of individual study toward the Ph.D. examination, for which each student uses his or her own reading lists. The examination is centered not on national lines, but on the study of particular periods, genres, and problems of literary study. Students are admitted to the program as Comparative Literature Fellows on a plan which attempts to integrate their financial support and their completion of residence requirements with training as prospective university teachers. Tenure as a Fellow, assuming satisfactory academic progress, will be for a maximum of four years (graduate-level work in literature completed elsewhere being counted as part of this four-year period). All Fellows, whatever their sources of financial support, are required to do three and a half quarters of supervised teaching at Stanford.

REQUIREMENTS

Residence—A candidate for the Ph.D. degree must complete three years (nine quarters) of full-time work, or their equivalent, in graduate study beyond the Bachelor of Arts degree. The student will be expected to offer at least 72 units of graduate work in addition to the doctoral dissertation. At least three consecutive quarters of course work must be taken at Stanford.

Languages — Students must know three foreign languages, two of them sufficiently to qualify for graduate courses in these languages and the third sufficiently to demonstrate ability to read a major author in this language. One of the three languages must be French or German, and one of the other two must be Latin (for which Greek, Chinese, or Japanese may be substituted when appropriate), if the period in which the student concentrates is earlier than the Romantic period. Students' language preparation must be sufficient before entrance so that they can take a graduate level course in at least one foreign language during their first year and in the second during the second year. Students must demonstrate a reading knowledge of the third foreign language no later than the beginning of the third year.

Of the three literatures in which a student takes courses, no more than two may be in the same department at Stanford. Literatures written in the same language (such as Spanish and Latin-American) are counted as one in the planning of the student's program. One of the student's three literatures will be designated as the primary field; the other two as secondary fields.

Minimum Course Requirements

1. Comparative Literature 369 (Major Modern Critics) and three additional seminars (or courses that assign a long paper) of a primarily comparative nature; at least one of these additional seminars must be on literary theory or criticism.

2. At least three graduate courses in each of two literatures other than the student's native literature.

3. A sufficient number of courses in the student's primary field to assure his knowledge of the basic works in one national literature from its beginnings until the present day.

Minimum course requirements must be completed before the student is scheduled to take the University Oral Examination. These requirements are kept to a minimum so that students will have sufficient opportunity to seek out new areas of interest.

Examination—The examination will consist of three sections, the last of which will constitute the University Oral Examination. Each student's reading lists for the examination must be approved by an examining committee. The examination will consist of the following sections, each of which takes the form of an oral colloquy between the student and a committee of faculty members with interests in the subject area of the particular section:

1. A literary genre, to consist of (1) a knowledge of a substantial number of literary works in a single genre, the list to include works from a number of centuries and from at least three national literatures, and (2) a grasp of the theoretical problems involved in dealing with this genre and with
the question of genre in general. This exam-
ination must be taken no later than the first
quarter of the student's second year of
graduate work (or the third quarter of the
first year for students who enter with a year
of previous graduate work).

2. Literary criticism, to consist of the ex-
ploration of a specific problem proposed and
defined by the student. The problem must be
sufficiently wide-ranging to demand the
reading of critical texts from a variety of
periods. This examination must be taken no
later than the first quarter of the student's
third year of graduate work (or the second
quarter of the second year for students who
enter with a year of graduate work). Stu-
dents may elect to take this section of the
examination before the genre section, in
which case it must be taken at the time
designated for the latter.

3. A literary period, to consist of a knowl-
edge of a literary period of at least a century
in three or more literatures. The reading list
for these two sections will cover not only the
major literary texts of this period but also
studies of intellectual backgrounds, trends
in the other arts, and modern critical dis-
cussions of the period. Students must dem-
onstrate a grasp of how to discuss and de-
fine this period as well as the concept of
periods in general. Students whose course
work combines an ancient with a modern
literature, or an Eastern with a Western lit-
erature, have the option of dividing the pe-
riod sections into two wholly separate pe-
riods. This examination, which will normally
be taken before the end of the student's
third year (or second year for students who
enter with a year of previous graduate
work), will serve as the University Oral Ex-
amination, which will also include a short
section on the student's plans for the disser-
tation.

Qualifying Procedures—The qualification
procedures for students in Comparative Lit-
erature will take place during the quarter
that the student takes the first section of the
Ph.D. examination. Ordinarily this will be
the first quarter of the second year, but stu-
dents who enter with a year of graduate
work elsewhere must take the examination
no later than the third quarter of the first
year. Any student may elect to take the ex-
amination during the third quarter of the
first year.

Students are judged qualified to proceed
to the Ph.D. on the basis of this section of
the Ph.D. examination as well as other as-
pects of their academic work. As soon as the
student has completed the qualifying pro-
cedures, the chairman will recommend him
for admission to candidacy for the Ph.D. At
this time he will also be recommended for
the A.M. in Comparative Literature if he has
completed 36 units of work at Stanford and
has not already completed an A.M. before
entering the program.

Dissertation—The student will propose a
dissertation topic for approval by the Com-
mitee on Comparative Literature, which in
turn will appoint a dissertation committee
to be drawn from at least two departments.

Minor—Students interested in the minor
should apply for admission to the individual
departments of literature. They may apply
to the Committee on Comparative Litera-
ture for entrance to the minor after they
have completed their first quarter of gradu-
ate work at Stanford. Requirements are as follows:

1. A knowledge of at least two foreign
languages, one of them sufficient for the stu-
dent to qualify for graduate-level courses in
that language, the second sufficient for the
student to read a major author in the origi-
nal.

2. A minimum of six graduate courses, of
which three must be in the department of the
second literature and three in Comparative
Literature, the latter to include a seminar in
literary theory or criticism. Except for stu-
dents in the Asian Languages, students must
choose a second literature outside the de-
partment of their major literature.

This minor is designed for students work-
ing toward the Ph.D. in the various foreign
language departments. Students working
oward the Ph.D. in English are directed
to the program in English and Comparative
Literature described among the English
offerings.

Courses primarily of a comparative nature
are listed below:

30. The Novel—(Enroll in English 30.) The
objectives of this course are to present the
novel as a significant, distinct genre, and by
close, sympathetic reading to increase the
student's appreciation of individual novels.

5 units, Spr (Stone)
40. Drama—(Enroll in English 40.) Principal dramatic forms; development of dramatic art, masterpieces of the theater from various periods, countries.

5 units, Aut (L’Heureux)

50. Poetry—(Enroll in English 50.) An introduction, through the careful reading of poems, with emphasis on contemporary American poetry, and through the study of language and technical elements of verse. There will be opportunity for the writing of poetry.

5 units, Spr (Felstiner)

61, 62, 63. Western Thought and Literature—An introduction to fundamental ideas of the past; lectures, discussions, reading of selected masterpieces.

61. The World of Classic Antiquity—(Enroll in Humanities Special Programs 61.) Homer, Aeschylus, Sophocles, Euripides, Plato, Aristotle, Cicero, Virgil, Seneca.

5 units, Aut (Raubitschek)


5 units, Win (Gillespie)

63. From the Enlightenment to the Present—(Enroll in Humanities Special Programs 63.)

5 units, Spr (Staff) MWF 11; two hours by arrangement

110. Japanese-Western Literary and Cultural Interactions—(Enroll in Asian Languages 110.) Discussion of cross-literary and -cultural topics, such as haiku in English, Marxism in Japanese prose fiction, and Zen in American literature. Graduate students may register under J257, in which case they will be required to do additional work.

4 units, Win (Ueda)

162A. Chicano Literature—(Enroll in English 162A. Same as Modern Thought and Literature 162A and Spanish and Portuguese 278.) Study of the emergence of a literature. Novels, poems, journals, unpublished works will be read and discussed. Knowledge of Spanish helpful but not essential. (Open to graduate students but not to freshmen.)

5 units, Aut (Islas)

163. Comparative Mythology: Topics from Greek and Roman, Near-Eastern and African Culture—(Enroll in Classics 163.)

3–4 units, Spr (Davis)

164. Introduction to Caribbean Literature: English, French, Spanish.

5 units (Davis) given alternate years

168. American Indian Mythology, Legend, and Lore—(Enroll in English 168.) An introduction to American Indian oral tradition, centering upon an investigation of the nature of native American prose and poetry, and especially the relationship between oral tradition and writing.

5 units, Aut (Momaday)

190. The Humanities in Western Thought and Literature—(Enroll in Humanities Special Programs 190.) Prerequisites: Humanities 61, 62, 63. Counts as Humanities 194.

5 units, Aut (Evans)

194. Literature and the Humanities—(Enroll in Humanities Special Programs 194.) The critical study of major texts; theory and practice of criticism.

5 units, Win (Davis)

208. Post-Classical Latin—(Enroll in English 208. Same as Classics 208.) Careful reading of Latin texts of graded difficulty, beginning with the Vulgate Bible, working through various patristic writings and medieval literature to the Latin of the Renaissance. Intended primarily for students not in classics. Prerequisite: two years’ high school Latin or equivalent.

5 units, Win (Damon)

230. Russian Formalist and American “New” Criticism—(Enroll in Slavic Languages and Literatures 230. Same as English 267 and Modern Thought and Literature 267.) Readings in the works of Russian Formalists and certain American “New Critics.” A knowledge of French, German or Russian is highly desirable.

4 units, Aut (Brown)

236. Forms of the Modern Novel—(Enroll in English 236. Same as Modern Thought and Literature 236.) An advanced course in the interpretation and criticism of novels, but open to any student with a serious interest in the art of fiction. Stendhal, Dickens, Dostoeyevsky, Conrad, Gide, Faulkner, and one or two living writers.

5 units, Win (Guerard)
252. Medieval and Renaissance Drama — (Enroll in Drama 252. Same as English 241.)
4 units, Win (Prosser)

260. The History of Literary Theory — (Enroll in English 260.)
5 units, Aut (Trimpi)

271. Spanish Literature in a Social Context I — (Enroll in Spanish and Portuguese 271.)
The Spanish novel after 1898: Valle Inclán, Gabriel Miró y Unamuno.
4 units, Aut (Franco)

272. Spanish Literature in a Social Context II — (Enroll in Spanish and Portuguese 272.)
The poet and the people in the 1930s: Lorca, Alberti and Cernuda.
4 units, Win (Franco)

291. The Poem Itself — (Enroll in Spanish and Portuguese 291.) A course on practical criticism based on the famous poems of Spain, Portugal, Brazil, and Spanish America. Students will be expected to write short papers on the texts discussed. Classroom debates as well as poetry readings will be encouraged. Reading knowledge of Spanish and/ or Portuguese required.
3–5 units (Coelho)

300. Theory of the Novel — (Enroll in Slavic Languages and Literatures 300. Same as English 230 and Modern Thought and Literature 300.) Studies of fiction as representation, social institution, and verbal structure. Discussions will relate Western theories (Gombrich, Auerbach, Frye, Barthes, Lukács, and others) to selected Russian novels. A seminar for graduate and advanced undergraduate students. Prerequisite: consent of instructor.
4 units, Spr (Todd)

311: Literary Theory and Hispanic Literature — (Enroll in Spanish and Portuguese 311.) Readings in contemporary literary theory, with special application to the practical criticism of Hispanic literature.
3–5 units, Win (Ball)

316C. Seminar: Romantic Irony — (Enroll in English 316C. Same as Modern Thought and Literature 316C.)
5 units, Aut (Mellor)

3–5 units, Spr (Ball)

353. Seminar: Medieval Drama — (Enroll in Drama 353.)
5 units, Aut (Prosser)

360A. Seminar: History of Literary Theory: Ancient — (Enroll in English 360A.)
5 units, Aut (Trimpi)

360B. Seminar: History of Literary Theory: Medieval Renaissance — (Enroll in English 360B.) Prerequisite: 360A.
5 units, Win (Trimpi)

361. Seminar: The Modern Tradition — (Enroll in English 361. Same as Modern Thought and Literature 361.)
5 units, Spr (Staff)

362A. Seminar: Literature and Psychology — (Same as Modern Thought and Literature 362A. Enroll in English 362A.) Studies in the dynamics of literary creation, with special attention to conscious and unconscious psychological constructs in Dickens and Dostoevsky.
5 units, Spr (Guerard)

369. Seminar: Major Modern Critics — (Enroll in English 369. Same as Drama 302 and Modern Thought and Literature 369.)
5 units, Aut (Lyons)

394. Poets of Infinity — (Enroll in German Studies 394.) Inquiry into the vision of cosmic, evolutionary, historical, and psychological time in selected lyrics by such major romantic poets as Novalis, Hölderlin, Keats, Shelley, Leopardi, Becquer, and Baudelaire. Readings in the original language and/or bilingual texts.
3–5 units, Win (Gillespie)

449. Seminar: Humboldt and Structuralism — (Enroll in German Studies 449.) A close study of Humboldt's writings on linguistics and the nature of language and their relation to modern structuralism. It is the aim of the seminar to examine critically the notion of structure and the limit of its applicability in literary studies. Taught in English. Readings in German.
3–5 units, Aut (Mueller-Vollmer)
COMPUTER SCIENCE

Emeritus: Arthur L. Samuel (Adjunct Professor)
Chairman: Robert W. Floyd

Visiting Professor: Michael Paterson
Assistant Professors: Forest Baskett III, Vinton G. Cerf (By Courtesy), Václav Chvátal, C. Cordell Green, Joseph Oliger, Robert E. Tarjan, Terry Winograd

Research Computer Scientists and Lecturers: Bruce G. Buchanan, Lester D. Earnest, David C. Luckham.

Lecturers: Daniel Bobrow, John R. Ehrman, Charles T. Zahn, Jr.
Lecturer and Research Associate: Howard C. Johnston

Affiliated Faculty:
Assistant Professors: Thomas H. Bredt (Electrical Engineering), John T. Gill III (Electrical Engineering)

OFFERINGS AND FACILITIES

The Department aims to acquaint students with the technological and intellectual roles of automatic digital computers, and to educate research workers in computer science. In spite of the diversity of the applications, the methods of attacking problems with computers show a considerable unity, and computer science is concerned with the underlying principles. The field is still young, and the student will find many more questions than answers.

The Department has competence in artificial intelligence, combinatorics and analysis of algorithms, design of computer and program systems, mathematical theory of computation, and numerical analysis.

Courses in data processing are offered by the Industrial Engineering Department and in the Graduate School of Business. Courses in optimization and mathematical programming will mainly be found in the Operations Research Department. Courses in the theory of switching and the logic design of digital systems are mainly offered in the Electrical Engineering Department, whose program is closely coordinated with ours.

Special Ph.D. programs with other departments are possible, either as a Ph.D. in Computer Science or otherwise (see “Graduate Division Special Programs” in this bulletin). For example, a joint program with Operations Research is designed for students interested in numerical analysis techniques that arise in optimization theory. Students interested in special programs should apply for admission to the department of primary interest.

Since computer science is inherently interdisciplinary, graduate students of computer science are encouraged to include in their study program a good deal of work in other departments; see the list of suggested courses below.

There is no Bachelor’s degree in Computer Science. Undergraduates who wish to enter the field are advised to major in Mathematics or in the Program in Mathematical Sciences (see page 536) and include Computer Science 106, 109 or 111, 137A, 144A, B, and 155 in their course of study.

In connection with its courses and research, the Department makes considerable use of the Center for Information Processing. See the section “Center for Information Processing” in this bulletin. For use in research and teaching, the Department has an HP-2116 computer and a PDP-11 computer.

The Artificial Intelligence Laboratory is located in the D. C. Power Building. Its research is in artificial intelligence, mathematical theory of computation, time sharing, human higher mental functions, semantics of natural languages, symbolic computation, and related topics. It operates a time-sharing system with PDP-6 and PDP-10 computers, 64 display consoles, computer controlled television cameras, computer controlled artificial hands, a computer controlled vehicle, etc. The Laboratory is part of the Computer
Science Department, but its facilities are
used by the departments of Electrical En-
gineering, Mechanical Engineering, Linguis-
tics, Psychology, Music, and others for proj-
ects that contribute to the research goals of
the Laboratory. Research appointments at
the pre- and post-doctoral levels are avail-
able to students with relevant interests.

The Department conducts a weekly col-
loquium, presented by the staff and visiting
scientists, which covers a spectrum of current
topics.

PROGRAMS OF STUDY

MASTER OF SCIENCE

The University's basic requirements for
the Master's degree are discussed in the sec-
tion "Degrees" in this bulletin. The Depart-
ment offers two distinct programs. In either
two of these the candidate must attain at least a
2.50 average in his course work and a 3.00
(=B) average in courses taken in the Com-
puter Science Department.

MASTER OF SCIENCE IN COMPUTER SCIENCE

A candidate is expected to complete a
course program of 42 units, at least 36 of
which will be in this Department or in re-
lated areas, and 24 of these 36 units must
be graded units. A list of suggested courses
in other departments appears at the end of
the course offerings in Computer Science.
These 36 units must include 6 units of course
293 and 15 additional units of courses num-
bered 200 or above. The course program
must be approved by the Computer Sci-
ence Department's Committee on Graduate
Study.

A candidate is also required to demon-
strate a suitable level of competence on the
departmental Comprehensive Exam.

MASTER OF SCIENCE IN COMPUTER SCIENCE:
COMPUTER ENGINEERING

The degree of "Master of Science in Com-
puter Science: Computer Engineering" may
be conferred upon students who have devel-
oped a competence in the design of sub-
stantial software-hardware computer sys-
tems. This degree will be administered by
the Committee on Computer Engineering,
composed of faculty from the Computer Sci-
ence and Electrical Engineering Depart-
ments. In 1974–75 the members were Vinton
G. Cerf, chairman, Joseph Oliger, and Cliff-
ford Hollander.

A student who wishes to enter the Com-
puter Engineering program should indicate
his or her preference for this degree when
applying for admission. Programs of at least
42 quarter units that meet the following
guidelines will normally be approved:

1. A required sequence of courses in Com-
puter Science and Electrical Engineering
to provide depth in hardware and soft-
ware design. This sequence includes courses 140A, B and one of the following:
(a) 211A,B and 311; (b) 211A,B and 246;
(c) 112, 246 and 311.

2. At least one course in mathematical foun-
dations for computer engineering. Ac-
ceptable courses: 150, 155, 156, Electrical
Engineering 284.

3. At least one course in numerical analysis
or, alternatively, at least one course in
Finance or Accounting at the Graduate
School of Business. Acceptable courses:
135, both 137A and 137B, 210 Manage-
ment Accounting I, 220 Business Finance
I.

4. At least one graduate-level course in Op-
erations Research or Statistics. Acceptable
courses: Operations Research 245, 252,

5. Six units of laboratory courses. Ac-
ceptable courses: 191, 193, 293, Electrical
Engineering 274, 282, 288, 391, Industrial
Engineering 341.

6. At least 3 units of seminar with a total
not to exceed 6 units. Acceptable courses:
300, 319, Electrical Engineering 350, 385.

7. Additional courses to bring the total to 42
or more quarter units, at least 36 units of
which must be in courses in which letter
grades are given. These courses may be in
departments other than Computer Sci-
ence and Electrical Engineering.

Computer engineering programs that de-
vote from one or more of the above guide-
lines in order to meet the valid objectives
of individual students will be considered by
the Computer Engineering Committee on
an individual basis. The student should sub-
mit a written statement of his or her individ-
ual objectives and how his or her program
and previous preparation meet these objec-
tives.

This program is normally open to students
with a bachelor's degree in Mathematics,
Statistics, Physics, or Engineering. A bache-
lor’s degree in another field may be accepted provided the applicant has a knowledge of calculus, linear algebra, and probability. Some knowledge of programming is required.

Students with very little background in programming should enroll in the basic programming course 106 during the summer quarter preceding entrance into this program.

The Computer Engineering program will begin in autumn quarter each year to enable a full-time student to complete the degree in one academic year. It is advisable, however, for the student to plan on remaining for a complete calendar year with the thought of completing the laboratory courses in the summer term. Honors Cooperative students able to take two courses each quarter should be able to complete the program in two academic years and one summer quarter.

The degree of “Master of Science in Computer Science: Computer Engineering” is intended as a terminal degree. Students planning to obtain the Ph.D. degree are advised to apply directly for admission to the Ph.D. program.

DOCTOR OF PHILOSOPHY

The University’s basic requirements for the doctorate (residence, dissertation, examination, etc.), are discussed in the section “Degrees” in this bulletin. The following are Departmental requirements:

1. A student should plan and successfully complete a coherent program of study covering the basic areas of computer science and related disciplines. The student’s advisor has primary responsibility for the adequacy of the program, which is subject to review by the Graduate Study Committee of the Department.

2. Each student is expected to enroll in course 204 at the first opportunity.

3. Each student, to remain in the Ph.D. program, must pass a comprehensive exam covering introductory level graduate material in major areas of Computer Science, and thereafter apply for admission to candidacy for the Ph.D., by the end of six quarters of full-time study (excluding summers). By the end of nine quarters (excluding summers) each student should pass a qualifying exam in the general area of his or her expected dissertation. The Department Secretary has further details.

4. As part of the training for the Ph.D., each student is required during one or more quarters to perform some supervised teaching equivalent to that normally performed by teaching assistants, and during one or more quarters to carry out some research equivalent to that normally performed by research assistants.

5. The most important requirement for the Ph.D. degree is the dissertation. After passing the qualifying examination each student must secure the agreement of a member of the department faculty to act as the dissertation advisor. (In some cases the dissertation advisor may be in another department.) The Department is currently conducting research in analysis of algorithms, automatic programming, automatic theorem proving, complexity theory, data structures, design of computer networks, design of program systems, graph theory, heuristic programming, measurement and performance evaluation, natural language understanding, numerical linear algebra, operating systems, optimization, partial differential equations, program verification, programming languages, reliability of computer systems, robotics, spline functions and vision and perception.

6. Each student must pass a University Oral Examination in the form of a defense of his or her dissertation. It will usually be held after all or a substantial portion of the dissertation research has been completed.

7. The student is expected to demonstrate the ability to present scholarly material orally, both in the dissertation defense and by a lecture in a departmental seminar.

8. The dissertation must be accepted by a reading committee, composed of the principal dissertation advisor, a second member from within the department and a third member chosen either from within the department or from another department. The principal advisor and at least one of the other committee members must be Academic Council members.

PH.D. MINOR

For a minor in Computer Science a candidate is required to demonstrate a suitable level of competence in the departmental comprehensive examination. There are no specific course requirements. For further information see the department secretary.
TEACHING AND RESEARCH ASSISTANTSHIPS

There are graduate student assistantships available in the Computer Science Department. Assistants receive a tuition scholarship for up to nine units of study per quarter during the academic year, and in addition receive stipends for the nine-month academic year ranging approximately from $2800 to $3200. Some may work full time in the summer for between $650 and $750 per month.

Duties in the academic year involve 20 hours of work per week. Teaching assistants help an instructor teach a course by meeting discussion sections, consulting with students, grading examinations, etc. Research assistants help senior staff members with research in computer science. Approximately two hours of the work week are spent in attendance at Computer Science Department colloquia and seminars.

Students with NSF fellowships and traineeships may have the opportunity to supplement their stipends by serving as graduate student assistants.

Further information may be obtained from the Chairman of the Computer Science Department.

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

101. Computers: Their Nature, Use, and Impact—Intended to introduce students from all departments to the world of computers and their uses. It is designed to survey for non-specialists a variety of issues relating to computers. Topics include basic concepts and vocabulary of computers and information processing; current applications of computers in education, business, music, art, medicine, science, transportation, law, law enforcement, and government; future trends in the economics of computing, technological advances, artificial intelligence; impact of computers on issues of privacy, employment, leisure, obsolescence, political and economic power, health care, and man's image of himself. Not intended for students who want to learn to program a computer. Alternates: 105, 106. No prerequisite.

3 units, Spr (Feigenbaum) MWF 2:15

103. Programming in Fortran—An introduction to Fortran IV for students with experience in programming in Algol W or Algol 60. Prerequisite: 105 or 106 or equivalent.

1 unit, Aut (Staff) MWF 12, first 4 weeks only
Win (Staff) MWF 12, first 4 weeks only

104. Programming in Algol W—A shortened alternative to 105 or 106, for students with previous knowledge of computer programming.

1 unit, Aut (Staff) MWF 12, first 4 weeks only
Win (Staff) MWF 12, first 4 weeks only

105. Introduction to Computing—Design and construction of computer programs; use of a specific programming language to solve problems over a wide range of applications on a digital computer. The applications are selected from problem areas in which no detailed knowledge of mathematics is required. Not intended for students with substantial mathematical training or with a previous knowledge of programming. Alternates: 104, 106. Prerequisite: Mathematics 1 or equivalent.

* 3 or 4 units, Aut (Staff) MWF 10, (Staff) MWF 2:15
Win (Floyd) MWF 2:15, Spr (Staff) MWF 11
Sum (Staff) MTWTh 10

106. Introduction to Computing—Design and construction of computer programs; use of a specific programming language to solve problems over a wide range of applications on a digital computer. This course is essentially the same as 105 except that some of the applications are mathematical in nature. Intended for students with some mathematical training. Not intended for students with a previous knowledge of programming. Alternates: 104, 105. Prerequisite: Mathematics 21 or 42 or equivalent.

* 3 or 4 units, Aut (Herriot) MWF 11, (Herriot) MWF 1:15
Win (Oliger) MWF 10
Win (Herriot) MWF 1:15
Spr (Staff) MWF 9
Sum (Staff) MTWTh 9
(Staff) MTWTh 11

* Normally 4 units for undergraduates, 3 units for graduate students.
109. Assembly Language Programming—Based on IBM System/360. Representation of numbers and other types of data. Binary arithmetic. Instruction execution. Assembly concepts: symbols; addressing expressions; data types and declarations; address resolution; binding times; macroinstructions. Simple data structures: arrays, lists. Accepted but not recommended as preparation for 144A, B. Not accepted as preparation for 112, 140A, B, or 311. Alternate: 111. Prerequisite: 105 or 106 or equivalent.

3 units, Win (Ehrman) MWF 1:15

111. Introduction to Computer Organization, Machine and Assembly Languages—(Same as Electrical Engineering 181, which is offered each quarter.) The organization of a simple digital computer. Binary arithmetic. Instruction execution. Machine language programs. Symbolic assembly language. The assembly process. Subroutines and coroutines. Simple data structures: arrays, stacks, queues. Input-output programming. Interrupts. Introduction to the IBM System/360. Students will program and operate a small computer such as the HP 2116. Enrollment limited to 50. Alternate: 109. Prerequisite: 105 or 106 or equivalent.

3 units, Aut (Staff) MWF 11
Win (Staff) MWF 1:15
Spr (Staff) MWF 1:15
Sum (Staff) MTWTh 10


3 units, Aut (Flynn) MWF 9
Win (Flynn) MWF 9

125. Nonnumerical Methods — This survey course is designed to acquaint students in the humanities, social sciences, and behavioral sciences with methods and techniques for solving scientific problems of a nonmathematical type on digital computers. Emphasis is given to practical problems and pragmatics. Program libraries are studied and used. Problems to be discussed include text processing, information retrieval, system simulation, graphics, elementary statistical calculations. Prerequisite: 105 or 106 or equivalent.

3 units, Win (Staff) TTh 11:00–12:15

127. Computer Models of Social Behavior—(Same as Education 218, Political Science 190M, Psychology 154, Sociology 273.) Models of human behavior in social situations. Particular attention is given to specifying simulation models, determining their properties, and testing them. Enrollment is limited to 20. Prerequisites: knowledge of at least one programming language, advanced courses in social science, consent of instructors.

4 units, Win (Feigenbaum, March)
M 3:15–5:05
Alternate years, given 1975–76

135. Numerical Methods — This survey course is designed to acquaint students in science and engineering with methods and techniques for solving scientific problems of a mathematical type on digital computers. Emphasis is given to practical problems and pragmatics. Program libraries are studied and used. Problems to be discussed include interpolation and approximation of data, solution of differential equations, numerical integration, solution of linear and nonlinear systems of equations, fast Fourier transform. Pitfalls in automatic computation and their remedies are discussed. Not intended for students with further interests in Numerical Analysis. Alternate: 137A, B. Prerequisites: FORTRAN; Mathematics 113 and 130; or equivalents.

3 units, Aut (Oliger) MWF 2:15

137A,B. Numerical Analysis—This course is designed to acquaint students of computer science and mathematics with the analysis of methods for solving mathematical problems on digital computers. Problems discussed in 137A include solution of nonlinear equations, interpolation and approximation of functions and solution of linear algebraic systems. Problems discussed in 137B include numerical differentiation and integration, solution of ordinary differential equations, matrix eigenvalue and least squares computations. Both courses will include analysis of convergence and estimation of truncation and round-off errors. Pitfalls in automatic computation and their remedies will be discussed. Assigned work will include both analytic problems and problems to be solved with the aid of a computer. Alternate: 135.
Prerequisites: 105 or 106; Mathematics 113, 130 or equivalents.

137A. 3 units, Win (Herriot) MWF 2:15
137B. 3 units, Spr (Herriot) MWF 2:15

140A,B. Systems Programming—(Same as Electrical Engineering 286A,B, which is offered Autumn and Winter quarters.) This two-quarter sequence is intended for those who wish to develop competence in the design of complex program systems. The course begins with a review of fundamental program design concepts such as systematic program design, modular programs, program verification, data structure, algorithms for sorting and searching, and translators including compilers and interpreters. Emphasis is on basic ideas illustrated through programming assignments. Specific systems programs and problems are then considered including: macro facilities, bootstrapping and portability, linkers and loaders, text editors, debugging systems, input/output systems, and file systems. The course concludes with a study of the facilities and structure of an operating system. Prerequisite: 111 or equivalent. Corequisite: 104.

140A. 3 units, Win (Baskett) TTh 9:30-10:45
140B. 3 units, Spr (Baskett) TTh 9:30-10:45

144A,B. Data Structures—This two-quarter sequence is intended for those who wish to study computer programming techniques intensively. Topics include basic concepts of data and its representation inside a computer; linear lists, strings; arrays, orthogonal lists; tree structures; data structures in programming languages. Detailed study of a variety of techniques for sorting and searching; use of external memory devices; database management. Analysis of algorithms to determine which is more efficient in a given situation. Prerequisites: 109 or 111; Mathematics 11 or 41; or equivalents. Course 155 is recommended but not required.

144A. 3 units, Win (Johnston) MWF 3:15
144B. 3 units, Spr (Knuth) MWF 3:15

150. Introduction to Combinatorial Theory—Intended as an elementary first course in combinatorics. Topics include permutations, combinations, partitions; the principle of inclusion and exclusion, and more general Möbius inversion; the elementary theory of graphs and trees; latin squares, block designs, finite fields, and finite geometries; an introduction to matroids. Prerequisite: Mathematics 44 or equivalent.

3 units, Win (Chvátal) MWF 2:15

151. Introduction to Discrete Mathematics—(Enroll in Electrical Engineering 284.) An introduction to the algebra and combinatorics required for theories of sequential machines and coding, and advanced study of digital systems and computer science. Sets, relations, functions, and homomorphisms. Semigroups and relevance to sequential machines. Groups and relevance to coding. Fields and relevance to linear sequential machines and codes. Prerequisite: Mathematics 113.

3 units, Win (Staff) MWF 9

155. Concrete Mathematics — Finite difference calculus; manipulation of sums and products; properties of binomial coefficients, Stirling numbers, harmonic numbers, Fibonacci numbers; use of generating functions to solve complex recurrence relations; asymptotic expansions; analysis of computing algorithms. An emphasis on obtaining simple closed-form answers to problems when it is possible to do so. Prerequisites: Mathematics 22, 42, or equivalent.

3 units, Aut (Knuth) MWF 3:15

156. Introduction to the Mathematical Theory of Computation—Mathematical logic, including propositional calculus and the first-order predicate calculus. Computability, recursive functions, undecidable problems.

3 units, Aut (Staff) MWF 10

191. Computer Systems Laboratory—(Enroll in Electrical Engineering 288.) Individual and group projects on the design and implementation of computer systems consisting of programs and/or logic circuits. Emphasis is on the design process and design evaluation. Logic subsystem design, interfacing, systems programming, and operating systems. Students are encouraged to suggest and define their own topics. A written report is required. Limited enrollment. Computer facilities including a PDP-11 computer are available. Prerequisite: previous or concurrent registration in one of the following: 140B, 144A,B, 212, 240B, or 246. May be taken for more than one quarter.

3 units, Aut (Bredt) Th 2:45
Win (Bredt) W 10:00
Spr (Cerf) W 10:00
Sum (Staff) W 10:00
192. Programming Service Project—Appropriate academic credit (without financial support) will be given for volunteer computer programming work of public benefit and educational value.

1 to 3 units, any quarter (Staff) by arrangement

193. Digital Logic Laboratory—(Enroll in Electrical Engineering 282.) Experiments in digital logic design using TTL integrated circuits, including SSI gates, and flip-flops, MSI registers and ALU’s, and LSI memories. Choice of projects, including: basic combinational and sequential circuits, various sequential machines, D/A converters and CRT displays, integrators, arithmetic processors, rudimentary stored program processors, game-playing machines. Prerequisites: 112 or 211A. Recommended: 211B.

3 units, Aut (Wakerly) T 9:00 plus 4 hour lab by arrangement
Win, Spr, Sum (Wakerly) T 11:00 plus 4 hour lab by arrangement

199. Independent Work.
Any quarter (Staff) by arrangement

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS

204. Problem Seminar—Solution of various problems, numeric and symbolic, on a computer, using various languages. Emphasis on efficiency of programming, proofs of correctness, and clarity of documentation. Presentation of solutions by students. Limited to degree candidates in Computer Science. Recommended for entering students in the Computer Science Ph.D. program. Enrollment limited to 20.

3 units, Aut (Floyd) TTh 9:30-10:45

206. Computing with Symbolic Expressions—The LISP programming language. Computing wherein the data are symbolic expressions rather than numbers, including algebraic expressions (simplification, differentiation), graphs, compiling. Preparation for work in Artificial Intelligence will be emphasized. Syntax-directed computation. Other list-processing systems. Prerequisite: 105 or 106 or equivalent.

3 units, Aut (Staff) TTh 11:00-12:15
Spr (Green) TTh 11:00-12:15

209. Topics in Computer Science — Given only when a suitable faculty member is available.

By arrangement

211A.B. Switching Theory and Logic Design—(Enroll in Electrical Engineering 381 A,B.) Analysis and synthesis of digital circuits with emphasis on basic design techniques and general concepts. Boolean algebra; simplification of switching functions; sequential circuits; simplification of sequential machines. Characteristics of switching, memory, and input/output devices. Comparison of digital integrated-circuit families. Introduction to large-scale integration. Logic design of a system such as a stored program computer, digital differential analyzer, desk calculator, or radar signal processor. Basic knowledge of Boolean algebra and number systems is assumed.

211A. 3 units, Aut (Peterson) MWF 9 and (McCluskey) MWF 11
Win (Staff) MWF 11
Sum (Staff) MTWTh 11

211B. 3 units, Win (McCluskey) MWF 11 and (Peterson) MWF 1:15
Spr (Staff) MWF 1:15

219. Topics in Digital Systems—Given only when a suitable faculty member is available.

By arrangement

224. Models of Thought Processes—Introductory survey of concepts and problems in artificial intelligence research; heuristic processes in problem solving, and heuristic programming; information processing models as explanations of human cognitive and affective behavior. Prerequisite: 105 or 106, or equivalent. Same as Psychology 224.

2 units, Spr (Green) TTh 1:15-2:30

225. Artificial Intelligence Research — Intermediate-level examination of problems of artificial intelligence research. Generality in problem-solving systems; theorem proving by computer; semantic information processing; problem representation; perceptual and effector processes; scientific reasoning processes. Not recommended for first-year graduate students. Research project involving computer program will be required. Prerequisites: 206 and 224 or equivalents.

3 units, Aut (Feigenbaum) by arrangement

226. The Representation Problem in Artificial Intelligence — Formalisms for repre-
senting what a general intelligent program must know about the world including facts of causality, ability, knowledge. Programs for manipulating these formalisms. Prerequisite: 225.

3 units, Win (McCarthy) TTh 11:00–12:15, alternate years, given 1975–76

227. Robotics—Theory and practice of constructing integrated Artificial Intelligence systems. Emphasis will be placed on perception problems for gathering of visual, tactile, and other information and its use in modeling the environment. Also considered are navigation and manipulation problems, automatic strategy generation, and systems design. Prerequisite: consent of instructor.

3 units, Aut (Binford) TTh 11:00–12:15

229. Topics in Artificial Intelligence—Given only when a suitable faculty member is available.

By arrangement

234. Numerical Methods of Optimization—Introduction to the numerical analysis, data processing, and software problems associated with decision problems, which form a significant proportion of all scientific computation. Unconstrained and constrained minimization, gradient methods with special metrics, pivotal optimization techniques, solving large-scale systems, partitioning methods, combinatorial search procedures, shortest path and other graph algorithms. No prior knowledge of Operations Research is necessary. Prerequisite: 137A or equivalent.

3 units, Aut (Danzig) TTh 9:30–10:45


3 units, Aut (Golub) MWF 1:15

237B, C. Advanced Numerical Analysis—Selected topics are covered in depth from the theory and practice of using automatic digital computers for solving ordinary and partial differential equations, approximating functions, and computing eigenvalues and eigenvectors. Testing and automation of methods on a digital computer. Prerequisite: 237A or consent of instructor.

237B. 3 units, Win (Golub) MWF 1:15

237C. 3 units, Spr (Oliger) by arrangement

239. Topics in Numerical Analysis—Given only when a suitable faculty member is available.

By arrangement


240A. 3 units, Win (Staff) TTh 2:40–3:55

240B. 3 units, Spr (Staff) TTh 2:40–3:55

246. Operating Systems—(Same as Electrical Engineering 386, which is offered spring quarter.) Multi-programming and time-sharing system design. Topics covered include processes and process communication, control of input-output, memory management, scheduling, file systems, protection, resource allocation, design methodologies. Prerequisites: Statistics 116 or equivalent; 140B or systems programming experience.

3 units, Aut (Baskett) TTh 11:00–12:15

247. Computer System Evaluation—(Enroll in Electrical Engineering 388.) Performance criteria in computer systems, queueing theory; queueing models of multiprogramming; analysis of bottlenecks, measurements via hardware and software; simulation; models of program behavior, storage devices, memory hierarchies, and file structures; allocation and scheduling of jobs and computer system resources.

3 units, Spr (Staff) alternate years, given 1975–76

249. Topics in Programming Systems—Given only when a suitable faculty member is available.

By arrangement

254. Graph Theory—The friendship theorem. Menger’s theorem and connectivity. Theorems of König, Hall and Dilworth, Edmonds’ matching algorithm. Tutte’s factor theorem. Hamiltonian cycles. Extremal graph theory: theorems of Turán and Erdös-

3 units, Spr (Chvátal) MWF 2:15

255. Analysis of Algorithms—An advanced course primarily for students who will be doing specialized work in the analysis of algorithms. The intent is to present each of the important paradigms used to analyze algorithms. The course studies combinatorial approaches, generating functions, techniques for exact solution of recurrences, and asymptotic methods in connection with important algorithms for sorting and searching.

3 units, Win (Knuth) MWF 1:15, alternate years, given 1975–76


3 units, Win (Gill) MWF 10

257. Advanced Computability—Mechanical theorem proving. Gödel theorems. Program schemata. Automatic program construction. Continuation of topics listed for 256. Prerequisite: 256 or equivalent.

3 units, Spr (Floyd) alternate years, given 1975–76


3 units, Win (McCarthy) alternate years, given 1976–77

259. Topics in Theory of Computation—Given only when a suitable faculty member is available.

By arrangement


4 units, Aut (Winograd) TTh 10:30–12:00

266. Computational Models for the Semantics of Natural Language—(Same as Linguistics 266.) Conceptual overview of problems of meaning. Formalisms from logic, psychology and linguistics, relevance to computer implementations. Survey and critical discussion of current computer systems for natural language.

4 units, Win (Winograd) TTh 9:30–11:00, plus 1 hour to be arranged

293. Computer Laboratory—A substantial computer program is designed and implemented. A detailed written report is required. Recommended as preparation for dissertation research.

Any quarter (Staff) by arrangement

300. Computer Science Colloquium—Presentations of current research in Computer Science.

1 unit, Aut, Win, Spr (Staff) T 4:15

310. Seminar on Digital Systems—(Enroll in Electrical Engineering 380.) Discussion of current research in the area of digital systems including logic design, switching theory, machine organization, and operating systems.

1 unit, Aut, Win, Spr (McCluskey) W 4:15

311. Advanced Computer Organization—(Same as Electrical Engineering 482.) Machine algorithms for high-speed arithmetic. Analysis of hierarchical memory systems and their management. Data formats, instruction sets, addressing, and control. Comparison of advanced systems including multi-processors, stack-organized computers, and pipeline computers. Prerequisites: 111; 112 or 211B or equivalents.

3 units, Spr (McCluskey) MWF 11

319A. Digital Reliability Seminar—(Enroll in Electrical Engineering 385A.) Student-faculty discussions of research problems in areas of reliability, testing, diagnosis, and redundancy in digital systems. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr, Sum (McCluskey and Wakerly) M 3:15–5:05
319B. Parallel Systems Seminar—(Enroll in Electrical Engineering 385B.) Student-faculty discussions of research problems in areas of hardware and software system design. Design methodologies for operating systems; system reliability including program verification, program testing, error detection, and error recovery; machine-independent system design; languages for systems implementation; models for parallel systems. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr (Bredt) M 4:15 and by arrangement

319C. Computer Systems Analysis Seminar—Student-faculty discussions on measuring, modeling and analyzing the performance of computer systems and computer system components. Prerequisite: consent of the instructor.

1 to 4 units, Aut, Win, Spr (Basket) by arrangement

319D. Communications Network Seminar—(Enroll in Electrical Engineering 385D.) Student-faculty discussions on computer communication networks, including study of packet switching, loop systems, topology and capacity assignment, reliability, and performance measurement. Major focus on inter-process communication methods and operating system design for distributed resource networks.

1 to 4 units, Aut, Win, Spr (Cerf) by arrangement

319E. Micro-programming and Emulation Seminar—(Enroll in Electrical Engineering 385E.) Student-faculty discussion of research problems in micro-programming, micro-program representation, machine representation and the emulation of both conventional and abstract machines. Students will use the Emulation Laboratory facilities and will write interpreters for specific machines.

1 to 4 units, Aut, Win, Spr (Flynn) by arrangement

320. Artificial Intelligence Seminar.

1 to 3 units, Aut (Green) Win, Spr (Staff) by arrangement


1 to 3 units, any quarter (Staff) by arrangement


1 to 3 units, any quarter (Staff) by arrangement


1 to 3 units, any quarter (Staff) by arrangement

365. Seminar in Computational Linguistics. —(Same as Linguistics 365.)

3 units, Spr (Winograd) by arrangement

390. Advanced Reading and Research.

Any quarter (Staff) by arrangement

The following courses offered in other departments may be of special interest to students of computer science:

Analog Computation—See Electrical Engineering 283.


Mathematical Logic—See Philosophy 160A, B, 161, and Mathematics 292A,B, 293A,B.

Mathematical Models in Behavioral Sciences—See Behavioral Sciences courses.

Mathematical Programming — See Operations Research courses.


Recursion Theory—See Mathematics 292A,B.


Theory of Automata—See Electrical Engineering 484.


Theory of Switching and Digital Computer Circuitry—See Electrical Engineering 483, 484.
DRAMA

Emeriti: H. Donald Winbigler, Helene Blattner, Elisabeth Buckingham (Associate Professors); Naomi Wrage (Assistant Professor)

Chairman: Charles R. Lyons

Professors: Wendell Cole, Charles R. Lyons, Drama and Comparative Literature, Eleanor Prosser

Associate Professors: Shirlee Dodge, Douglas A. Russell, Helen W. Schrader

Adjunct Professor: Evelyn Draper

Assistant Professors: William S. Eddelman, John Chicles, John Cochran

Lecturers: Michael Ramsaur, Sheila Weber, Julillen Weiss

PROGRAMS OF STUDY

BACHELOR OF ARTS

The requirements for the degree of Bachelor of Arts with a major in Drama are planned to integrate the critical and historical study of drama with the study and experience of performance. The major provides aesthetic and critical opportunities for students to develop special aptitudes. Students are encouraged to declare their major in their sophomore year.

The minimum program required of all majors:

1. Introduction. Introduction to Contemporary Theater. Drama 1 or Introduction to Theatrican Styles. Drama 2.
3. Literature and Criticism. Three courses to be chosen from the sequence Drama 151-158.
5. Design and Production. Introduction to Design and Production. Drama 30; and one of the following courses: 32, 35, 130A, 131A, 132A.
6. Performance. Each major must complete a minimum of 6 units in laboratory courses in departmental theater productions to be divided between Drama 29 and Drama 39 with a minimum of 4 units acquired in Drama 39.

Two years of a foreign language at college level are strongly recommended.

HONORS PROGRAM IN DRAMA

Students who are planning to take the special Honors Program in Humanities may fulfill the requirements for the major in Drama by satisfactory completion of the following program:

Fundamentals of Acting. Drama 120A, 120B, 120C
Dramatic Literature. Three courses from the sequence Drama 151-158.
Electives in literature, history, design, or acting to total at least eight units at undergraduate level or at graduate level with the consent of instructor.

JOINT PH.D. IN DRAMA AND HUMANITIES

The Department of Drama participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in Drama and Humanities. For a description of that program, see the section “Humanities Special Programs.”

TEACHING CREDENTIALS

The degree of Master of Arts in Teaching of Drama is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and who wish further to strengthen their academic preparation. The program consists of a minimum of 30 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section. Drama 5, Play Production, is specially designed to meet the needs and interests of candidates for the Master of Arts in Teaching of Drama.

Standard Teaching Credential (Secondary)—Students wishing to obtain the Stanford Standard Secondary Credential should consult the Credential Secretary of the School of Education for the general requirements, and the teacher training adviser, Professor Helen Schrader, in the Department of Drama for Departmental requirements.

ADVANCED DEGREES

DOCTOR OF PHILOSOPHY

All graduate study in the Department of Drama leads to the Ph.D. degree. The Ph.D. curriculum is based upon the need for integration between the critical and historical study of dramatic literature and the aesthet-
ics of its performance. Each Ph.D. candidate is expected to function both as an artist and a scholar and perform these activities throughout his or her work in the Department of Drama. Two programs are offered: one with a concentration in criticism and directing; one, in theater history and design.

Applicants for the Ph.D. program should write directly to the Department of Drama for information and applications. In addition to the required statement of purpose, all applicants must submit a statement detailing their practical theater experience and a sample of their written critical work. Applicants for the program in design and theater history must also submit a portfolio. Graduate students in the Department of Drama begin their course of studies in the autumn quarter of each academic year; there are no mid-year admissions. All graduate students must be degree candidates.

University regulations regarding this degree are discussed in the section “Degrees” in this bulletin. The following departmental requirements are in addition to the University’s basic requirements for the doctorate.

Units and course requirements.

1. A minimum of 72 units of graduate courses and seminars in support of the degree in addition to the doctoral dissertation.
2. The course sequence in research and criticism (300A, 300B, 301, and 302).
3. A minimum of four seminars in dramatic literature, theater history, or critical theory. One of the graduate seminars is to be taken outside of the Department of Drama.
4. One or two years (depending upon previous graduate experience) in the 370 series in directing. Students in criticism/directing must complete the second-year workshop in directing (371A, 371B, 371C) and a third-year production project (372). Students in history/design must complete the series of advanced design courses (330A, 330B, 330C) and a third-year design project (331).

Language requirements.

The candidate must demonstrate reading knowledge of two foreign languages in both of which there is a major body of dramatic literature. The language requirement may be fulfilled in any of the following ways:

1. Achievement of a sufficiently high score (70th percentile) on the foreign language examination prepared by the Educational Testing Service. Latin and Greek are not tested by ETS.
2. A reading examination given each quarter by the various language departments, except for Latin and Greek.
3. Passage with a grade of B or higher of a course in literature numbered 100 or higher in a foreign language department at Stanford.

The requirement in one language is to be met by the end of the first year. The requirement in the other language must be met by the end of the third year.

Teaching requirement.

Three and one-half quarters of supervised teaching are a required part of the Ph.D. program. The requirement is normally met by assisting a faculty member for one quarter during the first year, by teaching two courses during the second year, and by teaching one during the third.

Examinations.

1. A preliminary oral examination based on a problem defined by the student, to be taken during autumn quarter of the second year of residence.
2. Four written examinations, each four hours in duration, to be completed by the end of winter quarter of the third year. Examinations will be offered during the second week in May in each of the following periods of dramatic literature:
   - Classical
   - Medieval and Renaissance
   - Neoclassical
   - Romantic and early realistic
   - Modern, 1870–1918
   - Contemporary, 1918 to the present

Students in the criticism/directing program will be required to take the examinations in Classical, Medieval and Renaissance, and Modern drama. The fourth examination will be at the student’s choice. Students in the theater history/design program will be required to take two examinations in theater history and one in design. The fourth examination will be in one of the periods of dramatic literature, the specific period to be defined in consultation with his or her advisor and approved by the departmental Graduate Study Committee. Students are urged to take examinations as early as possible: e.g., one in the first year, two in the
second, and one in the third. At least two examinations must be completed by the end of the second year of residence. Those examinations remaining to be taken in the third year will be scheduled in either autumn or winter quarter, depending on the given student's production commitment.

3. A University oral examination, to be taken during autumn quarter of the fourth year. This examination will cover (1) the field of concentration, as defined by the candidate and his or her advisor, and (2) a dissertation prospectus. Both the field of concentration and a rough draft of the prospectus must be approved by the candidate's advisor and by the departmental Graduate Study Committee by the end of spring quarter of the third year.

Application for candidacy.
By the end of the second year of residence, the following requirements must be completed:

1. The course sequence in research and criticism and two years of advanced directing and/or design.
2. One language.
3. The preliminary oral examination.
4. At least two written examinations.

Based on its evaluation of the student's progress, the Graduate Study Committee will certify the student's qualifications for candidacy. Upon favorable action, the student will file formal application for candidacy, as prescribed by the University, by the end of spring quarter.

Dissertation.
Normally, this program should be completed in four years. The first year should be devoted to full-time graduate study; the second and third years to graduate study and teaching; the fourth year to writing the dissertation. Following formal admission to candidacy, the dissertation must be completed and approved within five years from the quarter in which candidacy is granted. A candidate taking more than five years will be required to re-pass his or her candidacy by re-passing the written examinations on dramatic literature.

FELLOWSHIPS
The Department of Drama awards a number of fellowships to graduate students in the Ph.D. program. Completed application forms for fellowships should be filed before January 15 at the Office of Financial Aids at the same time as completed application forms for admission are filed with the Admissions Office.

SUMMER SESSION
A special brochure is available, with full details of courses given in the summer by the Department of Drama.

INTRODUCTORY COURSES
Courses numbered 1 through 99 are introductory courses open to all students. Although they include basic courses required of the major, they are designed also for the student whose major is undeclared or is not in Drama.

1. Introduction to Drama—Introduction to major dramatic forms, concentrating on selected masterpieces in order to develop theatrical sensibility in reading dramatic texts.
   3 units, Aut (Gelb) MWF 9

2. Introduction to Theatrical Style—A lecture-discussion course introducing the major periods of western culture and demonstrating how the theatrical style of each period grew out of its cultural patterns.
   3 units, Win (Russell) MWF 11

5. Play Production—An introductory course in the art and craft of play production, including script analysis, acting, directing, lighting, scenery, costumes, and management. A group class in which students experience the many aspects of play production.
   5 units, Aut (Ramsaur) MWF 3:15-5:05

20. Introduction to Acting—Introduction to improvisational acting and basic scene study. Sections reserved for Freshmen.
   3 units, Aut, Win, Spr (Staff) TTh 2:15-4:05 and MW 2:15-4:05

29. Theater Performance: Acting—Students who have been cast in departmental productions may receive credit for their participation as actors, the number of units to be determined by the instructor. May be repeated. No more than 10 units, however, may be counted by drama majors toward graduation.
requirements of 180 units. Prerequisite: consent of instructor.

1 to 2 units, any quarter (Staff)

by arrangement

30. Introduction to Design and Production
—A lecture-laboratory course that introduces the undergraduate to the theatrical arts and crafts of stage design, lighting design, costume design, and stage production.

4 units, Aut (Eddelman, Ramsaur, Weiss) MWF 1:15 plus lab.

by arrangement

32. Costume Construction—The basic craft of planning and constructing costumes.

4 units, Aut (Russell) TTh 1:15-3:05

35. Stagecraft—A lecture-laboratory course in basic production practices. The student will be introduced to theory and use of standard tools and materials for stage scenery construction. It is recommended that Drama 35 be taken concurrently with Drama 39.

4 units, Spr (Ramsaur) TTh 1:15-3:05

39. Theater Performance: Crew—Students may receive credit for their participation in the technical areas of departmental productions. The number of units received is determined by the instructor. Prerequisite: consent of instructor.

1 to 4 units, any quarter (Staff)

by arrangement

INTERMEDIATE COURSES

Courses numbered 100–199 are intermediate courses designed primarily for the major but open to all undergraduates who have the necessary prerequisites.

120A,B,C. Fundamentals of Acting I — An introduction to the elements of self-awareness, characterization, and theatrical expression for the beginning actor. Prerequisite: sophomore standing or consent of instructor. 120A,B,C must be taken in sequence.

120A. 3 units, Aut (Weber) TTh 10-12 and 1:15-3:05

120B. 3 units, Win (Weber) TTh 10-12 and 1:15-3:05

120C. 3 units, Spr (Weber) TTh 10-12 and 1:15-3:05

121A,B,C. Fundamentals of Acting II—The study of characterization in workshop productions of complete plays. A company class. By audition. Prerequisites: 120A,B,C and 123.

121A. 3 units, Aut (Freidlander)

MWF 2:15-4:05

121B. 3 units, Win (Gelb)

MWF 2:15-4:05

121C. 3 units, Spr (Weber)

MWF 2:15-4:05

123. Movement and Imagination — It is recommended that 123 be taken concurrently with 120A,B,C. May be repeated for credit.

1 unit, any quarter (Dodge) T 2:00-3:30

124A,B,C. Stage Movement — It is recommended that 124A,B,C be taken concurrently with 120A,B,C and 121A,B,C. May be repeated for credit.

124A. Relaxation and Tap Rhythms

2 units, Aut (Dodge) MW 12:30-2:00

124B. Relaxation and Tap Rhythms

2 units, Win (Dodge) MW 12:30-2:00

124C. Relaxation and Tap Rhythms

2 units, Spr (Dodge) MW 12:30-2:00

125. Voice for the Theater—May be repeated for credit. It is recommended that 125 be taken concurrently with 121A,B,C. Prerequisite: consent of instructor.

3 units, any quarter (Draper) by arrangement

126A,B,C. Black Performing Arts—Prerequisite: sophomore standing and consent of instructor.

126A. 3 units, Aut (Cochran) MW 10-12

126B. 3 units, Win (Cochran) MW 10-12

126C. 3 units, Spr (Cochran) MW 10-12

130A. Theatrical Design I—Visual analysis of historical styles as interpreted for the modern theater and developed throughout various presentational media. Specific problems in spatial perceptions and compositions and the relationship between costuming and scenic design.

4 units, Win (Eddelman and Weiss)

MW 10-12 plus lab. by arrangement

130B. Theatrical Design II — Advanced work in theatrical design with an emphasis on complex theatrical presentations involving new materials and visual aesthetics. Prerequisite: Drama 130A.

4 units, Spr (Eddelman and Weiss) MW 10-12 plus lab. by arrangement
131A,B,C. Lighting Design

131A. Stage Lighting: Mechanics—A lecture-lab course dealing with all of the practical aspects of lighting: electricity, light sources, instrumentation, control, color, and design process.

4 units, Aut (Ramsaur) MWF 1:15 and lab. F 2:15

131B. Lighting Design: Aesthetics — A lecture-discussion course concentrating on the aesthetic principles of lighting design; interpretation, concept, process, and practice. Prerequisite: Drama 31.

4 units, Win (Ramsaur) TTh 10-12

131C. Advanced Stage Lighting Design — Projects in lighting and lighting design will be presented and resolved through experimentation, class discussion, and written reports. Areas of concentration will include color, special effects and projections. Prerequisite: Drama 131A.

1 to 3 units, Spr (Ramsaur) W 2:15-4:05

132A,B,C. Costume Design

132A. Costume Design—A discussion-laboratory course in basic techniques, materials, and methods of constructing historical stage costumes.

3 units, Aut (Russell) T 9-11 and Th 9

132B. Costume Design — A lecture discussion course in the technique and aesthetics of costume design with weekly design assignments.

3 units, Win (Russell) T 9-11 and Th 9

132C. Advanced Costume Design — Advanced design projects with an emphasis on more complex costume design problems presented weekly for analysis and discussion.

3 units, Spr (Russell) T 9-11 and Th 9

135. Project in Design and Technical Theater—Project in stage design, costume design, lighting design, or stage managing. Prerequisite: consent of instructor.

1 to 3 units, any quarter (Staff) by arrangement

151. Greek and Roman Drama.

4 units (Chioles) given alternate years

152. Medieval and Renaissance Drama.

4 units, Win (Prosser) MWF 9

153. Neoclassic Drama.

4 units, given alternate years

154. Romantic and Early Realistic Drama.

4 units, Spr (Cole) MWF 9

155. Modern Drama (1880–1918).

4 units, Win (Gelb) MWF 11

156. Modern Drama from 1918.

4 units, given alternate years


4 units, Aut (Cole) MWF 9

160. Theaters and Staging—Survey of theaters, staging methods, styles of theatrical production from the Greeks to the Modern period.

4 units, Win (Cole) MTWTh 9

162. History of Costume and Period Style—A lecture-survey course in the history of dress and period style in the Western world from ancient times to the present.

4 units, Aut (Russell) MTWTh 1:15

170. Introduction to Directing — Prerequisites: 120A,B,C and 30, 31, 32.

3 units, Spr (Hampton) TTh 4:15-6:05

190. Special Research—Individual project in the work of a playwright, period, or genre. Prerequisite: consent of instructor.

1 to 4 units, any quarter (Staff) by arrangement

**ADVANCED COURSES**

Courses numbered 200–299 are designed for advanced undergraduates and graduates.

235. Projects in Design and Technical Production.

1 to 3 units, any quarter (Staff)

251. Greek and Roman Drama.

4 units (Chioles) given alternate years

252. Medieval and Renaissance Drama.

4 units, Win (Prosser) MWF 9

253. Neoclassic Drama.

4 units, given alternate years

254. Romantic and Early Realistic Drama.

4 units, Spr (Cole) MWF 9

255. Modern Drama (1880–1918).

4 units, Win (Gelb) MWF 11

256. Modern Drama from 1918.

4 units, given alternate years

257. American Drama from 1920.

4 units, Aut (Cole) MWF 9
260. Theaters and Staging—Survey of theaters, staging methods, styles of theatrical production from the Greeks to the Modern period.
4 units, Win (Cole) MTWTh 9
262. History of Costume and Period Style.
4 units, Aut (Russell) MTWF 1:15
270. Independent Project in Directing—Prerequisite: consent of instructor.
2 to 4 units, any quarter (Staff) by arrangement
290. Special Research — Individual project in the work of a playwright, period, or genre. Requirement for department honors.
1 to 4 units, any quarter (Staff) by arrangement

GRADUATE COURSES

Courses numbered 300 and above are primarily for graduates but are open to advanced undergraduates with permission.

PH.D. COURSES

300A. Research Methods.
300A. 2 units, Aut (Prosser) T 10–12
300B. 2 units, Win (Prosser) T 10–12
301. History of Dramatic Criticism.
4 units, Spr (Chioles) MW 2:15–4:05
302. Major Modern Critics.
5 units, Aut (Lyons) MW 2:15–4:05
330A, B, C. Design Workshop — Advanced course in design for the theatre.
330A. 4 units, Aut (Staff) by arrangement
330B. 4 units, Win (Staff) by arrangement
330C. 4 units, Spr (Staff) by arrangement
331. Design Project—Design of a full-length production in conjunction with directing project (Drama 372).
4 units, any quarter (Staff) by arrangement
350. Seminar in Dramatic Genre.
4 units, given alternate years
351. Seminar in the Work of a Playwright.
4 units, given alternate years
352. Seminar in Comparative Drama.
4 units, given alternate years
353. Seminar in Dramatic Period: Medieval Drama.
4 units, Aut (Prosser) MW 10–12

Seminar in Dramatic Period: Classical Drama.
4 units, Spr (Chioles) MW 10–12
354. Seminar in a Special Critical, Aesthetic, or Historical Problem: Visual Aesthetics in 20th Century Theater.
4 units, Win (Eddelman) MW 2:15–4:05
370A, B, C. Directing Workshop I—Investigation of basic directorial problems in scenes, using a multi-form theatre space, designing actor/audience relationships and composing modular scenic units. Performances limited to class.
370A. 4 units, Aut (Lyons, Eddelman) MW 4:15–6:05
370B. 4 units, Win (Chioles, Eddelman) MW 4:15–6:05
370C. 4 units, Spr (Lyons, Eddelman) MW 4:15–6:05
371A, B, C. Directing Workshop II—Investigation of basic directorial problems in shorter plays or act units, working in a variety of styles, using a multiform theater space. Public performances.
371A. 4 units, Aut (Staff) by arrangement
371B. 4 units, Win (Staff) by arrangement
371C. 4 units, Spr (Staff) by arrangement
4 units, any quarter (Staff) by arrangement
390. Tutorial.
Any quarter (Staff) by arrangement
399. Dissertation Research.
Any quarter (Staff) by arrangement

INTER-PERSONAL AND SMALL GROUP COMMUNICATION

The following courses provide experience-based learning in inter-personal communication in small interacting groups. The members of the group learn a method of continually expanding competence in observing and assessing their own communication with others and of discovering their feelings, reactions, and perceptions about the processes of interaction.
110. Independent Study.
1 to 3 units, any quarter (Schrader) by arrangement

111. Exposition—Focuses on inter-personal communication in the small group.
3 units, Aut, Win (Schrader) MWF 11 and 1:15
Spr (Schrader) MWF 11

112. Discussion—Focuses on inter-personal communication and group processes.
3 units, Win (Schrader) TTh 2:15-4:05

113. Group Communication — Focuses on inter-personal processes of communication as they relate to inter-group experience. Prerequisite: 111 or 112 or consent of instructor.
4 units, Spr (Schrader) TTh 2:15-4:05

**CENTER FOR EAST ASIAN STUDIES**

Director: Victor H. Li
Faculty:
 Art: John LaPlante, Michael Sullivan
 Business: Richard T. Johnson
 Economics: John G. Gurley, Lawrence Lau
 Education: Douglas P. Murray
 Food Research Institute: Dennis Chinn
 History: Peter Duus, John K. Emmerson (Hoover Institution), Harold L. Kahn, Mark I. Mancall, Jeffrey Mass, Lyman P. Van Slyke, Stephen G. Vlastos
 Law: Victor H. Li
 Philosophy: David S. Nivison
 Political Science: Harry Harding Jr., Nobutaka Ike, John W. Lewis, Robert C. North, Kurt Steiner, Robert E. Ward, Franklin B. Weinstein
 Religious Studies: Winston B. Davis, Diana M. Paul, Lee H. Yearley
 Sociology: Stephen M. Olsen

In addition, a number of other Stanford faculty have some teaching or research interests related to East Asia: Takeshi Ame-miya (Economics), John C. Bock (Education), Arthur Coladarci (Education), Walter P. Falcon (Food Research), Robert D. Hess (Education), Bruce F. Johnston (Food Research), Dudley Kirk (Food Research), William G. Ouchi (Business), Robert B. Textor (Education), Pan A. Yotopoulos (Food Research)

The Center for East Asian Studies is the principal administrative mechanism for coordinating all University instructional, research, and special activities related to China and Japan. It serves to bring together faculty and students who share a common interest in the study of East Asia from a broad range of academic concerns covering nearly every discipline and historical period. In addition to supporting a wide variety of academic and extracurricular activities on the Stanford campus, the Center is also involved in a number of programs which link the University’s resources on China and Japan with civic groups, secondary schools, and local colleges in the San Francisco Bay Area. The Stanford–University of California (Berkeley) Joint NDEA East Asian Language and Area Center sponsors programs which provide opportunities for East Asian Studies faculty and students on the two campuses to meet and work with one another.

For further information concerning East Asian Studies at Stanford, please contact the Center for East Asian Studies, Building 600T, Stanford University, Stanford, California 94305, (415) 497-3362.

**DEGREE PROGRAMS**

**UNDERGRADUATE MAJOR IN EAST ASIAN STUDIES**

In past years, undergraduates seeking to major in Chinese or Japanese Studies have arranged their own independent interdepartmental programs according to the criteria established by the Dean’s Advisory Committee on Individually Designed Majors. A proposal to establish a formal East Asian Studies undergraduate (A.B.) major is being considered with the expectation that it will be in full implementation sometime in the academic year 1975–76.
MASTER OF ARTS IN EAST ASIAN STUDIES

The A.M. program in East Asian Studies is designed primarily for students who plan to complete a Ph.D., but who have not yet decided on the particular discipline in which they prefer to work, or students who have chosen such a discipline, but wish to obtain intensive language and area studies before beginning a doctoral program. Applications will also be considered from persons seeking to gain a strong background in East Asian Studies in connection with a career in non-academic fields such as business, law, education, journalism, or government service. However, it should be stressed that a Master's degree in East Asian Studies alone is often insufficient preparation for work in many professions, and students who are considering such careers are strongly advised to plan for professional training in addition to or in place of the A.M. degree in East Asian Studies.

The Master's degree program is intended to allow students a great deal of flexibility in combining language training, interdisciplinary area studies, and some disciplinary concentration. Each student has a faculty advisor in his or her field of special interest who is available to help with academic and career planning. The A.M. program is normally completed in two academic years, but students may shorten this time by receiving credit for prior language work or by attending summer sessions. Because of the limited availability of financial resources, students admitted to this program with aid are urged to complete the degree requirements in less than two years if their background makes that possible.

Applicants for this program must take the Aptitude Test of the Graduate Record Examination and have the results sent to the Office of Graduate Admissions. Applications for admission and financial aid may be obtained by writing to the Office of Graduate Admission, Old Union, Stanford University, Stanford, California 94305. The deadline for applications for admission and financial aid for 1976-77 is January 15, 1976.

The basic requirements for the A.M. degree in East Asian Studies are as follows:

Language Requirement: The student must complete the equivalent of the first three years of language training in either Chinese or Japanese. Students entering the program without any language preparation should complete 30 units of Chinese or Japanese (first- and second-year) within the first year of residence at Stanford. This may necessitate completion of a summer language program or enrollment in an intensive academic year course.

The language requirement may be satisfied in part or in full by receiving credit for courses taken at other institutions. Students who fulfill the minimum three-year language requirement before completing other requirements are encouraged to continue language study or take courses in which Chinese or Japanese are used as long as they are in the program. Language courses completed in addition to the third-year level may be applied to the Area Studies Courses requirement discussed below.

Students in the A.M. program are eligible to apply for the Inter-University Language Programs in Taipei and Tokyo and can receive credit toward the degree for work completed overseas at one of these programs. For further information see the sections on the Inter-University Programs elsewhere in this Bulletin.

Area Course Requirement: Students must complete a minimum of nine courses (numbered 100 or above) related to East Asia beyond the courses used to fulfill the third-year level language requirement. Three core courses must be within a single department; of these, one must be a seminar in which a research paper on China or Japan is written. The six additional area courses may be taken in departments of the students' choosing. Some theory-oriented or methodological courses may be used to meet part of these requirements provided they are demonstrably useful for understanding East Asian problems. Except in unusual circumstances, credit toward the area course requirement will not be given for courses taken prior to entering the A.M. program. Students in this program may, however, take courses for exchange credit at the University of California, Berkeley, with the approval of their advisor and the Dean of Graduate Studies.

JOINT DEGREE PROGRAMS

East Asian Studies and Law: This joint program grants an A.M. degree in East Asian Studies and a Doctor of Jurisprudence (J.D.) degree. It is designed to train students interested in a career in teaching, research, or the practice of law related to East Asian legal affairs. Interested students must apply
separately to the East Asian Studies A.M. Program and to the Stanford School of Law and be accepted by both. Completion of this combined course of study requires approximately four academic years depending upon the student's background and level of training in Chinese or Japanese.

East Asian Studies and Education: This joint program grants an A.M. degree in East Asian Studies and a secondary school teaching credential in social studies. To be eligible for this program, students should apply first to the A.M. program in East Asian Studies and then apply to the Stanford Teacher Education Program during their first year at Stanford. Completion of this program requires two years including at least one summer of study when beginning the education component of the program.

Doctoral Programs

Stanford does not offer a Ph.D. in East Asian Studies. However, there are more than a hundred doctoral students in various departments and schools of the University with a specialization on China or Japan. The departments which offer an East Asia concentration are: Anthropology, Art, Asian Languages, Comparative Literature, Economics, History, Linguistics, Philosophy, Political Science, Religious Studies, and Sociology. It is also possible to specialize in East Asia within some of the doctoral programs of the professional schools of Business, Education, and Law, and the Food Research Institute. Inquiries about these doctoral programs should be directed to the individual department or school concerned.

Financial Aid

Graduate students specializing in East Asia may apply for University Fellowships at the time of their initial applications for admission. Students in A.M. or Ph.D. programs who plan to do work in Chinese or Japanese language or language-related area courses may be eligible for National Defense Foreign Language (NDFL) Fellowships and are encouraged to apply for these fellowships at the time of their application to Stanford. For further information about NDFL Fellowships, contact Graduate Overseas and Special Programs Office, Room 465, Building 460, Stanford University, Stanford, California 94305.

Courses

Courses listed below all have a substantive East Asian component although some are primarily theoretical or methodological courses. For fuller descriptions of these courses, see individual departmental listings.

Anthropology

1A. Introduction to Cultural Anthropology. 5 units (Wolf) MTWThF 1:15
7. Marriage and the Family. 5 units, Spr (Wolf) MWF 11
117. Traditional Chinese Society. 5 units (Skinner) given 1976–77
118. Communist Chinese Society. 5 units (Skinner) given 1976–77
120. Religion and the Family in China. 5 units, Win (Wolf) MWF 10
121. Japanese Society and Culture. 5 units, Aut (Befu) MWF 11
123. Seminar on Japan. 5 units (Befu) given 1976–77
162. Seminar on Anthropology and Demography. 5 units (Wolf) given 1976–77
217. Social Change in Chinese Society. 5 units (Skinner) given 1976–77
220. Religion and the Family in China. 5 units (Wolf) given 1976–77
223. Education in Japan. 5 units, Win (Befu) M 2:15–5:05
238. Education and Sociocultural Change. 5 units, Spr (Textor) TTh 2:15–4:05
241. Comparative Peasant Societies. 5 units, Aut (Skinner) Th 2:15–5:05
243. Social Organization. 5 units, Spr (Befu) TTh 10:30–11:45
255. Political Anthropology. 5 units, Aut (Skinner) TTh 10:30–11:45

Art

125A. Oriental Art I. 4 units, Aut (LaPlante).
125B. Oriental Art II. 4 units, Win (LaPlante)
125C. Oriental Art III. 4 units, Spr (LaPlante)
126A. Introduction to Chinese Art. 4 units, Win (Sullivan)
126B. Introduction to Chinese Painting.  
4 units, Spr (Sullivan)  
126C. The Art of Japan.  
4 units, Spr (Sullivan) given 1976–77  
126E. The Meeting of Eastern and Western Art.  
4 units, Aut (Sullivan)  
4 units, Aut, Win, Spr (LaPlante)  
226A. Studies in Chinese Art.  
4 units, Win (Sullivan)  
226B. Studies in Chinese Painting.  
4 units, Spr (Sullivan)  
226C. Studies in the Art of Japan.  
4 units, Spr (Sullivan) given 1976–77  
226E. Studies of Meeting of Eastern and Western Art.  
4 units, Aut (Sullivan)  
227A,B. Seminar in Chinese Art and Culture Between 200 and 600 A.D.  
4 units, Aut, Win (Sullivan)  
227C. Seminar in Far Eastern Art.  
4 units, Spr (Sullivan)  
228A. Seminar in Japanese Ceramics.  
4 units, Aut (LaPlante)  
228B. Seminar in Architecture of India and Farther India.  
4 units, Win (LaPlante)  
228C. Seminar in Indian Painting.  
4 units, Spr (LaPlante)  

ASIAN LANGUAGES  
COURSES NOT REQUIRING KNOWLEDGE OF AN ASIAN LANGUAGE  

8. Languages of East Asia.  
3 units, Aut (Staff) given 1976–77  
46. Philosophical Chinese.  
3 units, Win (Nivison) MWF 10  
47. Philosophical Chinese.  
3 units, Spr (Nivison) MWF 10  
91. Traditional East Asian Civilization—(Same as History 91 and Humanities 91.)  
5 units, Win (Duus, Lyell, Matisoff) MTWTh 10  
92. Traditional East Asian Civilization—(Same as History 92 and Humanities 92.)  
5 units, Spr (Duus, Lyell, Matisoff) MTWTh 10  
110(257). Japanese-Western Literary and Cultural Interactions—(Same as Comparative Literature 110 and International Relations 110.)  
4 units, Win (Ueda) M 2:15–4:05  
131. Chinese Poetry and Drama in Translation.  
4 units, Aut (Liu) MWF 11  
4 units, Win (Staff) MWF 11  
133. Modern Chinese Literature in Translation.  
4 units, Spr (Lyell) MWF 1:15  
4 units, Aut (Harries) MWF 1:15  
4 units, Win (Matisoff) MWF 1:15  
4 units, Spr (Ueda) MWF 1:15  
143. The Philosophy of Wang Yang-ming (1472–1529)  
4 units, Win (Nivison) given 1976–77  
151. Chinese Historical Literature in Translation (Same as History 196.)  
4 units, Aut (Dien) MWF 1:15  
152. Cultural History of Central Asia (Same as History 195.)  
4 units, Win (Dien) MWF 1:15  
4 units, Spr (Wang) given 1976–77  
4 units, Spr (Matisoff) M 2:15–4:05  
4 units, Spr (Harries) W 2:15–4:05  
4 units (Ueda) given 1976–77
210. Japanese Cinema—(Same as Communication 210B.)
   4 units, Win (Kovács)

255A. The Nature of Literature: Japanese and Western Views (Same as Comparative Literature 255A.)
   5 units, Aut (Ueda) given 1976–77

255B. Chinese and Western Theories of Literature (Same as Comparative Literature 255B.)
   5 units, Spr (Liu) given 1976–77

I. COURSES IN CHINESE

1, 2, 3. First-Year Modern Chinese.
   1. 5 units, Aut (Kao, Shou, Staff)
      Section 1 MTWThF 9
      Section 2 MTWThF 10
      Section 3 MTWThF 1:15
   2. 5 units, Win (Kao, Shou, Staff)
      Section 1 MTWThF 9
      Section 2 MTWThF 10
      Section 3 MTWThF 1:15
   3. 5 units, Spr (Kao, Shou, Staff)
      Section 1 MTWThF 9
      Section 2 MTWThF 10
      Section 3 MTWThF 1:15

5. Intensive First-Year Modern Chinese.
   15 units, Sum (Staff) MTWThF 8–12

21, 22, 23. Second-Year Modern Chinese.
   21. 5 units, Aut (Chuang) MTWThF 9
   22. 5 units, Win (Chuang) MTWThF 9
   23. 5 units, Spr (Chuang) MTWThF 9

   15 units, Sum (Staff) MTWThF 8–12

51. Chinese Calligraphy.
   1 to 2 units, Spr (Chuang) by arrangement

81, 82, 83. First-Year Cantonese.
   81. 5 units, Aut (Wu) by arrangement
   82. 5 units, Win (Wu) by arrangement
   83. 5 units, Spr (Wu) by arrangement

ADVANCED

101, 102, 103. Third-Year Chinese.
   101. 5 units, Aut (Lyell) MTWThF 9
   102. 5 units, Win (Lyell) MTWThF 9
   103. 5 units, Spr (Lyell) MTWThF 9

   101A. 2 units, Aut (Lyell) TTh 9
   102A. 2 units, Win (Lyell) TTh 9
   103A. 2 units, Spr (Lyell) TTh 9

   15 units, Sum (Staff) MTWThF 9–12

   111. 5 units, Aut (Kao) MWF 11
   112. 5 units, Win (Kao) MWF 11
   113. 5 units, Spr (Kao) MWF 11

121, 122, 123. Advanced Conversation.
   121. 2 units, Aut (Chuang) by arrangement
   122. 2 units, Win (Chuang) by arrangement
   123. 2 units, Spr (Chuang) by arrangement

199. Individual Reading in Chinese.
   4 units, Aut, Win, Spr (Staff) by arrangement

GRADUATE

200. Directed Reading in Chinese.
   Number of units to be arranged, Aut, Win, Spr (Staff) by arrangement

201, 202. Proseminar.
   201. 5 units, Aut (Dien) T 2:15–4:05
   202. 5 units, Win (Dien) T 2:15–4:05

211, 212, 213. Modern Expository Chinese.
   211. 5 units, Aut (Chuang) MTWThF 10
   212. 5 units, Win (Chuang) MTWThF 10
   213. 5 units, Spr (Chuang) MTWThF 10

221, 222, 223. Advanced Classical Chinese.
   221. Historical Narration.
      4 units, Aut (Dien) MWF 9
   222. Philosophical Texts.
      4 units, Win (Nivison) MWF 9
   223. Literary Essays.
      4 units, Spr (Staff) MWF 9

   4 units, Win (Nivison) given 1976–77

253. Local Histories.
   4 units, Spr (Nivison) given 1976–77

   4 units, Aut (Liu) given 1976–77

262. Chinese Poetry.
   4 units, Win (Liu) given 1976–77

263. T'ang and Sung Lyrics.
   4 units, Aut (Liu) MWF 10

264. Yuan and Ming Songs.
   4 units, Win (Liu) MWF 11

   4 units, Win (Liu) MWF 10

   271. 4 units, Win (Staff) by arrangement
   272. 4 units, Spr (Staff) by arrangement

273. Chinese Drama.
   4 units, Win (Wang) given 1976–77
274. Early Chinese Prose Literature. 
4 units, Spr (Wang) given 1976-77

281. Modern Chinese Literature. 
4 units, Aut (Lyell) TTh 1:15

291. The Structure of Modern Chinese. 
4 units, Spr (Kao) by arrangement

4 units, Spr (Kao) given 1976-77

299. Translation. 
5 units (Staff) by arrangement

321. Seminar on Mencius. 
5 units, Aut (Nivison) given 1976-77

5 units, Aut (Nivison) M 2:15-4:05

351. Seminar in Chinese Traditional Historiography. 
5 units, Spr (Dien) given 1976-77

361. Seminar in Chinese Literary Criticism. 
5 units, Spr (Liu) W 2:15-4:05

5 units, Aut (Wang) given 1976-77

399. Dissertation. 
(Staff) by arrangement

II. COURSES IN JAPANESE

1, 2, 3. First-Year Modern Japanese. 
1. 5 units, Aut (Sakamoto, Nebrig) 
   Section 1 MTWThF 9 
   Section 2 MTWThF 11 
   Section 3 MTWThF 2:15
2. 5 units, Win (Sakamoto, Nebrig) 
   Section 1 MTWThF 9 
   Section 2 MTWThF 11 
   Section 3 MTWThF 2:15
3. 5 units, Spr (Sakamoto, Nebrig) 
   Section 1 MTWThF 9 
   Section 2 MTWThF 11 
   Section 3 MTWThF 2:15

15 units, Sum (Staff) MTWThF 8-12

21. 5 units, Aut (Kubota) MTWThF 9 
22. 5 units, Win (Kubota) MTWThF 9 
23. 5 units, Spr (Kubota) MTWThF 9

15 units, Sum (Staff) MTWThF 8-12

27, 28, 29. Intermediate Conversation. 
27. 2 units, Aut (Sakamoto) TTh 1:15
28. 2 units, Win (Sakamoto) TTh 1:15
29. 2 units, Spr (Sakamoto) TTh 1:15

ADVANCED

101, 102, 103. Modern Written Japanese. 
101. 5 units, Aut (Kubota) MTWThF 11 
102. 5 units, Win (Kubota) MTWThF 11 
103. 5 units, Spr (Kubota) MTWThF 11

15 units, Sum (Staff) MTWThF 8-12

121, 122, 123. Advanced Conversation. 
121. 2 units, Aut (Kubota) TTh 1:15 
122. 2 units, Win (Kubota) TTh 1:15 
123. 2 units, Spr (Kubota) TTh 1:15

199. Individual Reading in Japanese. 
4 units, Aut, Win, Spr (Staff) by arrangement

GRADUATE

Number of units to be arranged, Aut, Win, Spr (Staff) by arrangement

201, 202. Proseminar. 
201. 5 units, Aut (Matisoff) W 2:15-4:05 
202. 5 units, Win (Harries) W 2:15-4:05

211, 212, 213. Advanced Modern Japanese. 
211. 5 units, Aut (Matisoff) MW 11-12:15 
212. 5 units, Win (Matisoff) MW 11-12:15 
213. 5 units, Spr (Matisoff) MW 11-12:15

246. 4 units, Aut (Harries) TTh 2:15-4:05 
247. 4 units, Win (Harries) TTh 2:15-4:05 
248. 4 units, Spr (Harries) TTh 2:15-4:05

249. Japanese Historical Texts: An Introduction to Komonjo (Same as History 494). 
5 units, Spr (Mass) given 1976-77

250. Introduction to Kambun. 
4 units, Aut (Matisoff) given 1976-77

257. Japanese-Western Literary and Cultural Interactions. 
4 units, Win (Ueda) M 2:15-4:05

258. Major Haiku Poets. 
4 units, Aut (Ueda) TTh 10-11:30

4 units, Win (Harries) given 1976-77

276. Readings in Medieval Prose. 
4 units, Spr (Matisoff) given 1976-77

4 units, Spr (Harries) given 1976-77

279. Classical Japanese Drama. 
4 units, Spr (Matisoff) M 2:15-4:05

284. Murasaki Shikibu. 
4 units, Spr (Harries) W 2:15-4:05
4 units, Win (Ueda) given 1976-77

299. Translation.
5 units, (Staff) by arrangement

5 units, Spr (Ueda) W 2:15-4:05

396. Seminar in Modern Japanese Literature.
5 units, Spr (Ueda) given 1976-77

399. Dissertation.
(Staff) by arrangement

ECONOMICS

120. Marxian and Radical Tradition.
5 units, Aut, Spr (Gurley)

121/221. Economic Development in East Asia.
5 units, Aut (Lau)

220. Marxist Economics.
5 units, Win (Gurley)

EDUCATION

5 units, Aut (Textor) TWTh 2:15-4:05

306B. Education and Political Development—(Same as Political Science 116.)
4-7 units, Win (Bock) TTh 1:15-3:05

306C. Education and Sociocultural Change
(Same as Anthropology 238.)
5 units, Spr (Textor) TTh 2:15-4:05

307. Non-Formal Education: An Examination of Alternatives to Schooling in Western and Non-Western Societies.
3-5 units, Win (Bock) W 9-11

311A,B. Socialization of the Young in Contemporary Society.
3 units, Win, Spr (Hess) TTh 9

FOOD RESEARCH

103. The World Food Economy.
3 units, Spr (Johnston) MWF 10-11

3 units, Aut (Chinn) MWF 11

5 units, Win (Kirk, Edmonston) MTWTh 9

224. Problems of Poverty, Income Distribution and Unemployment in LDC's.
5 units, Spr (Chinn) MW 2:15-4:05

5 units, Win (Johnston) MW 10-12

5 units, Aut (Kirk) MW 1:15-3:05

HISTORY

91. Traditional East Asian Civilization.
4-5 units, Win (Duus, Lyell, Matisof) MTWTh 10

92. Traditional East Asian Civilization.
4-5 units, Spr (Duus, Lyell, Matisof) MTWTh 10

190. Imperialism and the International Order in Modern East Asia.
4-5 units (Duus, Van Slyke) given 1976-77

192A. China from Earliest Times to the 9th Century.
4-5 units, Aut (Kahn) MTWThF 11

192B. China from the 9th to the 19th Centuries.
5 units, Win (Van Slyke) MTWThF 11

192C. Modern China: 19th and 20th Centuries.
4-5 units, Spr (Van Slyke) MTWThF 11

194A. Japan to 1800.
5 units, Aut (Vlastos) MTWThF 11

4-5 units, Win (Duus) MTWTh 1:15

195. Cultural History of Central Asia (Same as Asian Languages 152.)
4 units, Win (Dien) MWF 1:15

196. Chinese Historical Literature in Translation (Same as Asian Languages 151.)
4 units, Win (Dien) MWF 1:15

5 units, Spr (Mancall) M 2:15-4:05

5 units, Aut (Van Slyke) T 2:15-4:05

297. Undergraduate Colloquium: Comparative Feudalism: Japan and Europe.
5 units (Mass) given 1976-77

299H. Senior Honors: Research in East Asian History.
1-5 units (Duus, Mancall, Van Slyke) by arrangement

390A. Graduate Colloquium: Topics in Modern Chinese History.
5 units, Aut (Kahn) by arrangement
390B. Graduate Colloquium: Topics in Modern Chinese History.
5 units, Win (Van Slyke) by arrangement

395B. Graduate Colloquium: Early Modern Japan.
5 units, Aut (Vlastos) Th 2:15-4:05

395C. Graduate Colloquium: Modern Japan from the Early 19th Century to the 1930’s.
5 units, Spr (Duus) Th 2:15-4:05

398D. Directed Reading in East Asian History.
(Staff) by arrangement

399H. Graduate Research in East Asian History.
(Staff) by arrangement

490. Graduate Seminar: Modern China: The Republican Period.
5 units, Spr (Van Slyke) T 2:15-4:05

494. Graduate Seminar: Japanese Historical Texts; An Introduction to Komonjo.
5 units (Mass) given 1976-77

495. Graduate Seminar: Research in Modern Japanese History.
5 units, Aut (Duus) by arrangement

LAW

3 semester units, Spr (Li)

244. Seminar in Chinese Law.
2 semester units, Aut (Li)

291. International Law.
3 semester units, Spr (Li)

PHILOSOPHY

122. Chinese Philosophy from Han through Sung.
Units to be arranged, Spr (Nivison)
MWF 1:15

3 units, Win (Nivison) given 1976-77

3 units, Aut (Nivison) MWF 1:15

POLITICAL SCIENCE

112. Contemporary Asian Politics.
4 to 5 units, Aut (Ike) MTWTh 10

4 to 5 units, Win (Ike) MTWTh 10

5 units, Spr (Harding) MTWTh 11

115L. Law and Society in the People’s Republic of China—(Same as Law 243.)
4-5 semester units, Spr (Li)

118LM. Political Leadership.
5 units, Win, Spr (Lewis)

122. Seminar: Modernization and Democracy in Asia.
5 units, Spr (Ike) Th 2:15-4:05

5 units, Aut (Lewis, Li) M 2:15-4:05

137. Seminar: World of the Superpowers.
5 units, Spr (North, Ike, Triska) Spr MTWThF 1:15

137W. Underdevelopment and Foreign Policy.
5 units, Aut (Weinstein) MTWF 1:15

138W. Strategic Doctrines and Security in East Asia.
5 units, Spr (Weinstein) MTWF 11

139. Chinese Foreign Policy.
5 units, Win (Harding) given 1976-77

141L. Seminar-Workshop: United States-China Relations.
5 units, Spr (Lewis, Li) Th 2:15-4:05

147. Seminar: China in the International System.
5 units, Aut (North) Th 4:15-6:05

220A. Colloquium in Comparative Politics: Japan.
5 units, Spr (Ward) W 2:15-4:05

5 units, Spr (Harding) T 4:15-6:05

5 units, Win (Ward) T 2:15-4:05

5 units, Aut (Ike) W 2:15-4:05

RELIGIOUS STUDIES

34. The Role of Women in Buddhism.
3-5 units, Aut (Paul) MWF 1:15

74. Patterns of Secularization.
3 units, Win (Davis) MWF 1:15

113. Hinduism.
3-5 units, Aut (Paul) MWF 10

114. Buddhism.
3-5 units, Spr (Paul) MW 2:15-4:05

115. Confucianism and Taoism.
3 units, Win (Yearley) MWF 11

117. Shinto.
3-5 units (Davis) given 1976-77

135. Ch’an and Zen Buddhism.
3 units, Spr (Paul) MWF 10
137. Religion in Japan.  
3-5 units, Aut (Davis) MWF 11

155. Mahayana Buddhism.  
3-5 units, Aut (Staff) MWF 1:15

211. Buddhist Sutras.  
5 units, Win (Paul) TTh 2:15-4:05

SOCIOLOGY

233. Family and Childhood in Chinese Communities.  
3-5 units, Spr (Olsen) MWF 1:15

ECONOMICS

Emeriti: Bernard F. Haley (Professor), Edward S. Shaw (Professor)  
Chairman: Bert G. Hickman


Lecturers: Ari Braverman, Michael Carter, Carl Van Duyne, Claudio Gonzalez-Vega, John Lipsky

Professors: Roger W. Gray, Bruce F. Johnston, Dudley Kirk, Gerald M. Meier (Graduate School of Business), Clark W. Reynolds (Food Research Institute), Robert B. Wilson (Graduate School of Business), Pan A. Yotopoulos (Food Research Institute), Robert Williams

Associate Professors: Henry M. Levin (School of Education), Scott R. Pearson (Food Research Institute)

Assistant Professors: Dennis L. Chinn, Omar Davies, Barry J. Edmonston, Tetteh Kofi (Food Research Institute), Harold S. Luft (School of Medicine), Myra Strober (Graduate School of Business), James L. Sweeney (Engineering-Economic Systems), David J. Teece (Graduate School of Business)

OFFERINGS AND FACILITIES

The Department’s purposes are to acquaint students with the economic aspects of modern society, to familiarize them with techniques for the analysis of contemporary economic problems, and to develop in them an ability to exercise judgment in evaluating public policy. There is training for the general student as well as for those who plan careers as economists in civil service, private enterprise, teaching, or research. Associated with the Department are the Research Center in Economic Growth in Encina Hall, for research and graduate training in problems of economic growth in both industrialized and developing countries, and comparable facilities in Encina Hall for mathematical economics and econometrics.

The University Library is well supplied with literature in all fields of economics. The Hopkins Transportation Library holds invaluable material on transportation problems, and there are special collections on the institutions and commerce of Latin America, the Orient, and Pacific Coast development. Advanced students have access to the Hoover Institution, with its comprehensive collections of original and secondary materials on many foreign nations. The Food Research Library in Encina Hall is particularly valuable for International Trade and Economic Development.

Qualified graduate students in economics are given the opportunity for training and research in the special fields of the Food Research Institute. A few undergraduate courses are also conducted by the Institute.

BACHELOR OF ARTS

To be recommended by the Department for the degree of Bachelor of Arts in economics, the student must have completed 45 units of economics:

1. The 45 units shall include Economics 51, 52, and 53 or their equivalents. Economics 51 and 52 should be completed if possible by the end of the junior year.

2. The 45 units shall include 25 units in
courses numbered 100 or above, of which 15 units must be taken at Stanford.

a) Two courses must be selected from the following list: 111, 118, 141, 145, 148, 157, 165.

b) Selected courses in Engineering-Economic Systems and courses numbered 205 and above in the Food Research Institute will count as economics courses in satisfying these requirements. A list of these courses is available in the Economics Department office.

c) Courses taken at other universities may be included in the 25 units of 100 level courses and 45 units of economics courses. The Director of Undergraduate Studies for the Economics Department will establish the amount of credit to be granted toward completion of the Departmental requirements. Students who have taken a year's elementary economics course at another university will normally be required to take Economics 51, 52, and 53.

3. Economics courses which are to be counted in the required 45 units must be taken for a letter grade.

4. An average grade of “C” or better shall have been received for all units completed at Stanford in economics.

Students who expect to undertake graduate study in economics, particularly prospective Ph.D. candidates, are strongly advised to take courses in quantitative methods beyond those recommended for other candidates for the Bachelor of Arts in economics. A list of recommended courses in Mathematics, Statistics, Operations Research, and Computer Science is available in the Economics Department office.

Students who completed Economics 5 and 10 under the previous requirements retain a choice of fulfilling either old or new versions of requirements 1 and 2. For these and other purposes, Economics 5 and 10 will be considered equivalent to 51 and 52, respectively.

HONORS PROGRAM IN ECONOMICS

Two programs are offered which lead to a Bachelor of Arts with Honors in Economics. Both programs are designed to encourage a more intensive study of economics than is required for the normal major, with course and research work of exceptional distinction.

The central feature of Honors Program I is completion of an honors thesis of appropriate quality. Honors Program II requires an especially high grade average sustained through more than the usual number of units of economics, and also calls for the submission of at least two term papers of appropriate quality, in economics, written at any point in the student's course work.

Both programs require completion of all requirements of the Bachelor of Arts in economics. Both programs also require an average grade of at least "B" in all courses (except courses taken on a pass/no credit basis) at Stanford.

Additional requirements of the Honors Program I are:

1. Completion of 10 units of Economics 179, or an equivalent combination of individual research courses, in addition to the 45 units ordinarily required. Before embarking on writing the honors thesis in Economics 199, students are advised to have completed all lecture courses associated with the subject they intend to pursue, such as the requirements under 1 and 2 for the A.B. degree.

2. An average grade in economics courses other than Economics 199 of at least “B.”


Additional requirements of the Honors Program II are:

1. Completion of 15 units of economics courses numbered 100 or above in addition to the units ordinarily required for the Bachelor of Arts in economics.

2. An average grade in economics at least midway between “B” and “A.”

3. Submission of two term papers of appropriate quality. These will ordinarily have been written in economics courses. They must have been read and graded by a faculty member in economics before being submitted.

Prospective candidates of Honors Program I should advise the Departmental Director of Undergraduate Studies of their interest and plans no later than the Spring Quarter of the junior year. Notice of the instructors and topic or topics offered for the next year in Economics 199 will be made available whenever possible by the beginning of the Spring Quarter. Students are encouraged to sign up in advance and to indi-
cate as early as possible if they plan to ask for individual directed research on another topic. Admission to this Program is not automatic and may have to be restricted if there are too many applicants.

Prospective candidates for Honors Program II are also encouraged to consult the Departmental Director of Undergraduate Studies before the end of the junior year. Applications for honors under this Program may be made at any time up to the end of the next-to-last quarter in which the student is enrolled. Potential applicants are responsible for saving copies of high-quality term papers for submission with the applications.

CO-TERMINAL A.B./A.M. PROGRAM

Qualified undergraduates may, upon admission to the co-terminal A.B./A.M. program, begin the A.M. part of the program after completing 180 units of undergraduate work. For admission, a student must have an average grade in Economics courses of approximately one "A" grade for every two "B" grades or better. For intelligent program planning, students are strongly urged to seek admission to the program prior to the end of the third quarter of their junior year and must apply prior to the end of the first quarter of their senior year. Application should be made to the Director of Graduate Studies for the Economics Department. In addition to meeting the requirements for the Bachelor of Arts in economics, students are required to complete the requirements for the Master of Arts as stated below. If the student takes Honors Program I, he may submit his Honors thesis as one of the alternative two term papers.

ADVANCED DEGREES

Graduate programs in economics are designed to provide students with a sound basis in modern theory, with a broad background in applied fields as well as specialization within fields of interest, with needed analytic and empirical tools, and with the perspective on the current state and uses of their discipline that is obtained by studying the development of economic thought and the economies of other cultures or other times. The department considers each of these objectives to be essential in the development of qualified researchers, teachers, and practitioners in economics. While departmental requirements for advanced degrees have been structured to secure these objectives, in the final analysis it is the responsibility of students to plan their studies so that these objectives are served.

A student who has been admitted to graduate standing in economics does not automatically become a candidate for a graduate degree. Rather, admission carries with it the expectation that students are preparing themselves for the Doctor of Philosophy degree. Admission to Candidacy and Recommendation for the Degree (and for the Master of Arts degree) occur subsequently, upon satisfaction of departmental requirements outlined below. Recommendation for the Degree and, especially, Admission to Candidacy are Departmental procedures separate from the formal procedures of the University Committee on Graduate Studies. The University's basic requirements for advanced degrees (residence, dissertation, etc.) are set forth in the section "Degrees" in this bulletin and must be satisfied along with the departmental requirements listed here.

An undergraduate major in economics or its equivalent is not required for admission to graduate standing, but is desirable and, in any event, some preparation in the social sciences is essential. Students admitted to graduate standing are expected to be prepared in mathematics at least to the level of one year's intensive study of calculus. Advanced calculus, linear algebra, differential equations, analysis, and mathematical statistics are useful preparations separately or collectively, and students are encouraged to continue the development of such analytic tools during their graduate study. Narrowly specialized undergraduate programs are not recommended.

Well prepared students proceeding toward the Doctor of Philosophy degree may expect to spend approximately two years in course work and another two years in seminars, independent study, and dissertation research, with some overlap in each direction. Exceptional progress may make a three-year program feasible and, occasionally, ambitious dissertation research cannot be completed within a four-year program.

Questions and petitions concerning admission to the program or the program itself should be addressed to the Director of Graduate Studies, who together with his administrative assistants and the Graduate Studies Committee, of which he is chairman, has de-
partmental responsibility for administering the graduate program. Students approaching their dissertation research are obliged to seek among the regular members of the Economics Department faculty a principal adviser who will supervise that research. Officers and members of the Graduate Economics Society actively participate in advising entering students and, in addition, provide an important channel through which student interests within the department are represented.

MASTER OF ARTS

The Department of Economics does not admit students who plan to terminate their graduate study with a Master of Arts degree. Students may (but need not) elect this degree in preparation for their Doctor of Philosophy degree in economics. Students who have been advanced to Ph.D. candidacy in other departments of the University may, however, be admitted to the A.M. program in economics. The following are departmental requirements for the Master of Arts degrees:

Admission to Candidacy—Completion of the Stanford requirements for a Bachelor of Arts degree in economics, or approximately equivalent training, is required of students who undertake a program of study for the degree of Master of Arts in Economics. Admission to candidacy for the degree will be restricted to students whose record bears promise of successful graduate work. All programs must be approved by the Director of Graduate Studies before filing the Application for Candidacy for the Degree of Master of Arts at least two quarters before expected completion of the degree. Programs lacking strength or coherence will not be approved.

Recommendation for the Degree—Students completing programs consistent with the departmental objectives listed in the introductory paragraph above will be recommended to the University Committee on Graduate Studies for the degree of Master of Arts in Economics, provided the following standards are satisfied:

1. Completion of a program of study at Stanford amounting to not less than 45 units of credit. Courses numbered below 100 may not be counted toward the 45 units required. The program must include at least 30 units of economics taken in the Department of Economics, of which at least 15 units (or 10 units in addition to the thesis) must be in courses at the 200 level. The 200 level courses in the program must include either 202 or 210, whichever is recommended by the Director of Graduate Study. Courses which are listed simultaneously with two numbers (e.g., 51 and 151, 121 and 221) may count towards the 45 units only at the level of the lower number. Courses in subjects closely related to economics may be included with the approval of the Director of Graduate Studies in Economics. Economics 1, 51, 52 and 53, which are required for the A.B. degree in economics, cannot be used to satisfy the basic 45 units. Likewise, no more than three courses from among 111, 118, 141, 145, 148, 157, and 165 can be used to satisfy the basic 45 units. Nor can seminar courses numbered 300 or above.

2. Completion of a thesis acceptable to the department or of two term papers of acceptable quality at least one of which is for a course numbered 200 or over. Credit will be allowed for the thesis to a maximum of 10 units toward the 45 units required for the degree.

3. An average grade of B or better shall have been received for the first 45 units of course work completed and for additional units approved by the department.

DOCTOR OF PHILOSOPHY

Programs of study leading to the Doctor of Philosophy degree are designed by the student, in consultation with his advisers and the Director of Graduate Studies, to serve his particular interests as well as to achieve the general departmental objectives outlined above. Simple satisfaction of a set of requirements is necessary but not sufficient for Admission to Candidacy or Recommendation for the Degree. Rather, programs of study will be weighed individually according to the following departmental standards or requirements:

Recommendation for the Degree—The Departmental Graduate Studies Committee will recommend to the University Committee on Graduate Studies that a student be granted the degree of Doctor of Philosophy in Economics when the student submits and the Graduate Studies Committee accepts a completed program of study which will sat-
isfy the following set of standards. This summary list is elaborated upon below.

1. Qualification established by comprehensive examination in five fields of study (if no minor subject is offered) or in four fields and a minor subject
2. Proficiency in either at least two other areas within economics or the minor subject
3. Qualification in Mathematics
4. Qualification in Econometrics
5. Qualification in Economic History
6. Professional competence in a foreign language or course work developing a needed research skill
7. Teaching experience
8. Research training and specialized study in seminars
9. University oral examination
10. Completion of dissertation

It should be noted that the fourth and fifth standards need not involve course work in addition to that offered in satisfying the first and second. More detailed discussion follows:

1. Qualification in five fields of study (if no minor subject is offered) or in four fields of study and a minor subject. All candidates will be expected to qualify in "Price and Allocation Theory" and "Theory of Income and Economic Fluctuations." Evidence of competence shall be at least equivalent to passing comprehensive examinations in each field.

Comprehensive field examinations will be scheduled annually, usually at the close of the sequence designed to prepare for them. The minimal standard of qualification in each field will be a grade of B on the appropriate examination. Successful candidates are expected to show distinction in at least one field of economics. Comprehensive examination papers become a part of each student's permanent file.

In addition to the two theory fields, students may select remaining fields according to the following options:

Option A—Without a Minor Subject. Consistent with the objectives of their program, students may choose to prepare themselves in three of the following fields of study:

- Alternative Approaches to Economic Analysis
- Econometrics
- Economic Development
- Economic History
- International Economics
- Labor Economics
- Mathematical Economics
- Monetary Theory
- Public Finance
- Structure of Industry
- Theory of Choice
- Urban Economics

Students should complete at least four comprehensives by the end of their second year in residence. Many complete all five. Normally students exercise Option A unless there are strong reasons leading them to take a program with a minor.

Option B—with a Minor Subject. Consistent with the objectives of their program and advance consent of the Director of Graduate Studies, students may choose to prepare themselves in a minor field. Normally, they would also prepare themselves in two of the fields of study listed under Option A. Additional credit elsewhere in the economics part of his program for the minor may be obtained by consent of the Director of Graduate Studies.

2. Distribution Requirement. To achieve a balanced program, students without a minor subject are required to show proficiency in at least two fields other than those in which they will take comprehensives under option A. Normally, a total of three five-unit courses approved by the Director of Graduate Studies, passed by grades B or better, will be regarded as evidence of such proficiency. Besides selecting from the remaining fields listed under option A for this purpose, the student may choose from all graduate lecture courses numbered 200 or above offered by the Economics Department. Economics 171 and/or Economics 172 may be counted as graduate courses for this purpose.

3. The student demonstrates competence in mathematics at least to the level of successful completion of Mathematics 7 or 43 with a grade of C or better or its equivalent (as judged by an examination administered by the department upon entrance). This standard should be satisfied as soon as possible after first graduate
registration and those with little previous mathematical background are advised to register their first autumn quarter for Mathematics 5 or 41. Those who have more background but are not quite up to the level of Mathematics 7 or 43 may either complete Mathematics 7 or 43, or complete Economics 180, depending upon their level. Additional preparation in mathematics is strongly suggested, and students should consult with their advisers in choosing courses beyond the level of Mathematics 7 or 43.

4. Students shall submit evidence of competence in Econometrics at least to the level of Economics 171 with a grade of B or better. Electing Econometrics as a comprehensive field automatically satisfies this standard. Students who do take the Econometrics comprehensive may still offer Economics 172 as one of their courses satisfying the distribution requirement under 2 above.

5. Students shall submit evidence of competence in Economic History either by electing to take the comprehensive exam in the field or by taking a course at the 200 level for five units. Students not offering the comprehensive exam may offer as many as two economic history courses in partial fulfillment of the distribution requirement under 2 above. In satisfying standards 1 through 4, in unusual circumstances a student may petition the Director of Graduate Studies to substitute Economics courses from outside the Economics Department if they demonstrably contribute more to the Ph.D. program.

6. Consistent with the aims of his program, each student shall demonstrate research capability in a relevant foreign language or mastery of a body of specialized research methods other than Econometrics. Research competence in a foreign language will automatically satisfy this standard, but evidence of particular skills in other areas may be accepted as an alternative; e.g., computer science (programming, data analysis), statistics (sample theory), psychology (test theory of survey technique), mathematical and quantitative methods of demographic analysis, and advanced topics in mathematics may be accepted.

7. Candidates for the Ph.D. in Economics are expected to acquire minimal teaching experience equivalent to that of a teaching assistant in the department for one quarter or more. It is not recommended that this requirement be satisfied during the first year of graduate study, and it will normally be satisfied by the end of the third year of residence.

8. Seminar studies are designed to develop independent research skills, to permit specialized study, and to foster dissertation research. Students are expected to participate in at least two seminars by the end of their third year in residence. Presentation of a well developed proposal for dissertation research should take place in one of these seminars or, alternatively, in a departmental workshop. A dissertation prospectus and two research papers must be submitted as part of each student's permanent file. Students in the process of dissertation research and in residence shall continue to participate in at least one seminar.

9. When these standards have been satisfied and upon a recommendation from the student's dissertation adviser, the Director of Graduate Studies will request that a University oral examination committee and time be set. The examination is based on the dissertation and on the field or fields of economics within which it lies.

10. Completion of a dissertation accepted by a departmental reading committee will be the final standard set in preparation for the Ph.D. degree.

Minor for the Degree of Doctor of Philosophy—To be recommended for the degree of Doctor of Philosophy with Economics as a minor subject, a student will qualify in three fields of economics, one of which must be either "Price and Allocation Theory" or "Theory of Income and Economic Fluctuations." Qualification in these fields is tested in the departmental comprehensive written examinations that are given once annually. The standard of achievement in these examinations is the same for minor as for major candidates.

Qualification for the Ph.D.—Current University regulations require that each department shall establish procedures for qualifying students for the Ph.D. As a result of the qualification procedure, a student shall be either (1) qualified for the Ph.D., or (2) explicitly terminated from the Ph.D. program.
If a student is adjudged by his department that he is qualified for the Ph.D., he will be recommended by his department for admission to candidacy for the Ph.D. Thus “Qualification for the Ph.D.” should be considered synonymous with “Recommendation for Admission for Candidacy for the Ph.D.” The University further requires such qualification procedure for a graduate student to take place no later than at the end of six quarters of graduate work at Stanford (quarters of nine units or more, excluding the summer quarters). There may be occasional exceptions to this rule, e.g., a graduate student who changes department after his first year, but all such exceptions must be approved in advance by the Dean of Graduate Studies.

The qualification procedure of the Department of Economics normally takes place at the end of the spring quarter of the graduate student’s second year. Based on his performance in the program up to that time, the Graduate Studies Committee will make a judgment as to his qualifications to complete the Ph.D. program successfully. If adjudged to be so qualified, the Department will recommend the student for admission to candidacy for the Ph.D. The student should then complete the University form “Application for Candidacy for Degree of Doctor of Philosophy,” which has to be signed by him, by the Director of Graduate Studies, and by his principal dissertation adviser, if one has been selected by that time. If the graduate Studies Committee judges the student not qualified to complete the Ph.D. program successfully, the student will normally be terminated from the Ph.D. program, unless extenuating circumstances are shown to exist.

Admission to candidacy for the degree of Doctor of Philosophy is granted by the University Committee on Graduate Studies. Candidacy, once approved by the University Committee on Graduate Studies, remains valid for five years from date of approval (if it has not been terminated earlier by the department because of unsatisfactory progress) and may be renewed by the submission and approval of a new application, or extended upon the recommendation of the department. Admission to candidacy does not imply that the student has completed all requirements for the Ph.D. except the dissertation. Rather, it implies that the department has made a careful review of the progress of the student and has decided that he is qualified to complete the Ph.D. program.

The Department of Economics recognizes that there will be differences in academic programs of the students and not all students will have proceeded in the same order or at the same rate. A representative minimum program on which the Graduate Studies Committee can make a judgment regarding qualification at the end of the spring quarter of the student’s second year is outlined below. Many students should expect to exceed this standard. A student who cannot meet this standard because of exceptional circumstances should consult the Director of Graduate Studies as early as possible during his second year.

Representative Minimum Program for Qualification

1. Successful completion of the comprehensive examinations in “Price and Allocation Theory” and “Theory of Income and Economic Fluctuations.”
2. For students without a minor subject, successful completion of comprehensive examinations in at least two other fields of study; for students with a minor subject, successful completion of comprehensive examinations in at least one other field of study and fulfillment of most of the minor requirements.
3. Qualification in Mathematics.
4. Qualification in Econometrics or in Economic History.

“Distinction” Requirement—In addition to the successful completion of the minimum program outlined above, a student to be qualified is expected to have shown “distinction” in some important aspect of his graduate program. The Graduate Studies Committee will determine what constitutes “distinction.” In the past, a grade of A— or better in one or more of the comprehensive examinations has been accepted as an indicator of “distinction.” This does not preclude a student from demonstrating “distinction” in some other way, e.g., writing and publishing an article in a scholarly journal.

The Dissertation—By the end of his third year, normally encompassing the two dissertation seminars and remaining course work, students will have selected an adviser and a dissertation subject or area. A short dissertation prospectus written by the student and signed by his adviser will be placed on file
with the Director of Graduate Studies. This prospectus is not binding on either party, but advisers should be informed of major changes in research directions.

As soon as a firm thesis proposal is agreed on between student and adviser, the second and third members of a reading committee are to be selected with the adviser’s approval. The principal adviser and one other member of the reading committee must be from the Department of Economics.

When either a first draft of the dissertation is completed, or core theoretical and/or empirical aspects of the dissertation have been developed, a student may petition for an oral exam with his adviser’s approval. The oral committee will normally consist of the three dissertation readers, a chairman drawn from outside the Department, and one additional examiner nominated by the Department. At least three out of these five examiners must be from the Economics Department.

For the candidate to pass the oral exam, the examining committee must be convinced that (1) he has mastered the existing literature and professional techniques in his dissertation area, and (2) that no major conceptual or empirical problems remain to be overcome in making his own significant contribution.

Joint Programs Leading to Dual Degrees

Attention is called to a joint program. The Department of Economics and the Stanford Law School offer a joint program leading to the Doctor of Philosophy in Economics and the J.D. degree in Law.

In the above case, the student’s program objectives must clearly justify such a joint program; decisions by the Departmental Graduate Studies Committee will govern. In this case, a student’s program in Economics must satisfy the same standards as a Ph.D. degree in Economics taken with a minor in Law. See the Law School catalogue for descriptions of its participation in the joint program. In this case, it is expected that dissertation research will cross departmental lines and that members of the dissertation committee will be drawn from both faculties.

Students may matriculate in Economics or Law, initially. After one year of study, they may apply for admission to a joint program by petition to the two appropriate faculty committees.

Similar joint programs involving the Master of Arts degree in Economics may be arranged upon application and following standards set up for that degree.

Fellowships and Assistantships

The attention of prospective graduate students is directed to the fact that the Department awards a number of fellowships for graduate study of economics. Current stipends under these grants range up to $2200 for an academic year in addition to tuition allowance. Students whose record justifies continuation in the program may be assured of favorable consideration for further support for a period of up to three additional years.

Such support for subsequent years may take the form of employment as research assistants or as teaching assistants. The salary scale in each case depends upon experience and ability. In the case of research assistants, students are currently receiving $3000 plus an allowance for tuition. In the case of teaching assistants, students are currently receiving $3000 per academic year, in addition to a tuition allowance. In each case the appointments are for half-time employment. Entering students are not normally considered for research or teaching assistantships.

Completed application forms for graduate fellowships should be filed before January 15 at the Office of Financial Aids at the same time as completed application forms for admission are filed with the Admissions Office.

Courses

Note: It is not possible at the date this announcement goes to press to schedule courses accurately for the year. Application should be made to the secretary of the Department after March for information about the exact times at which courses will be given in 1974–75.

1. Elementary Economics—The functioning of a modern market economy: the determination of national income and its distribution; the composition of output; growth of the economy.

5 units, Aut, Win, Spr (Foley, Bach, Boskin) MTWThF
4 units, Sum. (——) MTWThF
51. Economic Analysis I — The nature of economic systems; performance evaluation criteria. Consumer choice and production theory. The role of markets and prices in allocating resources in a decentralized system. Problems of equity and efficiency. (May be taken as 151 by graduate students.) Prerequisite: 1 or equivalent preparation.

5 units, Aut (Weiss, Newberry, Shoven)
MTWThF
Win, Spr MTWThF

52. Economic Analysis II — An analysis of equilibrium and instability in the economic system as a whole. National accounts and aggregate relationships among stocks and flows in markets for goods, services, and financial assets. (May be taken as 152 by graduate students.) Prerequisite: 51.

5 units, Aut, Win, Spr (Bisignano, Van Duyne, Kouri) MTWThF

53. Economic Analysis III — Application of micro- and macroeconomic analysis to comparative economic systems and selected aspects of economic growth. Centralized versus decentralized decision-making; questions of ownership; the performance of socialist economies. Growth as an economic goal. Sources of economic growth. Allocation of investment and growth performance in different systems. Term papers are required. (May be taken as 153 by graduate students.) Prerequisite: 52.

5 units, Win, Spr (McKinnon, Foley) MTWThF

90. Introduction to Accounting — An introduction to the principles and concepts underlying financial reports such as the income statement, statement of financial position, and the “funds” statement, and to the uses of such reports. No prior accounting is assumed. Students who have taken or are now taking a college-level accounting course may not enroll. (May be taken as 190 by graduate students.) Prerequisite: 90.

5 units, Aut (Ng)
Win (Griffin)

91. Introduction to Cost Accounting — The use of internal financial data for managerial decision-making. Students who have had or are now taking a college-level cost accounting course may not enroll. (May be taken as 191 by graduate students.) Prerequisite: 90.

5 units, Spr (——) MTWThF

100. Economic Theory in Historical Perspective — Concentration on the writings of the Physiocrats, Classical economists (Smith, Ricardo, Mill), Marx, Marshall, Walras, Keynes, and the American institutionalists (Commons, Veblen and Mitchell). Emphasis on the development of economic analysis as a particular branch of European and American social thought. Discussion of the influence of the German historical school on the development of American economics, as well as economic aspects of the writings of Pareto, Durkheim and Weber. Prerequisites: non-majors 1; majors 51 and 52.

5 units, Win (Field)

105/205. Theory of Income Distribution — This course will consider alternative theories of the determination of the distribution of income and the effects of various governmental policies (taxation, education, etc.) on the distribution of income. There will be some discussion of the measurement of inequality and of philosophical positions (such as Rawls’) concerning inequality. Special topics to be discussed will include the economics of discrimination, theory of screening, and stochastic models of income determination.

5 units, Aut (Stiglitz)

106. The World’s Food Economy — (Same as Food Research Institute 103.) This course will examine the interrelationships between food, population, and economic progress. The emphasis will be on the role of agriculture in the economic and social development of low-income nations. Attention will also be given to the economic and nutritional characteristics of the major categories of food and changes in food consumption associated with economic development.

3 units, Spr (Johnston)

107A. Commodity Futures Markets and Prices — (Same as Food Research Institute 105.) Description of the uses and functioning of commodity futures markets, with emphasis upon business uses of the markets. The meaning of hedging and the evolution of hedging practice. Determinants of the level of market use, and the relationship between level of use and market usefulness. Consideration from the evidence of price behavior, trading composition, and external influences, of the performance of futures markets in price determination and other functions. The
extent, influence, and importance of speculation in commodity futures.

3 units, Aut (Gray)

107B. Workshop in Commodity Price Analysis—(Same as Food Research Institute 106.) Applications of various approaches to commodity price analysis and forecasting. Student papers to report on analyses of particular commodities and markets. Prerequisite: 107A.

3 units, Win (Gray)


5 units, Win (Scitovsky)

111. Money and Banking—An investigation of financial processes, with an emphasis on the role of the banking sector and monetary policy. Implications for economic growth and stability are developed in the light of modern theory. Prerequisites: 51 and 52.

5 units, Aut, Spr (Bisignano, Johnson) MTWThF

115. European Economic History—Survey of growth and development in Western Europe from 1750 to World War II. Comparative approach, with primary but not exclusive emphasis on British, French and German experience. Special reference to general theories of growth, the role of the state in economic development, and the response of labor movements to industrialization.

5 units, Spr (Field)

116. American Economic History—Growth and development in the American economy from colonial times to the present. Historical and analytical discussion of the factors contributing to the growth of per capita output and its distribution. Special emphasis on the interplay between market-mediated and collective activity in determining outcome.

5 units, Win (Pincus) MTWThF

117. The Contemporary U.S. Economy in Historical Perspective—Recent departures in the functioning of the economy and their significance. Growth and composition of output and employment; population growth; urban concentration; labor-force participation; physical and human capital formation; technological progress; the expansion of government; economic instability.

5 units, Aut (Abramovitz) MTWThF

118. The Economics of Underdevelopment—This course presents an analysis of development within an historical perspective. The development process is analyzed with regard to the mechanisms of capital accumulation, technical change, and trade. Discussion is focused upon various theories and empirical evidence relevant for understanding the current structure and operation of underdeveloped economies. Prerequisites: 51, 52.

5 units, Win (Harris) MTWThF

120. The Marxian and Radical Tradition—Theories and ideologies in relation to practices in capitalist and communist economies. An analysis of the views of influential economic thinkers in the Marxist and radical tradition. Prerequisite: 1.

5 units, Aut, Spr (Gurley) MTWThF

121. Economic Development in East Asia I—The economic development of China in this century, with emphasis on Communist. The impact of Maoist ideology on economic development. Course also covers Korea, Taiwan, and Indonesia. Prerequisite: 1.

5 units, Win (Gurley, Lau) MTWThF

123. Economic Development in Latin America—(Same as Food Research Institute 218.) An examination of the historical problems of economic growth and structural change in selected Latin American countries. Emphasis is placed on the application of modern analytical methods to problems of savings and investment, income distribution, employment, trade and finance. Given seminar style with individual research papers. (Graduate students and advanced undergraduates.) (Graduate students enroll in 223.)

5 units, Aut (Reynolds)

127A,B. Economic Development Problems of Third World Economies with Colonial Heritage I and II—(Same as Food Research Institute 133, 134.) The two quarter courses count as 5 units toward Economics major A.B. requirements. An analysis of development theories, problems, and policies common to third world economies, the evolution
of these economies through the pre-colonial, colonial, and post-colonial eras, categorization of empirical growth models and patterns in terms of basic internal structures and institutions and international influences. Topics include development models of closed and open economies, problems associated with monoconomies, land tenure systems, agricultural development, foreign investment and multinational businesses, industrialization, balance of payments and debt servicing, terms of trade and remunerative incomes from sales of primary produce, commodity agreements and related problems. Contemporary theories of economic imperialism and dependency models of development will be analyzed.

Research papers initiated in the first or second quarter will emphasize area studies or case studies of individual countries—hypotheses will be formulated and tested qualitatively or quantitatively. Prerequisite: 1.

5 units each quarter, Win, Spr (Kofi)

128. Marketing, Consumption, and Price Analysis—(Same as Food Research Inst. 120.) Applications of micro-economic theory to problems of commodity price determination, with major emphasis on methods of analyzing consumption and marketing channels. Agricultural examples are stressed and the marketing analysis has an economic development focus.

3 units, Aut (Staff) TTh 1:15-3:05

129. Analytical Techniques for Development Planning—(Same as Food Research 129/229.) This course will emphasize linear programming and benefit/cost analysis as methods of evaluating projects and sectoral programs. The focus will be on applications rather than on theory, and on technique rather than on mathematically sophisticated methodology. Examples will be drawn primarily from the agricultural sector of less developed countries, but the techniques that are examined will be applicable to a much wider set of problems and issues. (Graduate students enroll in 229.)

3 units, Aut (Chinn) MWF 11

130. Economics of the Household’s Life-Cycle—Many interesting and puzzling economic phenomena are associated with household decision-making. Some of the more prominent questions relate to secular changes in male and female labor force participation, the number and spacing of children, life-cycle consumption and savings decisions, the acquisition of human capital, and the characteristics of the process of spouse selection. The course begins with a historical summary of data from the United States concerning these and other aspects of household behavior. Economic models dealing with these matters are discussed and evaluated in terms of their consistency with the historical observations. Among the models considered in the course are explicit economic models of natality, assortative mating, and differential mortality. Prerequisite: Economics 1 or consent of instructor.

5 units, Win (Sanderson) MTWThF

131. Population Problems—(Same as Food Research Institute 135 and Sociology 130.) Analysis of U.S. and world population growth. Economic and social causes and consequences of trends in births, deaths, and migration. Population in relation to food and development; population theories and policies; national family planning programs. Prerequisite: 1.

5 units, Win (Kirk and Edmonston) MTWTh

141. Public Finance and Fiscal Policy I—Effects of government expenditure, borrowing and taxation upon resource allocation, national income and employment, prices, and income distribution. Prerequisites: 51 and 52.

5 units, Aut, Spr (Sheshinski, Starrett) MTWThF

144. Economics of Agriculture: Policy, Poverty, and Politics—(Same as Food Research 144/244.) The course deals with American agriculture and its historical and contemporary role in the economy. Topics include the structure and characteristics of farming and processing units, the role of agriculture in American economic development, government policy toward commercial agriculture, poverty problems in rural America, and the international dimensions of United States agriculture. Emphasis is on policy alternatives rather than on farm management; special attention will be given to issues, involving California agriculture.

3 to 5 units, Aut (Falcon) MWF 9

145. Economics of Labor—Analysis and description of U.S. labor force and labor markets. Wage determination; effects of unions and institutional forces on wages; causes and

5 units, Aut (Michael) MTWThF

146. The American Woman at Work—This course analyzes economic aspects of women's changing role in the labor force. Present labor-force inequality between the sexes is assumed; the course then focuses on the causes and consequences of this inequality and on possibilities for its reduction. Particular topics examined are: determinants of labor-force participation; turnover, absenteeism and productivity; discrimination by exclusion; wage inequality; the role of the law; leisure and the value of housework; socialization and education of women; training for labor-force re-entry; women in the professions and in management; the economics of child care centers; and the implications of the women's liberation movement. (Same as Business 330.)

5 units, Spr (Strober)


5 units, Win (Gromau) MTWThF

148. Economics of Urban Problems—Application of elementary tools of economic analysis to public policy issues in areas such as: poverty, employment, education, housing, urban transportation, and the local public sector. Prerequisites: 1 and 51.

5 units, Spr (Muth) MTWThF

149. Location Theory and Spatial Analysis—(Same as Food Research Institute 153.) This course will be organized on a lecture-seminar basis and students will have the option of preparing research papers. The principal theories and techniques used in the analysis of spatial organization will be examined. In addition to more well-known classical theories, students will be exposed to the work of more recent scholars. Among the topics to be covered are: classical location theory, central place theory, spatial interaction, space in development planning, and certain aspects of spatial statistics.

Given 1976–77

151. Economic Analysis I—See 51.
152. Economic Analysis II—See 52.

155. Economics of Exhaustible Resources—Application of tools of economic analysis to the allocation of exhaustible resources, including both minerals and renewable resource populations. Particular emphasis on analyzing the ability of market mechanism to make socially rational decisions in this field, especially in the light of the importance of intertemporal considerations, uncertainty, and environmental effects.

5 units, Spr (Heal)

156. Economics of Health and Medical Care—Description of problems and institutions, review of analytical studies, and discussion of policy issues. Topics covered include mortality and morbidity, physicians and other personnel, hospitals, the drug industry, national health insurance and health maintenance organizations. Open to graduate students, undergraduate economics majors (seniors and juniors), or by permission of instructor. Prerequisite: Preparation in micro theory and some statistics desirable.

5 units, Win (Fuchs) MTWThF

157. Theory of Firms and Imperfect Markets—This course is designed to extend and develop the basic tools of price theory in the context of U.S. industrial market structure. Emphasis will be on the application of theoretical models and concepts to the behavior of firms and markets when the conditions of perfect competition are not satisfied. Among the subjects to be covered: monopoly, oligopoly, monopolistic competition, concentration measures, behavioral theories of the firm, advertising, innovation, externalities, economies of scale, and the role of information in markets. Prerequisite: Economics 51.

5 units, Aut (Owen) MTWThF

158. Social Control of Industry—Building on the framework developed in Economics 157, this course considers the history, economics and legal background of those institutions under which U.S. industry is subject to government control. The two principal subjects of the course are antitrust law and economics and the economics and practice of public utility regulation in the communications, transportation, and energy sectors. The effects of licensing are also considered.
Emphasis is placed on application of economic concepts in evaluating the performance and policies of government agencies. Prerequisite: Economics 157.

5 units, Win (Lipsky) MTWThF

160. Trade and Development Problems of Tropical Africa—(Same as Food Research Institute 160.) Analysis of selected international aspects of tropical African economic development. Topics include African/non-African international trade and economic relations (theoretical background, historical perspective, case studies of export-led growth, and the impacts of international capital flows) and intra-African trade and economic integration (customs union theory, historical perspective, case studies of African economic integration). Prerequisite: 1.

3 to 5 units, Spr (Kofi)

165. International Economics I—Comparative advantage in production and trade among nations; the international monetary mechanism; domestic monetary, fiscal, and tariff policies and their relationship to foreign trade. Prerequisite: 1. Should be taken by majors after 51 and 52.

5 units, Aut (Gonzales-Vega) MW 11–1

166. International Trade and Investment Policy — (Same as Economics 166.) This course is concerned with the formulation, implementation, effects, and possible improvement of selected governmental policies affecting international trade and foreign investment. Topics include policies affecting international trade in energy resources, influences of domestic agricultural policies on international commodity trade, issues underlying the international negotiation of reductions of barriers to trade, governmental responses to competition from imports, international implications of environmental control, special trade and investment arrangements for developing countries, and domestic and international impacts of multinational corporations. With respect to each topic, initial attention is focused on existing institutions and practices, and policy analysis is then carried out to suggest improvements in current regulations. Prerequisite: Economics 165 or consent of instructor.

5 units, Win (Pearson) TTh 2:15–4:05

168. Problems in International Political Economy — This course introduces the student to the complexity and controversy of international economic policy problems through the study of a selected number of specific policy-making situations relating to international trade policy, international monetary policy, and international development policy. Approximately one-half of the sessions will be devoted to small group policy conferences in which students will present and discuss “position papers” on the specific policy problems. Considerable independent study is encouraged in the preparation of the position papers. These problems are studied primarily through sets of specially prepared source materials. Lectures will present some international economic principles that can be applied to the problems and will place the problems in their wider context. Prerequisites: 1, 51, 52.

5 units, Aut (Meier) TTh 3:15–5:05

170. Introduction to Econometrics I—Review of probability, random variables, distribution theory. Theory of estimation and hypothesis testing. Introduction to regression and correlation analysis. Applications to economics. Prerequisites: 51 and 52; Mathematics 7 or 43 or the equivalent; Statistics 60 or the equivalent.

5 units, Aut (Nold) MTWThF

171. Introduction to Econometrics II—Application of regression analysis to time series and cross-section data. Problems in the formulation of econometric models and introduction to simultaneous equations. Prerequisite: 170.

5 units, Win (Grossman)

172. Applied Econometrics—Critical review of the literature in econometric applications. Discusses the estimation of production functions, demand functions, consumption functions, etc. Prerequisite: 171 or equivalent.

5 units, Spr (Lau) MTWThF

180. Mathematics for Economists — Training in areas of mathematics which have frequent applicability to economic problems. Intended for students who have already had some calculus but lack a strong mathematical background. Topics covered include: functions of several variables; partial derivatives and differentials; mean value theorem and Taylor’s theorem, integral calculus; elementary matrix algebra, determinants, and characteristic roots; quadratic forms; and maximization of a function of several variables subject to equality constraints. Selected
applications in economics are discussed. Pre-requisites: 51 and Mathematics 41 or the equivalent.

5 units, Aut (Braverman) MTWThF

181. Optimization and Economic Analysis — The development of optimization techniques, including calculus, linear and non-linear programming, the calculus of variations, and control theory. Emphasis on concepts and results rather than techniques and proofs. Examples will include static and dynamic theories of the household and the firm, and problems in aggregative planning and control. Prerequisites: 51, 180 or Mathematics 43 or equivalent and an introductory statistics course.

5 units, Win (Sheshinski) MTWThF

190. Introduction to Accounting—See 90.

Undergraduate Seminars in Economics—Courses 142 through 198 are quarter-long seminars on topics of current interest. Each will meet once a week for two or three hours. The preparation of a research or review paper together with collateral reading will be the principal task of each. Consult the listed instructor or department for more information about seminars of interest.

142. Topics in Public Finance: The Role of Government in Economic Life.

5 units, Spr (Sheshinski)

189. Economics Of Natural Resources.

5 units, Spr (Kouri)

192. U.S. Monetary History.

5 units, Spr (Sanderson, Bisignano)


5 units, Aut (Rosenberg)

194. Economic Demographic Interactions.

5 units, Spr (Edmonston, Sanderson)


5 units, Win (Block)

196. Marxist Economics.

5 units, Aut (Carter)

197. Imperialism and Dependency.

5 units, Win (Williams)

198. International Trade and Investment Policy—Prerequisite: Econ 165 or consent of instructor.

5 units, Spr (Pearson) TTh 2:15–4:05

199. Senior Honors Research in Economics —Individual research leading to the writing of a senior honors thesis. One or more seminars will be offered with all members writing on related topics and meeting throughout the year under the guidance of one instructor. Maximum number of students in such a seminar is ten. Alternatively, by special arrangement, an Honors student may be permitted to write on a topic of his choice in consultation with an appropriate faculty member. Prerequisites: admission to Honors Program (see requirements for appropriate grade point averages) and consent of instructor.

Up to 10 units (Johnson, Owen)

200. Topics in the History of Economic Thought—This course will focus upon the development of economic thought in the classical school, beginning with Adam Smith and running through John Stuart Mill and Karl Marx. Brief attention will be given to both the predecessors and the successors of the classical economists, and to issues in the philosophy of science. Primary attention will be devoted to the development of the corpus of classical economic analysis in relation to the economic conditions of the period as well as to difficulties inherent in the nature of economic analysis itself.

5 units, Aut (Rosenberg)

COURSES PRIMARILY FOR GRADUATE STUDENTS


A. CORE THEORY CURRICULUM

202. Price and Allocation Theory I—Perfect competition. Meaning, conditions of efficiency in economic organization. General and partial equilibrium. Open to advanced undergraduates with consent of instructor. May be omitted by graduate students with adequate background in the subject. (May be taken as 202A by non-majors.) Prerequisite: Econ 165 or consent of instructor.

5 units, Aut (Pencavel)

203. Price and Allocation Theory II—Different forms of competitive and monopolistic behavior; their effect on efficiency of economic organization. (May be taken as 203A by non-majors.) Prerequisite: 202.

5 units, Win (Starrett)
204. Price and Allocation Theory III—Theory of consumer allocation over time and under uncertainty. Capital theory and pricing of factors of production. Growth theory and applications. Introduction to the theory of income distribution. Prerequisite: 203. 5 units, Spr (Kurz)


210, 211, 212. The Theory of Income and Economic Fluctuations—Theory of money, employment, income considered from points of view of comparative statistics, causes of instability and long-term change. 210 is prerequisite for 211, 210 and 211 are prerequisites for 212. Consent of instructor required for 210, 211, and 212.

210. 5 units, Aut (Scitovsky)
211. 5 units, Win (Foley)
212. 5 units, Spr (Hickman)

301A,B,C. Seminar in Microeconomics. 10 units (———) by arrangement

310A,B,C. Seminar in Macroeconomics. 10 units (———) by arrangement

B. ALTERNATIVE APPROACHES TO ECONOMIC ANALYSIS

219. Income Distribution—This course will examine alternative theories of income distribution. Topics will include: the classics (Smith, Ricardo, Marx), population, technology and property; marginal productivity theory from J. B. Clark to the present; deductive reasoning wrestling with empirical challenge; income distribution determined by market imperfections (Kalecki); the long-term problem; income distribution determined by investment (Kalecki); inflation as an unresolved struggle about income distribution; and the stochastic approach of Champernowne. Prerequisite: graduate standing, but open to advanced undergraduates with the consent of the instructor. 5 units, given 1976–77

220. Marxist Economics—This course offers the Marxist approach for analyzing economic problems such as price theory, national income accounting, income and employment analysis, income distribution, development economics and the economics of education. These topics are dealt with methodologically, historically and theoretically. 5 units, Win (Gurley)

395A,B,C. Seminar in Alternative Approaches to Economic Analysis. 10 units (———) by arrangement

C. ECONOMIC DEVELOPMENT

215. Economic Development I—Comparative analysis of presently underdeveloped economies. The process of development. Alternative theories of growth. Prerequisites: 204 and 212 or consent of instructor. 5 units, Win (Scitovsky)

216. Economic Development II—Major problems of development policy. Planning, prices, and market processes. Investment criteria and resource allocation, technological choices, agricultural problems, investment in foreign trade, and manpower. Stress on programming methods and social benefit-cost analysis. Prerequisite: 215 or consent of instructor. 5 units, Spr (Newberry)

221. Economic Development in East Asia I—See 121.

223. Economic Development in Latin America—See 123.

229. Analytical Techniques for Development Planning—See 129.

315A,B,C. Seminar in Economic Development. 10 units (———) by arrangement

D. ECONOMIC HISTORY

225. Technology, Economy and Society—Consequences of the diffusion of technological innovations in the economic history of the West from the ninth to the nineteenth centuries. Selected “clusters” of technical innovations will be examined for the light they throw upon the determinants of the rate and bias of innovative activity, economic and cultural conditions governing diffusion, and the problems of identifying and measuring the primary and second-order economic consequences of new modes of production and warfare. 5 units, given 1976–77

226. Problems in American Economic History—Analysis of broad trends and selected aspects of American economic history as they appear in the light of recent quantitative and non-quantitative research. 5 units, Spr (Pincus)
227. European Economic History — Economic growth and development in Western Europe from the eleventh to the twentieth centuries, with primary emphasis on the period from the Industrial Revolution to the First World War. The course will concentrate on the experiences of Britain, France, Germany, and other continental countries, roughly with that order of emphasis. Special emphasis will be placed on the interrelations between the growth and distribution of output, demographic trends, technological and organizational changes in the agricultural and manufacturing sectors, and the changing formal and informal institutions governing political and economic activity.

5 units, Aut (Field)

228. Economic Growth in Industrialized Countries — Historical and analytical treatment of the growth records of industrialized countries. Topics include the growth of resources and productivity, structural change in output, employment, and international economic relations and the inter-connections of demand and potential output growth.

5 units, Win (Abramovitz)

325A,B,C. Seminar in Economic History.

10 units (——- by arrangement

E. MONETARY THEORY AND INSTITUTIONS


230. Monetary Theory — Advanced topics in monetary theory with special reference to policy criteria and control techniques. Prerequisites: 211 and 265.

5 units, Spr (McKinnon)


10 units (——- by arrangement

335. Workshop on Microeconomics of Inflation.

10 units (Johnson, Pencavel, Shoven, Starrett) by arrangement

F. PUBLIC FINANCE

241, 242. Public Finance and Taxation I and II — Welfare criteria for optimal government expenditure, taxation and debt; positive analysis of the effects of taxation, expenditure and debt on resource allocation and income distribution; project evaluation; pricing policies in government enterprise; the local public sector and intergovernmental fiscal relations.

241. 5 units, Win (Shoven)

242. 5 units, Spr (Boskin)

341A,B,C. Seminar in Public Finance — Prerequisite: 241 or consent of instructor.

10 units (——- by arrangement

G. ECONOMICS OF LABOR


5 units, Win (Pencavel)

247. Labor Economics II — Economics of the family: marriage, fertility, schooling, migration, family labor supply and consumption; the personal distribution of earnings, income and wealth; social mobility; growth in real wages, aggregate production functions and the functional distribution of income.

5 units, Spr (Willis)

345A,B,C. Seminar in Labor Economics — A seminar in the application of tools of economic and econometric theory to topics in fertility, child rearing, marriage, health, schooling, post-school training, determinants of earnings, labor force participation of various groups, the personal distribution of income, and life cycle decision making. The focus will be on the application of theory to observed phenomena.

10 units (——- by arrangement

H. URBAN ECONOMICS

249. Urban Economic Analysis — Cities as open regions in a larger economy; urban spatial structure and urban transportation systems; segregation, slums and local land-use controls; federal policy toward urban areas. Prerequisite: 204 or Engineering-Economic Systems 212.

5 units, Spr (Muth)

250. The Urban Public Sector — The economic effects of property and other local taxes, principles and problems of local public expenditure; the influence of government on income distribution: education and labor
market programs, housing programs, and income maintenance. Prerequisite: 204 or Engineering-Economic Systems 212; 249 recommended.

5 units, Win (Muth)

349A,B,C. Seminar in Urban Economics. 10 units (——) by arrangement

I. ECONOMICS OF INDUSTRY

256. Economics of Health and Medical Care—See 156.

257. Economics of Industry I—Theories of industrial structure; the role of economies of scale; cost production functions; merger activity; measures of efficiency; investment decisions; inter-industry analysis; emphasis on empirical technique.

5 units, Spr (Mitchell)

258. Economics of Industry II—Models of imperfect competition; behavioral models of the firm; advertising, innovation, and information; measures of concentration; antitrust economics, law, and cases; regulation of public utilities; public policy problems.

5 units, Win (Owen)

355A,B,C. Seminar in the Economics of Industry. 10 units (——) by arrangement

J. INTERNATIONAL ECONOMICS

265. International Finance—Capital movements. Balance of Payments adjustments. Domestic economic effects of alternative international monetary institutions. Prerequisites: 204 and 212 or consent of instructor.

5 units, Aut (McKinnon)

266. International Trade Theory—Causes of trade and its effects on the allocation of resources, income distribution, growth and development, commercial policies. Prerequisite: 265.

5 units, Win (Kouri)

365A,B,C. Seminar in International Economics. 10 units (——) by arrangement

K. ECONOMETRICS

272. Econometrics I—Includes a review of classical least squares theory, problems pertaining to serial correlation of the residual, autoregressive models, distributed-lag models, and other single-equation methods and problems. Selected applications in economics. Prerequisites: Mathematics 113, Statistics 219 and 220, or the equivalent.

5 units, Aut (Lau)


5 units, Win (Anderson)

370A,B,C. Seminar in Econometrics. 10 units (——) by arrangement

L. MATHEMATICAL ECONOMICS*

Field I: Theory of Choice

280. Theory of Information—This course will examine the role of information in economic theory, analysis of markets with incomplete information; search, signaling and related phenomena.

5 units, Aut (Grossman)

281. Welfare Economics—General theory of welfare economics; social welfare functions and social choice processes; welfare measurement, the compensation principle, and benefit/cost analysis; theory of second-best; externalities and public goods; problems in social planning.

5 units, Win (Wilson)

282. The Economics of Uncertainty—A systematic examination of the implications of uncertainty on microeconomic behavior using axioms of choice under uncertainty and the expected utility theorem. Topics include optimal static and dynamic portfolio choices, insurance, the effect of uncertainty on savings and production decisions, stochastic stability of markets, and general equilibrium and welfare considerations under uncertainty. Prerequisites: 181, Statistics 116, or equivalents.

5 units, Spr (Stiglitz)

Field II: General Theory

283. Game Theory—(Same as Operations Research 364 and Graduate School of Business 463.) The course will provide a com-
prehensive treatment of the elements of game theory: Von Neumann-Morgenstern utility theory, two-person games, N person cooperative Games and the Core, non-cooperative game theory.

5 units, Aut (Aumann) Th 1:15-3:05; F 10-12 gsb

284. Dynamic Economics—Introduction to the theory of optimal control and applications in Economics. Advanced capital theory and principles of efficient and optimal allocation over time. Prerequisites: Mathematics 45, 113 and 114 or equivalent. Recommended: 283 and Mathematics 130.

5 units, Win (Heal)

287. General Equilibrium Theory—A comprehensive treatment of Arrow-Debreu equilibrium theory both for economies with a finite number of traders and for economies with a continuum of traders.

5 units, Spr (Aumann) Th 1:15-3:05; F 10-12 gsb

288. Special Topics—Being a "Special Topics" course it will be a continuation of the basic "Game Theory" course, Econ. 283, except that here Professor Aumann will plan a great deal of emphasis on alternative solution concepts, their meaning and application.

5 units, Win (Aumann) Th 1:15-3:05; F 10-12 gsb

385A,B,C. Seminar in Mathematical Economics.

10 units (——) by arrangement

ENGLISH

Emeriti: Robert W. Ackerman, John W. Dodds, Albert H. Grommon, Paul H. Kocher, Herbert D. Meritt, George F. Sensabaugh, Claude M. Simpson, Jr., Wallace E. Stegner, Virgil K. Whitaker (Professors)

Chairman: John Loftis

Director of the Creative Writing Center: Richard P. Scowcroft


Associate Professors: John B. Bender (on leave autumn and winter quarters, 1975-76), William M. Chace, John Felstiner (on leave autumn and winter quarters, 1975-76), Kenneth W. Fields, David Halliburton (English and Comparative Literature), Joseph C. Harris (on leave 1975-76), Anne K. Mellor, Diane W. Middlebrook, Nancy H. Packer, Robert M. Polhemus (on leave autumn quarter, 1975-76), Ronald A. Rebholz, David R. Riggs, Elizabeth C. Traugott (Linguistics and English) (on leave 1975-76)

Adjunct Professor: Larry Friedlander


Lecturers: Linda Jo Bartholomew, JoAn Chace, Timothy Dekin, Barbara Charlesworth Gelpi, Charles Kinder, Albert Phillips, Anne Scowcroft, Timothy Steele, Al Young

The Department of English offers work in English and American Literature, English Philology, and Creative Writing. In connection with these programs, it maintains the William Dinsmore Briggs Memorial Library for the use of graduate students and the Jones Room as a center for its work in Creative Writing. The Jones Room includes a library and facilities for small meetings.

PROGRAMS OF STUDY

BACHELOR OF ARTS

Before declaring an English major, students should have satisfied the University writing requirement and should also have taken at least one course in either English or American literature (not including Freshman English).

Any student who declares an English major should begin preparing to fulfill the De
partment's requirement of proficiency in a foreign language.

The following Departmental requirements are in addition to the University's basic requirements for the Bachelor's degree. (Any two of the required courses may be taken on a pass/no credit basis at the discretion of the instructor. Students intending to go to graduate school, however, should weigh the fact that a grade of pass will provide little evidence of their abilities.)

1. Students majoring in English are required to take one course from each of the six divisions listed below. The English Department recognizes that the interests of its majors are extremely various; for this reason the stated formal requirements are minimal. At the same time the Department strongly recommends that all English majors take courses with broad historical perspectives on language and literature such as English 102, 110, 111, 113, 115, 117, 119, 121, 122, and 125, and also more concentrated courses on the great major figures, notably courses in Chaucer, Milton, and Shakespeare. No one of these courses is mandatory, but those covering the background and the evolution of English and American literature, or focusing on the greatest writers, constitute the best preparation, not only of prospective candidates for admission to graduate schools of English, but of all students seriously interested in the study of English and American literature.

   a) Language: English 100A, 101, 102, 200A, 201, 205, 206; Linguistics 1, Linguistics 10, Linguistics 200.

2. Students are required to take at least three additional courses.

   a) Except for creative writing majors, students may choose additional courses from those offered by the English Department numbered 100 and above (though only one may be chosen from those numbered 90, 92, 162B, 190, 191, 192, 290, 291, 293, 390, 392, and 393). Students may also choose one course in a foreign literature read in the original.

   b) Students wishing to major in Creative Writing are required to take, in addition to the six courses in the six divisions, the following: for fiction writers, Narration (English 90), Development of the Short Story (English 137), plus 2 quarters of Directed Writing (English 190) or of a more advanced course, all with grades of B or better; for poets, Reading and Writing Poetry (English 92), either The English Lyric (English 250) or Theme and Form in the Modern English Lyric (English 254A) or Six Major American Poets (English 257), plus two quarters of Directed Writing of Poetry (English 192), or of a more advanced course, all with grades of B or better.

3. English majors are required to demonstrate proficiency in a foreign language. "Proficiency" means that the student is able to read at least at the level of facility expected in second-year college courses in a foreign language. As a minimum, the requirement may be fulfilled by passing a fourth-quarter foreign language course other than a "conversation" course or by demonstrating equivalent knowledge. English majors are strongly urged to continue with literature courses in whatever language or languages they study. Under rare circumstances, including a student's recent acquisition of Standard English, exemption from the requirement may be granted.

HONORS PROGRAM IN ENGLISH

Students who wish to undertake a more intensive and extensive program of study, including seminars and independent work, are invited to apply for the Honors Program during the spring quarter of their sophomore year, or early in the junior year. Applications
during the junior year will sometimes be accepted. Admission will be selective.

Students in the program will take one course in each of the six divisions required of English majors. In their junior year students will take a Junior Honors Seminar (196A), focusing on the close reading of a literary text or series of texts. In exceptional cases, English 100A-G may meet this requirement. In the autumn of their senior year students will take a Senior Honors Seminar (196B), focusing on Zfundamental questions of critical theory and practice. Each Honors student will consult with the Honors adviser to define a concentrated program of four additional courses in one of the six required areas, or, according to the student's interests, in a combined field: for example, Middle English and Renaissance, Renaissance and Restoration, Neoclassic and Romantic, Drama, Fiction, Poetry. Alternatively, a student who wishes broad coverage may take one additional course in four of the six fields required of regular English majors.

Finally, in their senior year, students will write a Senior Honors Essay (197) under the guidance of a faculty adviser. In November, they should submit a detailed prospectus, a short annotated bibliography, and a more extensive prospective bibliography: these must be approved before the student receives credit for work on the Essay.

On the basis of their performance in the program as a whole, candidates for Honors will be awarded either 'Highest Honors' or 'High Honors' or 'Honors'.

Note: Exceptional English majors who are not in the Honors Program but elect Senior Independent Study (199) may apply in their senior year for departmental 'Honors,' if their program of study has been approximately equivalent to that required of regular honors students.

COMBINED MAJOR IN CLASSICS AND ENGLISH

Students may with the consent of the Chairman of the departments concerned offer for the degree of Bachelor of Arts a combined Major in Classics (Latin and/or Greek) and English. Students interested in such a major should consult the Chairmen of both departments.

EXTENDED MAJORS

English and French Literatures—This major provides a focus in English literature with additional work in French literature, read in the original. Candidates for the A.B. in English and French Literatures complete eight courses in English, including, as in the regular English major, one course in each of six divisions: Language, Medieval, Renaissance, Neo-Classic, Romantic and Modern, and American literatures. In addition they must complete a coherent program of four courses in French literature, read in the original. The program of each student must be approved by the Director of Undergraduate Studies in English and by the Department of French and Italian.

English and Italian Literatures—This is arranged as in the major in English and French Literatures, requiring the completion of eight courses in English, including one from each of the six divisions, and a coherent program of four courses in Italian literature, read in the original. The program of each student must be approved by the Director of Undergraduate Studies in English and by the Department of French and Italian.

English and German Literatures—Candidates for the A.B. in English and German Literatures must complete a program exactly analogous to the two preceding majors, with eight courses in English, including one from each of the six divisions, and a coherent program of four courses in German literature, read in the original, with approval by the Departments involved as specified above.

English and Spanish or Spanish-American Literatures—Candidates for the A.B. in English and Spanish Literatures must complete eight courses in English, including one from each of the six divisions, and a coherent program of four courses in Spanish literature, totaling at least twenty units and read in the original. The program of each student must be approved by the Departments involved as specified above.

HONORS PROGRAM IN HUMANITIES

An Honors Program in Humanities is available for majors of this Department who wish
to supplement their Departmental major by a related and carefully guided program of studies. See the section "Humanities Special Programs" for a description of the Honors Program. Students wishing to take the Comparative Literature option within the Honors Program in Humanities should see the section "Comparative Literature."

VISITING STUDENTS

Students who do not wish to become candidates for a graduate degree, but who are qualified to meet the standards of admission to a Master's or Ph.D. program, may apply to the Graduate Study Office (118 Old Union) for admission as non-matriculated students for a period of not more than three consecutive quarters. Each quarter they may take up to three English courses numbered 101 to 299, or two such courses and (with the permission of the instructor) one English course numbered above 300. Such students are not eligible to apply for admission to the Ph.D. program.

TEACHERS' CREDENTIALS

Students wishing to obtain the Standard Teaching Credential (Secondary) entitling them to teach in grades 7-12 in the public schools of California, or a Community College Credential for grades 13 and 14, should consult the statement on credentials under "School of Education" in this bulletin and the Credential Secretary of the School of Education for the requirements.

1. General Secondary Credential. Candidates for the Stanford General Secondary Credential with a teaching major in English are required to take the following courses or their equivalents before they complete the program at the end of the fifth year. Undergraduates who are interested in preparing to teach English in public secondary schools should give first priority to the Departmental requirements for the A.B. with a major in English. But they should elect whenever possible some of the additional courses required for the "teaching major." The courses in the following list are in keeping with the Guidelines for the Preparation of Teachers of English developed cooperatively by the Modern Language Association, the National Association of State Directors of Teacher Education and Certification, and the National Council of Teachers of English:

<table>
<thead>
<tr>
<th>Teaching Major</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman English</td>
<td></td>
</tr>
<tr>
<td>English 102. The History of the English Language; option for English 102: Linguistics 45. Language, Society, and Culture</td>
<td>5</td>
</tr>
<tr>
<td>English 101. The Structure of the English Language; option for English 101: Linguistics 10. Introduction to General Linguistics or Linguistics 50. Language in Use</td>
<td>5</td>
</tr>
<tr>
<td>English 191. Prose Writing</td>
<td>3</td>
</tr>
<tr>
<td>English 173A,B,C. Shakespeare</td>
<td>5</td>
</tr>
<tr>
<td>English 113. The Renaissance</td>
<td>5</td>
</tr>
<tr>
<td>English 115. The Neoclassic Period</td>
<td>5</td>
</tr>
<tr>
<td>English 117. Romantic and Victorian</td>
<td>5</td>
</tr>
</tbody>
</table>

At least two courses in American literature (Courses in "minority" literatures and in literary criticism are strongly recommended. One course in minority literature in the U.S. can be considered as one of the required courses in American literature.)

| Education 184. Literature for Adolescents | 3 |

Drama 5. Play Production (Autumn quarter; option for Drama 5: Drama 39. Theater Performance: Crew (1 to 4 units, any quarter) or Communication 100. Editorial Techniques I (4) and Communication 102. Editorial Techniques I (1)

The teaching major in English must include a minimum of 36 quarter units of upper division and graduate courses in English. Of these, 9 must be in graduate standing.

All candidates for a Stanford credential with a teaching major in English are required to take at least three courses in the Stanford Department of English; for the teaching minor, two such courses are required.

<table>
<thead>
<tr>
<th>Teaching Minor</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman English</td>
<td></td>
</tr>
<tr>
<td>English 191. Prose Writing</td>
<td>3</td>
</tr>
<tr>
<td>English 102. The History of the English Language</td>
<td>5</td>
</tr>
<tr>
<td>English 173A,B,C. Shakespeare</td>
<td>5</td>
</tr>
<tr>
<td>English 117. Romantic and Victorian</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American literature</td>
<td>10</td>
</tr>
<tr>
<td>Elective, preferably in the English novel or English 101. The Structure of the English Language</td>
<td>5</td>
</tr>
</tbody>
</table>

A candidate for the Stanford Community College Credential must begin the program during the summer or autumn quarter and should apply for admission with graduate standing before the stated deadlines. The Department will accept only those applicants who seem promising candidates for an advanced degree offered by the Department and meet the standards for college instructors — in other words, those fully qualified to study for the Ph.D. degree, whether or not they plan to do so. Other graduate students interest-
ed in obtaining a teaching credential are advised to work for the Stanford General Secondary Credential.

2. The Stanford Community College Credential. Candidates who wish to teach English in public community colleges in California must complete a Master’s degree in English. They are not required by the State of California to complete courses in professional education. However, the California State Accreditation Committee points out that a “program of professional preparation for the standard community college credential should prove of great employment and professional value to those seeking that credential.” To qualify for the Stanford Community College Credential, candidates must meet the following requirements:

a) Completion of the Master’s degree in English, which, as described in the section on “Advanced Degrees” below, requires a minimum of 45 units of graduate work, one foreign language, and the successful completion of a comprehensive examination. The candidate with the help of his or her adviser in the Department of English and of a representative of the School of Education selects a coherent program of courses chosen from those offered by the Department of English and closely related departments that are most appropriate for a prospective teacher of English in a two-year college. But among the courses for the A.M., Education 362 is required, and either Education 239 or a course in Linguistics is also required:

- Education 362 (Teaching English in the Two-Year College, Autumn Quarter only).
- Education 239 (Study Skills and Developmental Reading and Participation in a Study Skills Center in a nearby Community College).
- English 101 (Structure of the English Language), or Linguistics 200 (The Goals of Grammar), or Linguistics 201 (Introduction to Formal Grammars).

b) Education 248 (Student Teaching in the Community College). This course is required but is not included in the minimum of 45 quarter units required for the A.M. The student must furnish his or her own transportation.

3. Master of Arts in Teaching. The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

ADVANCED DEGREES

For University regulations governing advanced degrees see the section “Degrees” in this bulletin.

Eligibility — A student may enter upon graduate work toward an advanced degree in English at Stanford if he or she received a Bachelor’s degree of acceptable quality. (Formal application for candidacy is a separate step taken somewhat later.) Students whose previous preparation falls short of the requirements for the degree of Bachelor of Arts in English at Stanford will be expected to make up deficiencies. Credits for previous graduate work at Stanford or elsewhere more than five years old may be reevaluated or rejected.

Graduate students are admitted only as candidates in one of the following programs: the Ph.D., the Master of Arts in English literature, the Master of Arts in an approved Credential Program, the Master of Arts in Teaching (MAT), or the Master of Arts in Creative Writing. Since Master’s degree candidates are accepted for a specific terminal program, they will not normally be admitted to the Ph.D. program.

Master of Arts

Candidates may earn the Master’s degree in English literature by passing satisfactorily 45 units of specified work, one foreign language, and an oral qualifying examination. The examination, which is taken in September, is based on the Ph.D. qualifying examination Reading Guide (except that Master’s candidates may read the Old English selections in translation). Candidates for the co-terminal Bachelor’s and Master’s degrees must complete 45 units of specified work beyond that required for the undergraduate
major in English or another subject. The language requirement and examination are the same as those for other candidates for the Master’s degree.

Candidates in an approved college-level Credential Program may earn the Master’s degree by passing satisfactorily 45 units of specified work, one foreign language, and a qualifying examination. No thesis is required.

Candidates for the Master of Arts in Teaching must complete a minimum of two-thirds of their specified work in the English Department.

Candidates for the Master’s degree in Creative Writing must submit a sample of their writing with their application. Should this sample be approved, the candidate will be provisionally admitted to the program, but will not be finally accepted until he or she has demonstrated ability through one quarter’s work in an advanced writing course. A candidate may then earn the Master’s degree by passing satisfactorily nine courses of specified work (including the qualifying advanced writing course) and one foreign language, and by submitting a piece of imaginative writing of substantial length and merit. This must be submitted at least four weeks before the close of the quarter in which the degree is to be granted.

Candidates for the Master’s degree in Creative Writing who, after a quarter’s work, are not accepted as degree candidates in the writing program may earn the Master’s degree in English by completing satisfactorily nine courses of specified work, by passing one foreign language, and by passing the qualifying examination for the Ph.D. in English.

DOCTOR OF PHILOSOPHY

University regulations regarding this degree are discussed in the section “Degrees” in this bulletin. The following Departmental requirements, dealing with such matters as residence, dissertation, and examinations, are in addition to the University’s basic requirements for the doctorate.

A candidate for the Ph.D. degree must complete three years (nine quarters) of full-time work, or their equivalent, in graduate study beyond the Bachelor’s degree. He or she will be expected to offer at least 90 units of graduate work in addition to the doctoral dissertation. At least three consecutive quarters of graduate work, and also the last course work in the doctoral program, must be taken at Stanford.

Normally, this program should be completed in four years. The first year should be devoted to full-time graduate study; the second and third years to graduate study and teaching; the fourth year to writing the dissertation. Three and one-half quarters of supervised teaching are a required part of the Ph.D. program.

A candidate may take the Ph.D. degree in English literature, in English and American literature, in English and comparative literature, in English and humanities, in English and linguistics, in English philology, or in English medieval literature.

Requirements of the Ph.D. program in English literature are as follows:
1. A five-unit course in Old English (usually to be 205) and a five-unit course in Middle English language or literature (read in the original)—or equivalent work elsewhere.
2. A minimum of four seminars, in different genres and periods as approved by the adviser.
3. Students are encouraged to take an advanced course in literary theory or criticism.
4. A minimum of 60 additional units of graduate courses and seminars (excluding 396, 396A, 397, and 399) distributed according to the adviser’s judgment and the candidate’s needs. A student may receive graduate credit for three courses numbered 101–199 in the offerings of the English Department.
5. A student must have the consent of the adviser to have courses taken outside the English Department count toward the requirement of 90 units.
6. An oral qualifying examination based on a Reading Guide, to be taken at the end of the summer after the first year of graduate work. The final decision as to qualification is made by the Graduate Studies Committee in consideration of the student’s course record in conjunction with his or her performance in the examination.

A student coming to Stanford from graduate work in another university where he or she took a qualifying examination and received an A.M. may petition in the third quarter of residence for exemption from the qualifying examination here. In the student’s third quarter, he or she may submit for approval by the Graduate Stud-
ies Committee an alternative list, endorsed by the student's adviser and comparable in breadth and range to the Reading Guide. A student may petition to take a written qualifying examination, but such a petition will be granted only in cases involving extraordinary circumstances.

A student who has isolated a topic or area which seems promising for a doctoral thesis subject and who wants to explore it right away, and to incur additional specific course requirements insuring coverage and balance in program, may petition upon entrance to qualify upon the recommendation of a committee of advisers who would oversee and evaluate a full year's course of study, but such petitions will be rigorously scrutinized by the Graduate Studies Committee and granted only in exceptional cases.

7. A University oral examination to be taken no later than the winter quarter of the student's third year of graduate work. This examination will cover (1) the field of concentration (as defined by the student and the student's adviser, subject to the approval of the Departmental Graduate Studies Committee) and (2) plans for the dissertation based upon a prospectus approved by the adviser.

Requirements of the Ph.D. program in English and American literature are as follows:

1. A five-unit course in Old English (usually to be 205) and a five-unit course in Middle English language or literature (read in the original)—or equivalent work elsewhere.

2. A minimum of 35 units of graduate courses in American literature and 35 units in English literature, including at least two seminars in each. The four seminars should be in different periods and genres as approved by the adviser. A student may receive graduate credit for three courses numbered 101–99 in the offerings of the English Department.

3. Students are encouraged to take an advanced course in literary theory or criticism.

4. A student must have the consent of the adviser to have courses taken outside the English Department count toward the requirement of 90 units.

5. Qualification: (See paragraph 6 under requirements of the Ph.D. program in English literature.)

6. A University oral examination to be taken no later than the winter quarter of the student's third year of graduate work. This examination will cover the period of the dissertation, together with plans for the dissertation itself based upon a prospectus approved by the adviser.

The Ph.D. program in English and Comparative Literature is designed for students wishing an extensive knowledge of the literature, thought, and history of England and of at least one foreign country, for one period. Approximately half of the student's course work and reading will be devoted to this period, with the remainder of the time given to other periods of English and American literature since 1350.

This degree, administered by the Department of English, is to be distinguished from the Ph.D. in Comparative Literature. The latter program is intended for students unusually well prepared in foreign languages, and will involve advanced work in three literatures, of which one may be English. Students interested should consult Professor W. B. Carnochan, Acting Chairman of the Committee on Comparative Literature.

The requirements for the Ph.D. in English and Comparative Literature are as follows:

1. Qualification: (See paragraph 6 under requirements of the Ph.D. program in English literature.)

For qualification in the doctoral program in English and Comparative Literature candidates are not held responsible for literature before 1350.

2. A knowledge of the basic structure of the English language and of Chaucer. This requirement may be met by examination, or by taking ten units of courses chosen from among those offered in linguistics, English philology, and early and middle English literature including Chaucer. No particular courses are required of all students.

3. A knowledge of one foreign language comparable to that demanded under the basic program and an advanced reading knowledge of a second language.

4. A minimum of 45 units in the history, thought, and literature of one period, in two or more languages, one of which must be English and one foreign. Students will normally include at least two courses in a foreign literature read in the original language and two courses listed under Com-
parative Literature or Modern Thought and Literature. As much as 20 units of this requirement may be satisfied through courses in Reading and Research. A student may receive graduate credit for three courses numbered 101–199 in the offerings of the English Department.

5. A minimum of four seminars, of which at least three must be in the English Department. Among the four seminars, students will take at least one seminar in literary theory or criticism. No more than two of the four required seminars may be on the same genre or period.

6. A University oral examination covering the period of the dissertation and plans for the dissertation itself. This examination, based on a reading list established by the candidate in consultation with his or her adviser, would normally be taken no later than the winter quarter of the third year of graduate study. However, those who spend the third year studying abroad may take this examination after their return early in the fourth year.

Language Requirements—All candidates for the Ph.D. degree (except those in English and Comparative Literature and in English Philology, for whom special language requirements prevail) must demonstrate a reading knowledge of two foreign languages. Candidates in the earlier periods must offer Latin and one of the following languages: Greek, French, German, Italian, or Spanish. In some instances they may be required to offer a third language. Candidates in the later period (i.e., after the Renaissance) must offer either Latin or French or German as one language, and may choose the second language from the following: Greek, Latin, French, German, Italian, Spanish. In all cases the choice of languages offered must have the approval of the candidate’s adviser. Any substitution of another language must be approved by the Graduate Studies Committee.

The candidate must satisfy one language requirement by the end of the first year (that is, before Registration in the following year), and the other by the end of the third year. Foreign language requirements for the Ph.D. may be fulfilled in any of the following ways:

1. Achievement of a sufficiently high score (70th percentile) on the foreign language examination prepared by the Educational Testing Service. Latin and Greek are not tested by ETS.

2. A reading examination given each quarter by the various language departments, except for Latin and Greek.

3. For Latin and Greek, an examination by the English Department. The Latin examination will be given before registration in the autumn quarter in order to permit those who need the course to register for Latin 3. It will also be given in the eighth week of the winter and spring quarters, along with other departmental examinations for languages not tested by the Educational Testing Service.

4. Passage with a grade of B or higher of a course in literature numbered 100 or higher in a foreign language department at Stanford. As an alternative for Latin, French, and Spanish, passage of Latin 51 and 52, French 10, and Spanish 10, respectively, with a grade of B or higher.

Dissertation—As early as possible during their graduate study, Ph.D. candidates will be expected to find a topic requiring extensive original research and to seek out a member of the Department as his or her adviser. The adviser will request the Chairman to appoint a committee to supervise the dissertation. Candidates should take this crucial step as early in their graduate careers as possible. The committee may well advise extra preparation within or outside the Department, and time should be allowed for such work.

Immediately after the dissertation topic has been approved by the adviser, the candidate should file a formal application for candidacy as prescribed by the University. Ph.D. dissertations must be completed and approved within five years from the date of that application. Candidates taking more than five years will be required to reinstate their candidacy by passing the written qualifying examination again.

The dissertation must be submitted to the adviser in rough draft but in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive the Ph.D. degree. Dissertations may not be submitted during the summer quarter.

JOINT PH.D. IN ENGLISH AND HUMANITIES

The Department of English participates in the Graduate Program in Humanities
leading to the joint Ph.D. degree in English and Humanities. For a description of that program, see the section "Humanities Special Programs" in this Bulletin.

GRADUATE PROGRAM IN MODERN THOUGHT AND LITERATURE

Stanford also offers a Ph.D. degree in Modern Thought and Literature. Under this program students devote approximately half of their time to a modern literature from the Enlightenment to the present, and the other half in interdisciplinary studies. Students interested should see the section "Modern Thought and Literature" and consult Professor Arnold Rampersad, Acting Chairman for 1975–76, in the English Department.

COURSE NUMBERING SYSTEM

1-9: Freshman Writing Courses; 101-109, 200-209, 300-309: English Language Courses
10-19, 110-119, 210-219, 310-319: English Period Courses
20-29, 120-129, 220-229, 320-329: American Period Courses
40-49, 140-149, 240-249, 340-349: Genre Courses: Drama
50-59, 150-159, 250-259, 350-359: Genre Courses: Poetry
60-69, 160-169, 260-269, 360-369: Topic Courses
70-79, 170-179, 270-279, 370-379: Author Courses
80-89, 180-189: Overseas Campuses Courses; 280-289, 380-389: Author Courses
90-99, 190-199, 290-299, 390-399: Writing Courses, Workshops, Individual Study, etc.

COURSES NUMBERED 1 THROUGH 99 ARE INTRODUCTORY COURSES DESIGNED PRIMARILY FOR STUDENTS WHOSE MAJOR IS UNDECLARED OR IS NOT IN ENGLISH

1, 2, 3, 4, 5, 6. Freshman English—Any two of the following writing courses, taken singly or in sequence, satisfy the University Writing Requirement. The writing will be mainly expository, but a few courses emphasize creative writing.

1A. Writing Workshop — An intensive course in which the primary basis of discussion is the students’ own writing.
   3 units, Aut, Win, Spr (Staff)

1B. Creative Writing Workshop — Like Writing Workshops but with emphasis on creative writing (fiction and poetry).
   3 units, Aut, Win, Spr (Staff)

1C. Writing Workshop for Transfer Students.
   3 units, Win, Spr (Staff)

1, 2. Thematic Writing Courses—Two quarter courses. Writing will be based on discussions arising out of the assigned reading.
   3 units, Aut-Win, Win-Spr (Staff)

3. Thematic Writing Courses—One quarter courses. Writing will be based on discussions arising out of the assigned reading.
   3 units, Aut, Win, Spr (Staff)

4. Small Group Tutorials—Each student meets with a group of approximately 10 students once a week and again individually with instructor.
   3 units, Aut, Win, Spr (Staff)

5. Small Group Tutorials for Second Language Students—The format is the same as for regular Small Group Tutorials, but the instructor is especially skilled in handling problems encountered by non-native speakers of English. Can be taken twice.
   3 units, Aut, Win, Spr (Staff)

6. Parallel Courses — Writing classes attached to certain large undergraduate courses.

6A. Writing About Political Science — Must also take Political Science 1.
   3 units, Aut (Staff)

6B. Writing About History— Must also take Modern Europe I.
   3 units, Aut (Staff)

6C. Writing About Psychology — Must also take Psychology I.
   3 units, Aut (Staff)

6D. Writing About Human Biology — Must also take Human Biology 1.
   3 units, Spr (Staff)

7. Writing Workshops for Exempted Students and Others—These Workshops are essentially free-form courses which will be
shaped by the instructor to reflect the needs of the students.

3 units, Aut, Win, Spr (Staff)

10. Studies in English Literature—A study of selected masterpieces of English literature, including poetry, drama, and the novel.

5 units, Win (Riggs)

20. Studies in American Literature — A study of selected masterpieces of American literature, including poetry, drama, the essay, the novel.

5 units, Aut (Middlebrook)

30. The Novel—(Same as Comparative Literature 30.) The objectives of this course are to present the novel as a significant, distinct genre, and by close, sympathetic reading to increase the student's appreciation of individual novels.

5 units, Spr (Bartholomew)

40. Drama—(Same as Comparative Literature 40.) Principal dramatic forms; development of dramatic art, masterpieces of the theater from various periods, countries.

5 units, Aut (L'Heureux)

50. Poetry—(Same as Comparative Literature 50.) An introduction, through the careful reading of poems, with emphasis on contemporary American poetry, and through the study of language and technical elements of verse. There will be opportunity for the writing of poetry.

5 units, Spr (Felstiner)

60. American Jewish Writing—(May be taken as 160 by English majors.)

5 units, given alternate years

61. The Way We Live Now: Recent American Fiction.

5 units, Spr (Young)

63. Women and Literature.

63A. Masculine/Feminine in Literature —(May be taken as 163A by English majors.)

5 units, given alternate years

63B. Studies in Women's Consciousness —(Same as Modern Thought and Literature 63B.) An interdisciplinary approach to the relationship between women novelists' positions as women and their ways of interpreting and expressing reality. Concentration on George Eliot and Virginia Woolf, but including Jane Austen, Charlotte Brontë, and Doris Lessing as well. (May be taken as 163B by English majors.)

5 units, Aut (E. Rogat) not given 1975–76

65. Medieval Culture: An Interdisciplinary Introduction—(Same as Medieval Studies 65, History 65, German Studies 21A.) (See Medieval Studies.)

66. The English Bible as Literature—Readings in Old and New Testaments and selected books of the Apocrypha, with some attention to the history of the English Bible and the use made of Biblical themes in English literature. (May be taken as 166 by English majors.)

5 units, Win (Ford)

68. American Indian Mythology, Legend, and Lore—An introduction to American Indian oral tradition, centering upon an investigation of the nature of native American prose and poetry, and especially the relationship between oral tradition and writing. (May be taken as 168 by English majors.)

5 units, Aut (Momaday)

69. Post-Modernism: The Literature of the Last Decade—(May be taken as 169 by English majors.)

5 units, given alternate years

73. Shakespeare—A reading of representative comedies, histories, and tragedies; designed to introduce the general student, as well as the prospective English major, to Shakespeare's art.

5 units, Aut (Ford)

Spr (Friedlander)

76. Fitzgerald and Hemingway—An intensive examination of the works of Hemingway and Fitzgerald, with some consideration of the work of their contemporaries.

5 units, Win (Islas)

77. William Faulkner—Most of the major works—perhaps half a dozen novels and some stories—will be read with attention to Faulkner's life, his rural Southern heritage, his interest in Freudian psychology, and his experimentations in structure and style.

5 units, Spr (Moser)

90. Narration—Basic problems of narrative and imaginative writing. Prerequisite: completion of the writing requirement.

5 units, Aut, Win, Spr (Staff)
92. Reading and Writing Poetry—An introductory course in the understanding and writing of poetry. Prerequisite: completion of the writing requirement.

5 units, Aut, Win, Spr (Staff)


COURSES NUMBERED 100 THROUGH 199 ARE MAINLY BASIC UNDERGRADUATE SURVEYS, SEMINARS, AND WORKSHOPS

Note: Graduate students may receive graduate credit for 3 courses numbered 101–199.

100A–G. Basic Seminars — Basic seminars on the scholarly and critical study of literary texts; given each quarter and strongly recommended for beginning English majors. English 100A–F will satisfy the appropriate area requirements A–F (see program for Bachelor of Arts, 1, above). The subject matter of English 100A will be mainly linguistic studies; of English 100B, medieval literature; of English 100C, Renaissance literature; and so on. The subject matter of English 100G, which will count as one of three required electives (see program for Bachelor of Arts, 2, above), will be mainly the theory of literary genres. This course is limited to students who have previously declared an English major and have taken at least one course in English or American literature (not including Freshman English). Sign up at the English Department. (Instructors: Allen, Canno chan, J. Chace, Fifer, Ford, A. Gelpi, B. Gelpi, L’Heureux, Mellor.) Consult the Time Schedule for specific offerings.

5 units, Aut, Win, Spr

101. The Structure of the English Language —(Same as Linguistics 180.) Study of what it means to be a “native speaker of English.” Emphasis on the semantic, syntactic, and phonological structure of English, with some attention to the application of linguistics to literature.

5 units, Aut (Oehrle)

102. The History of the English Language —Studies in the evolution of the English language as a medium of literary expression.

5 units, Spr (Allen)


110. The Earliest English Literature —Cultural backgrounds, reading (in translation), and critical analysis of Anglo-Saxon heroic legend, elegies, and other forms.

5 units, Spr (Allen)

111. Middle English Literature—Emphasis on major works, most of which will be read in the original language (often in simplified texts).

5 units, given alternate years

113. The Renaissance.

5 units, Aut (Rebholz)

115. The Neoclassic Period.

5 units, Win (Fifer)

117. Romantic and Victorian.

5 units, Spr (Mellor)

119. Modern British Literature.

5 units, Spr (Felstiner)

121. American Literature to 1855.

5 units, given alternate years

122. American Literature, 1855–1917 — (Same as Modern Thought and Literature 122.)

5 units, Win (Rampersad)

125. American Literature, 1917 to the Present—(Same as Modern Thought and Literature 125.)

5 units, Spr (W. Chace)

128. The American Condition in the Twentieth Century.

5 units, given alternate years

136. Trends in Modern Fiction.

5 units, given alternate years

137. Development of the Short Story—Required of creative writing students in fiction. Reading and discussion of American, British, and Continental short stories, with emphasis on changes and developments in the form.

5 units, Aut (Packer)

138. The Autobiographical Narrative.

5 units, given alternate years

147. Twentieth-Century Theater.

5 units, given alternate years

160. American Jewish Writing—See 60.

162A. Chicano Literature—(Same as Comparative Literature 162A, Modern Thought and Literature 162A, and Spanish and Portuguese 278.) Study of the emergence of a
literature. Novels, poems, journals, unpublished works will be read and discussed. Knowledge of Spanish helpful but not essential. (Open to graduate students but not to freshmen.)

5 units, Aut (Islas)

162B. Chicano Writing—(Same as Spanish and Portuguese 281.) A basic fiction and narrative writing course in which students will be encouraged to draw from their bicultural, bilingual experience. Knowledge of Spanish and familiarity with barrio dialects essential. (Not open to graduate students or freshmen.) 162A recommended.

5 units, Aut (Islas)

162C. Contemporary Mexican Writers (In Translation)—An intensive study of Mexico’s major twentieth-century novelists, poets, and philosophers. (Open to graduate students but not to freshmen.)

5 units, given alternate years

163. Women and Literature.

163A. Masculine/Feminine in Fiction—See 63A.

163B. Studies in Women’s Consciousness—(Same as Modern Thought and Literature 163B.) See 63B.

164. Introduction to Caribbean Literature: English, French, Spanish.

5 units, given alternate years

166. The English Bible as Literature—(Same as Modern Thought and Literature 166.) See 66.

167. The Literature of Fantasy—(Same as Modern Thought and Literature 167.) Major forms of fantasy in literature and other arts. Examining science fiction, pornography, gothicism, and religious and romantic adventure, we will attempt to formulate a theory of the nature and uses of fantasy.

5 units, Spr (Friedlander)

168. American Indian Mythology, Legend, and Lore—(Same as Comparative Literature 168 and Modern Thought and Literature 168.) See 68.


171. Chaucer.

5 units, Win (Damon)
Spr (Brown)

173A. Shakespeare — Intensive study of eight plays: *Romeo and Juliet*, *Twelfth Night*, *Richard II*, *Julius Caesar*, *Troilus and Cressida*, *Hamlet*, *King Lear*, *Antony and Cleopatra*. Students may take any or all of the 173 series in any order.

5 units, Aut (Friedlander)


5 units, Win (Rebholz)


5 units, Spr (Riggs)

190. Directed Writing: Fiction—Intermediate course. May be taken twice. Prerequisite: 90.

5 units, Aut (Young, Staff)
Win (Packer)
Spr (L’Heureux, Packer, Staff)
Sum (Staff)

191. Prose Writing—Advanced course dealing with problems of writing expository prose. Prerequisite: 2 or the equivalent.

3 units, Spr (Dekker)
Sum (Staff)


5 units, Aut, Win (Staff)
Spr (Young)

195. Ad Hoc Undergraduate Seminars—In any quarter a group of undergraduates (at least three but preferably more) who wish in the following quarter to study a subject or an area not covered by regular courses may plan an informal seminar and approach a member of the Department to supervise it. A syllabus for the course should be submitted to the director of undergraduate advising at least two weeks before the end of the quarter. No more than five units of credit will be given for English 195 and/or English 198 in any one quarter. English 195 may not be used to fulfill Departmental area or elective requirements without permission.

Any quarter, by arrangement

196A. Junior Honors Seminar—Required of all juniors in the English Honors Program.

5 units, Win (Carnochan)
Spr (Mellor)
196B. Senior Honors Seminar—Required of all seniors in the English Honors Program.
5 units, Aut (Middlebrook)

197. Senior Honors Essay.
15 units (during 2 quarters)
Aut, Win, Spr (Staff)

198. Individual Work—Advanced undergraduates who wish to study a subject or an area not covered by regular courses may, with permission, enroll for individual work under the supervision of some member of the Department. No more than five units of credit will be given for English 198 and/or English 195 in any one quarter. English 198 may not be used to fulfill Departmental area or elective requirements without permission. Group seminars are not considered appropriate to English 198.

Any quarter, by arrangement

199. Senior Independent Study—Open, on approval by the Department, to seniors majoring in English who wish to work throughout the year on a critical or scholarly essay of about 10,000 words (see “Note” under “Honors Program in English”). Applicants should submit (1) a sample of their expository prose and (2) a proposed topic for independent study to the secretary of the Department before preregistration in May of their junior year. Each student who is accepted will be assigned to an instructor, with whom he or she will prepare an appropriate reading list before the end of the spring quarter.

10 to 15 units (for the entire year)
Aut, Win, Spr (Staff)

**COURSES NUMBERED 200–299**

**ARE MAINLY COURSES ON SPECIFIC TOPICS AND AUTHORS; FOR UNDERGRADUATE AND GRADUATE STUDENTS**

**Note**—Graduate students in other departments who wish to broaden their programs will find many of these courses useful.

200A. Old Norse—(Enroll in German 205.)
Introduction to the language; reading of selected texts.
5 units, Win (Andersson)

200B. Old Icelandic Sagas—Prerequisite: 200A.
5 units, given alternate years

200C. Readings in Eddic Poetry—(Enroll in German 271B.)
3–5 units, Spr (Andersson)

201. Old Saxon—(Enroll in German 207.)
3–5 units, given alternate years

205. Old English—Elements of Old English grammar; critical reading of short poems and selected prose in Old English.
5 units, Aut (Damon)

206. Middle English—No prerequisite; 205 suggested.
5 units, given alternate years

208. Post-Classical Latin—(Same as Comparative Literature 208 and Classics 208.) Careful reading of Latin texts of graded difficulty, beginning with the Vulgate Bible, working through various patristic writings and medieval literature to the Latin of the Renaissance. Intended primarily for students not in classics. Prerequisite: two years' high school Latin or equivalent.
5 units, Win (Damon)

5 units, given alternate years

211. Readings in Medieval English Literature.
5 units, Aut (Damon)

212A. Medieval to Renaissance: The Development of Literary Forms—(Same as Comparative Literature 212A.)
5 units, given alternate years

212B. Continuation of 212A—(Same as Comparative Literature 212B.)
5 units, given alternate years

213. Literature of the Sixteenth Century.
5 units, Win (Trimpi)

214. Literature of the Seventeenth Century.
5 units, Spr (Rebholz)

216. Literature of the Nineteenth Century.

216A. Romanticism(s) in the “Romantic” Poets—Study of various attempts to define or corral “R[romanticism]” by friends and foes, and of the actual poetic practice of Wordsworth, Coleridge, Byron, Shelley, and Keats.
5 units, Aut (Ford)

217A. The Bloomsbury Group.
5 units, given alternate years
5 units, given alternate years

226. American Literature of the 1930's.  
5 units, given alternate years

227. Modern Southern Writers.  
5 units, given alternate years

230. Theory of the Novel.—(Enroll in Slavic 300. Same as Comparative Literature 300 and Modern Thought and Literature 300.) Studies of fiction as representation, social institution, and verbal structure. Discussions will relate Western theories (Gombrich, Auerbach, Frye, Barthes, Lukács and others) to selected Russian novels. A seminar for graduate and advanced undergraduate students. Prerequisite: consent of instructor.  
4 units, Spr (Todd)

231. The English Novel through the Eighteenth Century—Study of the most significant novels, with emphasis on development of the form.  
5 units, Aut (Scowcroft)

231A. Eighteenth-Century Fiction and the "Great Confinement."  
5 units, given alternate years

231B. Gothic and Comic: Jane Austen and Others—Prerequisite: English 231 or equivalent.  
5 units, given alternate years

232. The English Novel in the Nineteenth Century—(Same as Modern Thought and Literature 232.) Study of the most significant novels, with emphasis on development of the form.  
5 units, Spr (Polhemus)

233. The Twentieth-Century English Novel—(Same as Modern Thought and Literature 233.)  
5 units, Aut (Stone)

234. American Fiction and Prose.  
234A. Colonial American Prose.  
5 units, Spr (Momaday)

234B. American Romanticism.  
5 units, given alternate years

234C. Romance to Realism.  
5 units, given alternate years

5 units, Win (Dekker)

235. The Impressionist and Experimental Novel.  
5 units, given alternate years

236. Forms of the Modern Novel—(Same as Comparative Literature 236 and Modern Thought and Literature 236.) An advanced course in the interpretation and criticism of novels, but open to any student with a serious interest in the art of fiction. Stendhal, Dickens, Dostoevsky, Conrad, Gide, Faulkner, and one or two living writers.  
5 units, Win (Guerard)

237. Eighteenth Century Prose.  
5 units, given alternate years

238. Culture and Society from Coleridge to T. S. Eliot—(Same as Modern Thought and Literature 238.) A survey of English intellectual prose with some attention to contemporaries on the Continent. Main topics: changing definitions of the function of literature, responses of the literary sensibility to social developments and scientific thought, the fashioning of prose style.  
5 units, given alternate years

239. American Short Fiction — Thematic and formal approaches to novellas and stories by such writers as Hawthorne, Melville, James, Faulkner, Williams, Porter, Tillie Olsen, Richard Wright.  
5 units, Win (Fields)

241. Medieval and Renaissance Drama—(Enroll in Drama 252. Same as Comparative Literature 252.)  
4 units, Win (Prosser)

242. Elizabethan and Jacobean Drama.  
5 units, Win (Riggs)

245. Drama of the Restoration and Eighteenth Century.  
5 units, given alternate years

248. Modern British Drama—(Same as Modern Thought and Literature 240.) Survey of major writers and trends—from Shaw through the present.  
5 units, Win (Friedlander)

250. The English Lyric.  
5 units, given alternate years
   5 units, given alternate years

   253A. Some Eighteenth-Century Poets.
      5 units, given alternate years
   253B. Poetry and Ideas: Johnson to Blake—(Same as Modern Thought and Literature 253B.)
      5 units, Win (Davie)

   254A. Form and Theme in the Modern English Lyric.
      5 units, given alternate years
      5 units, given alternate years
   254C. Victorian and Early Modern Poetry—(Same as Modern Thought and Literature 254C.)
      5 units, Spr (Davie)

255. Twentieth-Century British Poetry — (Same as Modern Thought and Literature 255.) Hardy to Larkin.
      5 units, Aut (Dekker)

256. American Poetry: An Historical Survey
   —Any section of this course may be taken separately and independently without prerequisites, or the sections may be taken as a sequence.
   256A. American Poetry Before 1900.
      5 units, Aut (A. Gelpi)
   256B. American Poetry, 1900–1945 — (Same as Modern Thought and Literature 256B.)
      5 units, Win (A. Gelpi)
   256C. American Poetry, 1945 to the Present.
      5 units, given alternate years

   5 units, given alternate years

258. Twentieth-Century Neo-Romantic British and American Poetry—(Same as Modern Thought and Literature 258.) Extensive readings of a few poets, including Wallace Stevens, Theodore Roethke, Hart Crane, W. H. Auden, Dylan Thomas, Kathleen Raine, and Charles Tomlinson.
   5 units, Win (Middlebrook)

259A. French Symbolist Poets and Some Americans.
   5 units, given alternate years

   5 units, given alternate years

260. The History of Literary Theory — (Same as Comparative Literature 260.)
   5 units, Aut (Trimpi)

261A. Afro-American Fiction — (Same as Modern Thought and Literature 261A.) A survey of the principal works of black novelists and short story writers in America, especially those of the twentieth century.
   5 units, Spr (Rampersad)

261B. Afro-American Poetry — (Same as Modern Thought and Literature 261B.) A chronological survey of poetic expression in black America, with emphasis on the work of Paul Laurence Dunbar, Langston Hughes, Gwendolyn Brooks, and LeRoi Jones (Imamu Amiri Baraka).
   5 units, Aut (Rampersad)

262. Nietzsche and the Literary Imagination.
   5 units, given alternate years

263. The Existential Hero in Modern Literature.
   5 units, given alternate years

   5 units, given 1976–77 (Bender)

265. Literature of the American West, 1850 to the Present—(Same as Modern Thought and Literature 265.)
   5 units, Spr (Momaday)

266. Colloquium on the Apocalypse in Medieval Art and Literature—(Same as Art 206A and Medieval Studies 183.)
   4–5 units, Spr (Brown, Lewis)

267. Russian Formalist and American “New” Criticism — (Enroll in Slavic Languages and Literature 230. Same as Comparative Literature 230 and Modern Thought and Literature 267.) Readings in the works of Russian Formalists and certain American “New Critics.” A knowledge of
French, German or Russian is highly desirable.

4 units, Aut (E. J. Brown)

269A. Toward an Understanding of Romanticism.

5 units, given alternate years

269B. Toward an Understanding of Modernism.

5 units, given alternate years

270A. Beowulf—Reading and critical analysis of Beowulf, with some attention to other heroic poetry in Old English. Prerequisite: 205 or equivalent.

5 units, Win (Allen)

270B. Germanic Heroic Poetry—(Enroll in German Studies 271A.)

3-5 units, Aut (Andersson)

271. Chaucer.

5 units, given alternate years


5 units, given alternate years

273. Advanced Study of Shakespeare.

5 units, given alternate years


5 units, given alternate years

276. Milton.

5 units, Aut (Evans)

277. Dryden and Pope.

5 units, Aut (Loftis)

278. Johnson and His Circle.

5 units, given alternate years

279. Blake—(Same as Modern Thought and Literature 279.) A study of the poetry, prose, and visual arts of William Blake.

5 units, Win (Mellor)

280A. Wordsworth and Coleridge.

5 units, given alternate years

280B. Byron, Shelley, and Keats.

5 units, Spr (Ford)

281. Dickens and Trollope.

5 units, Win (Polhemus)

283. Pater and the Pre-Raphaelites.

5 units, given alternate years

284A. Emerson and Thoreau.

5 units, given alternate years

284B. Emerson, Whitman, and Emily Dickinson.

5 units, given alternate years

285B. Twain and James.

5 units, Spr (Moser)

285C. Edgar Allan Poe.

5 units, given alternate years

287. Conrad and Faulkner.

5 units, given alternate years

288A. Joyce — (Same as Modern Thought and Literature 288A.) Joyce's essential work up to Finnegans Wake.

5 units, Win (W. Chace)

288B. Virginia Woolf.

5 units, given alternate years

288C. Forster and Lawrence.

5 units, given alternate years

288D. W. B. Yeats.

5 units, given alternate years

290. Fiction Writing — Preference given to senior Creative Writing majors. Samples of writing should be submitted not later than registration day. Prerequisite: consent of instructor.

5 units, Win (Scowcroft)

291. Workshop in Creation and Criticism.

3 to 5 units, given alternate years

293. Workshop in Verse Translation.

5 units, given alternate years

Curriculum and Instruction in Secondary School English I—See Education 262.

COURSES NUMBERED 300 THROUGH 399 ARE GRADUATE SEMINARS AND WORKSHOPS; OPEN TO UNDERGRADUATES ONLY WITH PERMISSION

Note—Some of these courses are relatively broad in scope; some focus on a single theme or genre. Students should consult the instructor before registering for any course in this category.
301. Seminar: Language and Literature.
   5 units, given alternate years
310. Seminar: Problems in Old English Literature—Prerequisite: 205 or equivalent.
   5 units, given alternate years
311. Seminar: Methods and Materials for the Study of Medieval Literature.
   5 units, given alternate years
312. Seminar: Middle English Literature—Prerequisite: 206 or equivalent.
   5 units, given alternate years
314. Literary Problems of the Renaissance—Prerequisite: 113 or 213 or 214, or equivalent.
   5 units, given alternate years
   314B. Seminar: English Literature in the 1590’s.
   5 units, given alternate years
315. Literary Problems of the Restoration and Eighteenth Century—Prerequisite: 115 or equivalent.
   315A. Seminar: Eighteenth Century Fiction.
   5 units, given alternate years
   315C. Seminar: Johnson and His Circle.
   5 units, given alternate years
   315D. Seminar: Neoclassical Drama.
   5 units, given alternate years
   315E. Seminar: Lyric Poetry of the Eighteenth Century.
   5 units, given alternate years
   315F. Seminar: The Enlightenment and Its Literary Traditions.
   5 units, given alternate years
   315G. Seminar: Eighteenth-Century Literature of Travel — (Same as Modern Thought and Literature 315G.) Fictional and non-fictional travel literature by such writers as Swift, Johnson, Sterne, and Smollett.
   5 units, Spr (Fifer)
316. Literary Problems of the Romantic Period—Prerequisite: 117 or 213, or equivalent treatment of Romantic period.
   316A. Seminar: Romanticism and Romanticisms.
   5 units, given alternate years
   316B. Seminar: Nineteenth Century Poetry.
   5 units, given alternate years
   316C. Seminar: Romantic Irony—(Same as Comparative Literature 316C and Modern Thought and Literature 316C.)
   5 units, Aut (Mellor)
317. Seminar: Approaches to Research in English and American Literature Since 1700—(Same as Modern Thought and Literature 317.) A course for second-year graduate students on standard research methods and the presentation of research findings.
   5 units, Aut (Dekker)
326. Seminar: American Literature of the 1930’s—(Same as Modern Thought and Literature 326.) An examination of writers in a political context and of later writers who took their bearings from them: e.g. Dos Passos, Steinbeck, Lionel Trilling, Edmund Wilson, Mary McCarthy, E. L. Doctorow.
   5 units, Aut (W. Chace)
359. **Seminar: Rediscovered Poets: 1900-1940.**
5 units, given alternate years

360A. **Seminar: History of Literary Theory: Ancient**—(Same as Comparative Literature 360A.)
5 units, Aut (Trimpi)

360B. **Seminar: History of Literary Theory: Medieval/Renaissance**—(Same as Comparative Literature 360B.) Prerequisite: 360A.
5 units, Win (Trimpi)

360C. **Seminar: Neoclassicism: Origins and Later Developments.**
5 units, given alternate years

361. **Seminar: The Modern Tradition**—(Same as Comparative Literature 361 and Modern Thought and Literature 361.)
5 units, Spr (Staff)

362A. **Seminar: Literature and Psychology**—(Same as Comparative Literature 362A and Modern Thought and Literature 362A.)
Studies in the dynamics of literary creation, with special attention to conscious and unconscious psychological constructs in Dickens and Dostoevsky.
5 units, Spr (Guerard)

362B. **Seminar: Death in Literature and Psychology.**
5 units, given alternate years

364. **Topics in British Literature.**
364A. **Seminar: Capitalism and Literature in the Nineteenth Century.**
5 units, given alternate years

365. **Topics in American Literature.**
365A. **Seminar: The Landscape in American Literature.**
5 units, given alternate years

365B. **Seminar: American Historical Romance.**
5 units, given alternate years

368. **Topics in Criticism.**
368A. **Seminar: American Critics.**
5 units, given alternate years

369. **Seminar: Major Modern Critics**—(Same as Comparative Literature 369, Drama 302, and Modern Thought and Literature 369.)
5 units, Aut (Lyons)

371. **Seminar: Chaucer.**
5 units, given alternate years

373. **Seminar: Shakespeare**—Prerequisites: the equivalent of 73, or 173A or B or C, or 213; and 242.
5 units, Spr (Riggs)

376. **Seminar: Milton.**
5 units, Spr (Evans)

385. **American Authors of the Nineteenth and Twentieth Centuries.**
385A. **Seminar: Whitman and Dickinson.**
5 units, Win (A. Gelpi)

385B. **Seminar: Wallace Stevens.**
5 units, given alternate years

385C. **Seminar: William Carlos Williams.**

388. **British Authors of the Nineteenth and Twentieth Centuries.**
388A. **Seminar: James, Conrad, and Ford**—(Same as Modern Thought and Literature 388A.)
5 units, Win (Moser)

388B. **Seminar: Virginia Woolf and Her Circle.**
5 units, given alternate years

388C. **Seminar: James Joyce.**
5 units, given alternate years

390. **Advanced Fiction Writing**—A workshop group open by permission to graduates and exceptionally advanced seniors. All applicants should leave samples of their writing with the Creative Writing secretary at least ten days before the beginning of each quarter.
31 to 5 units, Aut (Scoivcroft)
Win (L’Heureux)
Spr (Guerard)

391. **Advanced Work in Writing and Criticism.**
Any quarter, by arrangement

392. **The Writing of Poetry**—Primarily for students seriously interested in the composi-
tions of poetry. May be repeated for credit.
Prerequisite: consent of instructor.

3 to 5 units, Aut (Fields)
Win (Davie)
Spr (Fields)

393. Workshop in Verse Translation.
5 units, given alternate years

395. Ad Hoc Graduate Seminars—In any quarter, a group of graduate students (at least three but preferably more) who wish in the following quarter to study a subject or an area not covered by regular courses and seminars may plan an informal seminar and approach a suitable member of the Department to supervise it, either on a graded or pass/no credit basis.

396. Introduction to Teaching Freshman English—A short seminar for first-year graduate students and other prospective teachers of Freshman English. Students will talk with experienced teachers, look at video tapes of classes, read freshman papers, and plan their own courses for the following year. At the end they will write their own descriptions for Approaching Stanford and help with editing. Students will be asked to visit classes in progress and, whenever possible, to do practice teaching.
2 units, Win (Director of Freshman English and Teaching Administrator)

397A. Seminar in the Teaching of Composition—A seminar, with meetings before fall quarter classes begin and weekly two-hour sessions thereafter. Beginning teachers will be joined by experienced teachers attending informally. Discussion of writing assignments, marking and grading of essays, coordination of reading and writing in the course, the conduct of conferences, and other subjects. Video tapes of classes in progress will be shown. Open for credit to graduate students teaching Freshman English for the first time.
5 units (2 to 4 by special arrangement),
Aut (Director of Freshman English and Teaching Administrator)

397B. Teacher's Workshop—Continuation of 397A. Discussion and evaluation of teaching methods, with particular emphasis on certain theoretical approaches. Some meetings held jointly with 396 in the winter. The teachers taking this course will assume a tutorial relationship with the students in 396.

5 units (2 to 4 by special arrangement),
Win, Spr (Director of Freshman English and Teaching Administrator)

398. Research Course—Student pursues a special subject of investigation under supervision of some member of Department. Thesis work not to be registered under this course.
Any quarter, by arrangement

399. Thesis.
Any quarter, by arrangement

**FRENCH AND ITALIAN**

Emeriti: Roberto B. Sangiorgi (Professor);
Jessie E. Smith (Assistant Professor)
Chairman: Alphonse Juilland

**FRENCH DIVISION**


Associate Professors: Marc Bertrand, Ralph M. Hester

Acting Assistant Professor: David Brostoff
Adjunct Professor: John G. Barson


**ITALIAN DIVISION**

Assistant Professor: Michael Leone

Lecturers: Leda S. Mussio, Annamaria Napolitano, Emily Olmsted

The Department accepts candidates for the degrees of Bachelor of Arts in French and in Italian, Master of Arts and Doctor of Philosophy in French.

**PROGRAMS OF STUDY**

**FRENCH**

**BACHELOR OF ARTS IN FRENCH**

Candidates should normally have completed the series of first- and second-year courses through French 24 or its equivalent. Regular placement tests enable students who have begun their study of French elsewhere to be granted advanced standing.
Candidates are expected to take at least three advanced language courses (123, 124, 125), the introductory series to French literature (130, 131, 132) and three advanced courses (numbered above 132) in different periods of literature. Students may then select one of the following areas of specialization to complete their A.B. in French.

**Specialization in Literature**

Majors concentrating in literature must take in addition a minimum of four Literature or Civilization electives numbered above 132. Students who intend to pursue graduate studies are urged to take courses in all periods of French literature. They should note that most graduate schools require proficiency in at least one additional modern language.

**Specialization in Language**

Majors primarily interested in language and culture must take in addition four of the following courses:

- Séminaire sur des problèmes contemporains
- Phonétique et Orthoépie
- Histoire de la langue française depuis le Moyen Âge
- Civilization I—Du siècle de Louis XIV à la Révolution
- Civilization II—de la Révolution à l'époque contemporaine

**Bachelor of Arts in French Studies**

The aim of this program is to allow students to plan a more broadly based major, combining the study of French language, culture and literature with such fields as History of Art, Musicology, Political Science, History, Economics, Anthropology and other literatures. Candidates should formulate their plans early in consultation with the Department of French.

**Honors Program in French**

In addition to the basic undergraduate program, qualified French majors in their junior year may apply for admission to an Honors Program in French. A "B" average in French courses is required; other prerequisites include having completed at least two courses of the language-composition series, French 123, 124, 125, and two of the literature series, French 130, 131, 132. Juniors may apply while still taking the second course of these two series. Ideally, then, the Honors program could be established by spring quarter of the junior year. The student's application must include a proposal and general outline of a senior essay, which will be accredited between 9 and 12 academic units, at the student's option; it may be either in English or French, depending upon the student's preference and his adviser's recommendation. Honors program students also fulfill all regular requirements for the A.B. in French. A faculty-student committee will consider all applications for admission to the program.

**Exchange with the Ecole Normale Supérieure**

The department has an annual exchange with the Ecole Normale Supérieure. Every year one of the French doctoral candidates spends the academic year at the Ecole in Paris.

**French Cultural House**

The French Cultural House, located at 610 Mayfield, is a new undergraduate residence which will offer a wide variety of opportunities for students to expand their knowledge, understanding and appreciation of French language and culture. Assignment is made through the regular undergraduate housing draw.

**Combined Majors, Joint Degrees, Minors**

**Combined Major in French and English Literatures (for French Majors)**

In addition to the requirements for the A.B. in French Literature, candidates should complete four English literature courses numbered 100 or above, and related to their French courses. However, two English literature courses can count toward the four electives in French.

**Combined Major in French and Italian Literatures (for French Majors)**

In addition to reading proficiency in Italian, candidates should satisfy requirements similar to those stated in the previous paragraph.

**Honors Program in Humanities**

For majors who wish to supplement their departmental major by a related program of studies. See section “Humanities Special Program.”
COMBINED MAJOR IN ENGLISH AND FRENCH, AND ITALIAN AND FRENCH

English majors and Italian majors interested in a combined degree with French literature should refer to “Combined Majors” in the English and Italian sections.

MINOR IN FRENCH LITERATURE

Candidates should satisfy the following requirements:

1. Reading proficiency in French, i.e., ability to read in one quarter 5 to 8 major works of French literature.

2. Four French literature courses distributed over two centuries or two genres, two of which must be in the original. For this purpose the Department offers a number of advanced undergraduate courses with readings in French and discussion in English.

TEACHING CREDENTIALS

For information concerning the requirements for teaching credentials, consult the “School of Education” section of this bulletin and the Credential Secretary, School of Education.

DEPARTMENTAL PROGRAM AT THE UNIVERSITY OF PARIS

Each year, French majors in their sophomore or junior year, graduate students, as well as other students with an adequate command of the French language, may apply for the Departmental program at the University of Paris during the following autumn and winter quarters. If desired, studies may be continued during spring quarter. Students live in residence halls or with private families and attend courses at the University of Paris. A faculty supervisor accompanies the group and offers a supplementary program of studies. Applications must be received by April 15. Forms and information may be obtained from the Overseas Studies office.

INTENSIVE AND ACCELERATED LANGUAGE WORK AT STANFORD IN FRANCE

(Open to All Students)

Students attending Stanford in France, in Tours, have the opportunity to take courses in French language, literature, conversation, and civilization. All students will be required to take a language course for the first quarter, and possibly the second quarter of the session overseas. All courses in language bear the designation French 70, 80 or 90. Assignment to a particular level is made by the Director and language faculty at the campus.

ITALIAN

BACHELOR OF ARTS IN ITALIAN

This major is oriented toward Italian Studies and offers students an opportunity to bring together in a unifying program a broad cross-section of disciplines other than language and literature having their common denominator in Italian culture and civilization. To allow maximum flexibility, pertinent courses taken in other fields, such as Classics, Humanities, Comparative Literature, History, Philosophy, Architecture, Romance Literatures, English, German, Anthropology, Social Sciences, Political Science, Drama, Art, and Music, will count toward satisfying the major requirement.

Upon completion of the Italian first- and second-year language courses, Italian 1, 2, 3, 51 and 52 (or the equivalent courses taken at the Florence center), students wishing to concentrate in Italian Studies may, under the guidance of a departmental adviser, select a course of study best suited to their individual needs and cultural interests. It should be noted that Italian 2A may be taken concurrently with Italian 2.

At least 45 additional units of courses are required, including:

a) 32 units of Italian courses beyond the 52 level.

b) Up to 15 units of courses outside the department, but in related fields.

In this perspective, the program at the Florence campus will offer students a selection of courses acceptable toward the fulfillment of the degree in Italian Studies. Further alternatives may be provided at the Florence center through directed work (in Italian and/or in the above mentioned disciplines) arranged by the students with their advisers. Although attendance at the Florence center is particularly advisable, valid alternative programs will be accepted.

Courses in Italian literature taken at Stanford in Italy will count, with the approval of the Italian division, toward the fulfillment of the requirements for combined majors.
Students are encouraged to structure their program individually in consultation with a departmental adviser.

**Combined Major in Italian and English Literatures (for Italian Majors)**

In addition to the 32 units (beyond the 52 level) required for the A.B. in Italian, candidates should complete four English literature courses numbered 100 and above and related to their field of concentration in Italian literature.

**Combined Major in Italian and French Literatures (for Italian Majors)**

In addition to the 32 units (beyond the 52 level) required for the A.B. in Italian, candidates should complete four courses in French literature related to their field of concentration in Italian literature. Reading proficiency in French is required.

**Honors Program in Humanities**

This program is offered for majors who wish to supplement their departmental major by a related, carefully guided program of studies. See section "Humanities Special Program."

**Combined Major in English and Italian Literatures, and French and Italian Literatures**

English and French majors who wish a combined degree in Italian literature should refer to "Combined Majors" in the English and French sections.

**Intensive and Accelerated Work at Stanford in Italy (Open to All Students)**

Students attending Stanford in Italy, in Florence, have the opportunity to take courses in Italian language, literature, conversation, and civilization. All students will be required to take a language course for the first quarter, and possibly the second quarter of the session overseas. All courses in language bear the designation Italian 70, 80, or 90. Assignment to a particular level is made by the Director and language faculty at the campus.

**Advanced Degrees in French**

Applicants should read carefully the general regulations governing advanced degrees (see the section entitled "Degrees" in this Bulletin). They should have preparation equivalent to an undergraduate major in French with a minimum average grade of "B" and should also have reached a high level of speaking proficiency, to be demonstrated either in a personal interview or by a tape recording sent to the Department. Previous study of a language other than French is highly desirable.

In addition to the Ph.D., the Department offers two different kinds of Master's programs and participates with the School of Education in its Master of Arts in Teaching program.

**Master of Arts in Teaching**

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and wish further to strengthen their academic preparation. The program consists of a minimum of 25 units of French courses selected in consultation with the M.A.T. departmental adviser, and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

**Master of Arts in French (Terminal Program)**

The Master of Arts provides a combination of language, literature, civilization and methodology courses designed to prepare secondary school, junior college, or college teachers.

Candidates must complete a minimum of 36 units of graduate work, with a "B" average, and pass a final examination. To fulfill the requirements in one year, they should enroll for an average of 12 units per quarter.

Candidates for this degree are not eligible for financial aid.

The basic course program, intended for those who plan to teach French (modifications are possible for those who do not), is as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 210</td>
<td>Problèmes de l'expression écrite</td>
<td>4</td>
</tr>
<tr>
<td>French 211</td>
<td>Phonétique et orthographe</td>
<td>4</td>
</tr>
<tr>
<td>French 212</td>
<td>Histoire de la langue française depuis le Moyen Age</td>
<td>4</td>
</tr>
<tr>
<td>French 289</td>
<td>Methodology</td>
<td>4</td>
</tr>
<tr>
<td>French 292</td>
<td>Du Classicisme à l'Age des Lumières</td>
<td>4</td>
</tr>
<tr>
<td>French 293</td>
<td>Du Romantisme à nos jours</td>
<td>4</td>
</tr>
<tr>
<td>One course from the Civilization series</td>
<td></td>
<td></td>
</tr>
<tr>
<td>French 290</td>
<td>Du Siècle de Louis XIV à la Révolution</td>
<td>4</td>
</tr>
</tbody>
</table>

or
French 291. De la Révolution à l'époque contemporaine
Two electives from courses numbered above 200  8
Total ...................................................... 36

Candidates are advised to develop teaching skills by participating in supervised teaching of language courses. Practice teaching will be conducted in conjunction with the Methodology course. Candidates will, on occasion, assist in the teaching of languages.

MASTER OF ARTS IN FRENCH (Ph.D. Program)

The Master of Arts in French is required from all Ph.D. candidates. All doctoral candidates must apply for A.M. candidacy upon arrival. Upon successful completion of a minimum of 36 graduate units and of the first Ph.D. qualifying examination, all candidates will receive an A.M.

DOCTOR OF PHILOSOPHY IN FRENCH

Normally the Ph.D. program should be completed in four years. The first and second years should be devoted to full-time study; the third and fourth years to study, teaching and dissertation work.

The Ph.D. graduate in French Literature is expected to have attained a reasonable mastery of the literature and the language. Students will emphasize some areas or centuries rather than others, but knowledge of the whole field should be well advanced at the time of graduation. A primary goal of the Program is excellence in the art of writing scholarly articles and books. The Department also emphasizes competence in the teaching of language and literature.

All candidates, regardless of their field of specialization, are expected to fulfill the following general requirements:

1. Course requirements. A total of no fewer than 72 units of graduate work. A minimum of 36 graduate units (9 courses) during the first year of graduate study and a minimum of two courses or seminars per quarter for at least four of the six quarters following the first year (for a total of no less than 36 additional units). Additional units of graduate courses, seminars or individual work in the candidate's major or minor field are strongly recommended and will be determined according to the adviser's (or advisory committee's) judgment and the candidate's needs.

French 210 “Problèmes de l'expression écrite” and one philology course are to be among the 72 required units.

All candidates, regardless of their area of specialization, must take in the Department at least ten literature courses exclusive of directed reading, covering four centuries. (For the purpose of this requirement the Middle Ages count as a century). In addition each candidate must take at least four seminars or colloquia, two of which are to be outside his or her special field of interest.

2. Examinations. Preliminary written examinations are in two parts: the first, on a broad literary period, is to be taken in January of the second year of study; the second, on a broad literary genre, in October of the third year. Success in these examinations qualifies a student for the University oral examination, which requires comment on a text in the student's area of specialization and a defense of the dissertation project.

3. Dissertation. The doctoral dissertation should demonstrate ability to carry out research, organize and present the results in publishable form. The scope of the dissertation should be such that it could be completed in one to one-and-one-half years of full-time work. However, the Department will encourage, in appropriate cases, projects requiring more time for completion.

Various kinds of dissertations are acceptable to the Department; for example, a historical study of a particular phenomenon, the discussion of one or more representative works of a genre, a comparative study, etc.

4. Teaching experience. The Department expects Ph.D. candidates to demonstrate proficiency by teaching three language courses during his or her third year of study. The Department encourages students to participate in the teaching of literature whenever possible, usually by assisting a professor in conducting an undergraduate literature course.

5. There is no formal language requirement other than French and English. In areas of specialization in which additional languages are essential, students are expected to acquire the necessary knowledge before beginning work on the dissertation.
JOINT DEGREES AND MINORS

A candidate may also take a joint degree in French and Humanities (for a description of this program, see the section “Humanities Special Programs”). Minors are possible in Medieval Studies, in Linguistics, in Comparative Literature, in Modern Thought, and in departments offering related courses such as History, History of Art, Music, Philosophy, Social Thought, etc.

Students interested in a joint degree or a minor should plan their course of study with their adviser(s). Joint degrees and minors usually require 24 additional units. By carefully planning their programs, students may complete their course work for the Ph.D. and the minor in a total of nine quarters.

GRADUATE MINOR IN FRENCH LITERATURE

The Department offers a minor in French Literature to students from other departments.

The requirements for a graduate minor in French Literature are:
1. A sound reading knowledge of French.
2. A minimum of 24 units of course work (six courses) covering at least two centuries or two genres (poetry, fiction, theater, or other prose) or a combination of both.

COURSES OPEN TO ALL STUDENTS

The courses in this section do not require a knowledge of any language other than English.

GENERAL COURSES

FRENCH

104. Contemporary French Novelists—Significant authors of contemporary France: Proust, Gide, Malraux, Sartre, Camus, etc. Lectures, readings in English.
4 units, Aut (Cohn) TTh 1:15

105. The Writings of Albert Camus.
4 units, Spr (Cohn) TTh 1:15

107. Sartre: Literature and Politics—Study of Sartre's view of the purpose and function of literature in the context of his philosophical and political thought, and also his own imaginative writing. (Reading and discussion in English.)
4 units, Win (Giraud) TTh 2:15–4:05

115. Introduction to Existentialism—Existentialism as a philosophical system (theory of knowledge, theory of being, theory of value) with reference to other philosophical systems; French Existentialism as reflected in the writings of Sartre, Camus, Céline, and Malraux. Readings in French, discussion in English.
4 units, Aut (Juilland) MW 11

FRENCH COURSES

FIRST- AND SECOND-YEAR

(Under the direction of John G. Barson)

Note—Students registering for the first time in a first- or second-year course must take a placement test, if they have had any training in French before entering Stanford. Tests will be given September 25, 29, October 1 and 6 (for autumn quarter); November 17, January 5 and 7 (for winter quarter); February 24, March 29 and 30 (for spring quarter); May 18 (for summer and autumn quarters). The placement test is not given in the summer.

1. Initiation au français—I — Basic French through a rationalist direct method. Systematic acquisition of vocabulary and grammar in the immediate reality of the classroom. Only French is used by both instructor and students. Multiple approach: listening-comprehension, oral expression, original oral and written composition.
5 units, Aut, Win, Spr (Staff) MThWThF

5 units, Aut, Win, Spr (Staff) MThWThF

2S. Le français sans complexes—(Supplément du Français 2.) Cours de conversation au niveau linguistique du Français 2. Prerequisite: 1 or equivalent.
2 units, Aut, Win, Spr (Staff)

5 units, Aut, Win, Spr (Staff) MThWThF

3S. Coup d’œil sur la France—(Supplément du Français 3.) Cours de conversation. Les étudiants utilisent leurs connaissances en
les appliquant à l’étude de la culture et de la vie françaises: actualités, théâtre, cinéma, voyages, agences, etc. Renseignements utiles pour les étudiants qui partent pour le Campus de Tours ou qui projettent un voyage en France. Prerequisite: 2 or equivalent.

2 units, Aut, Win, Spr (Staff)

5. Initiation au français—I, II ou I, II, III—(an intensive first-year French course in which either 2 or 3 quarters of French may be covered). For 9 units, French 5 will cover French 1 and French 2. For 3 extra units, motivated, high-aptitude students may opt to cover French 3 in a special section. Students are introduced to the essentials of first-year grammar and vocabulary with stress placed on simultaneous acquisition of listening, speaking, writing and reading skills. Classes are conducted entirely in French, with oral presentation immediately reinforced in small group conversation sections. Written exercises, compositions, as well as daily work in the Language Laboratory are also an integral part of the course. (No auditors permitted.)

9-12 units, Sum (Staff) MTWThF

10. Reading French—An accelerated course designed specifically for the acquisition of reading ability. Primarily intended for graduate students seeking to meet the University reading requirement for advanced degrees. Also open to seniors. No auditors permitted.

4 units, Aut (Staff) MTWTh 8
Sum (Staff) MTWThF

20. L’art de la conversation — Le français dans les situations de la vie de tous les jours. Prerequisite: French 3 or equivalent.

2 units, Aut, Win, Spr (Staff)


4 units, Aut, Win, Spr (Staff) MTWTh

23. Le français en action II—Continuation du Français 22. Partant de lectures groupées selon des thèmes de portée universelle, les étudiants discutent les idées et leurs points de vue personnels. Continuation de la grammaire essentielle.

4 units, Aut, Win, Spr (Staff) MTWTh


4 to 5 units, Aut, Win, Spr (Staff) MTWTh

26. Le français en action I et II — Cours accéléré de deuxième année. Révision complète de grammaire essentielle, lectures choisies de genres différents, et discussions. Correspond au Français 22 et 23. For an additional 1-3 units, students may pursue individual interests: either in informal small group discussions of supplementary reading, or by writing an essay on a novel or play. Prerequisite: French 1, 2, 3, or equivalent (one full year of college French).

6 to 9 units, Sum (Staff)

30. Conversation et Culture — La France vue par des écrivains français et étrangers. Présentation et discussion des opinions. Prerequisite: French 23 or equivalent. May be repeated once for credit after an interval of two quarters.

2 units, Aut, Win, Spr (Staff)

32, 33, and 34. Seminars: French Language Through Literature—In the belief that literature is the form of language that provides the adult with the fullest linguistic challenge, incorporating a mature emotional and intellectual apprehension of the world and of ourselves, these seminars, for freshmen and transfer students and limited to 10, will concentrate on literary texts; no formal study of grammar is planned. All other means will be employed to strengthen and deepen the student’s knowledge of French: the use of the language exclusively by teacher and student; the commitment to memory of short texts, translation, and explication de texte (as both an oral and written exercise).

32. The Short Story and the Novel—Selected short stories from Voltaire, Diderot, Balzac, Maupassant and Camus: the conte as a genre. Gide: La Symphonie pastorale. Prerequisite: placement in French 22 and consent of the instructor.

4 units, Aut (Lapp) M 2:15-4:05; T 2:15-3:05

33. The Theatre—Plays by Molière, Racine, Sartre, Camus, Ionesco. Prerequisite: placement in French 23 and consent of the instructor.

4 units, Win (Brostoff)
34. Poetry—Representative French poets from Ronsard to Yves Bonnefoy. Prerequisite: placement in French 24 and consent of the instructor.

4 units, Spr (Hester)

70-80-90. Intensive and Accelerated French—Given only at Stanford in France.

3 or more units, Aut, Win, Spr, Sum (Staff)

THIRD- AND FOURTH-YEAR

Language Courses

(Under the direction of John G. Barson)

120. Séminaire sur des problèmes contemporains—Conversation et discussion sur des problèmes actuels à partir de journaux, revues ou films français. Prerequisite: 30 or 82 through 86 or equivalent. May be repeated once for credit after an interval of two quarters.

3 units, Aut, Win, Spr (Staff) TTh

123. Composition, grammaire et étude de textes—Convergences et divergences de la langue orale et écrite, grammaire descriptive, analyse grammaticale, composition. Prerequisite: 24 or equivalent.

4 units, Aut (Staff) MWF 9

124. Langue, style et écriture — Continuation du Français 123. Le commentaire littéraire, les styles de la critique, composition.

4 units, Win (Weinstein) MWF 9

125. Cours avancé de français — Exercices de style, traduction et explication de texte; enrichissement du vocabulaire. Prerequisites: 123 and 124 or equivalent.

4 units, Spr (Staff)

Literature Courses

For literature courses in English, see also General Courses, page 323.

130. L'Amour, la société et la rébellion — Étude générale de la littérature française du roman courtois du Moyen-Age jusqu'à l'essai philosophique de la Renaissance (Chrétiens de Troyes, Villon, poètes du 16ème siècle, Rabelais, Montaigne). Prerequisite: 24 or equivalent.

4 units, Win (Lapp) given 1976-77

131. La Liberté, la volonté et la passion— Étude générale de la littérature française de la tragédie classique jusqu'au roman érotique du 18e siècle (Corneille, Racine, Molière, Diderot, Rousseau). Prerequisite: 24 or equivalent.

4 units, Win (Hester) TTh 12:50-2:05


4 units, Spr sec. 1 (Bertrand)

4 units, Spr sec. 2 (Weinstein)

Note—Prerequisites for the following courses are normally 130, 131, and 132, or 85 and 86, or equivalent.

140. Platonisme et féminisme: Renaissance et Réforme—Les grands courants littéraires et philosophiques de la Renaissance. Études de Rabelais (Gargantua) et Montaigne (Les Essais).

4 units, Spr (Hester) TTh 12:50-2:05


4 units, Spr (Lapp) given 1976-77


4 units (Lapp) given 1976-77


4 units, Win (Lapp) M 2:15-4:05; T 2:15

152. La Muse comique—Corneille, Le Menteur; Racine, Les Plaideurs; Molière, Le Malade imaginaire, Le Tartuffe, Dom Juan.

4 units (Lapp) given 1976-77


4 units, Aut (Weinstein) TTh 11
180. La Poésie française du Symbolisme au Surréalisme.
4 units (Newman-Gordon) given 1978–79

4 units, Win (Newman-Gordon) given 1978–79

182. Le Roman en France depuis 1898.
4 units (Newman-Gordon) given 1976–77

188. Le Surréalisme —Définition du Surréalisme à travers les Manifestes d’André Breton. Étude de poèmes et de romans surréalistes par A. Breton, Soupault, Eluard, Aragon, J. Gracq.
4 units, Spr (Newman-Gordon) MWF 11

190. Introduction à la poésie française—Analyse et étude de poèmes, thèmes, images, versification, technique descriptive, depuis le 16ème siècle jusqu’à nos jours.
4 units (Lapp) given 1976–77

191. The Idea of Revolution in Modern French Literature—A study of the representation of revolution and attitudes toward it in French texts from the Romantic period to the twentieth century. Most readings in French. Discussion in English.
4 units, Aut (Giraud) TTh 2:15–4:05

199. Individual Work—Open only to majors in French and with special permission of the Department. May be repeated for credit.
1 to 3 units, any quarter (Staff) by arrangement

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

4 units, Aut (Newman-Gordon) Th 2:15; F 2:15–4:00

211. Phonétique et Orthographe —Étude théorique et travaux correctifs: articulation, rythme, intonation. Pédagogie de la graphie traditionnelle et de la graphie phonétique. Prerequisite: 24 or equivalent.
4 units, Win (Juilland)

212. Histoire de la langue française depuis le Moyen Age—Pour chaque siècle: le cadre historique, politique, social et culturel; prononciation et orthographe; grammaire (morphologie et syntaxe); vocabulaire; style; rapports entre langue et littérature; la langue des grands écrivains.
4 units, Spr (Juilland)

213. Old French—Elements of Old French grammar; reading and interpretation of selected Old French texts.
4 units, Aut (Brostoff) W 2:15–5:05

214. Old Provencal—Reading and interpretation of selected medieval texts written in the langue d’oc, with special emphasis on troubadour lyric poetry. Prerequisite: 213 or equivalent.
4 units, Win (Brostoff)

270. Modern Critical Thought: The Symbolist Heritage—(Same as Comparative Literature 270.) The development of the mainstream of modern French (and allied) philosophico-critical thinking; from Baudelaire through Mallarmé, Valéry, Bergson, Proust, Edmund Wilson, Mauron, Blanchot, Richard, Frye, Benjamin and Derrida. Readings in French and English. Discussions in English.
4 to 5 units, Win (Cohn)

285. Voltaire—Stress will be laid on development of Voltaire’s political, social, philosophical and metaphysical thought in the context of contemporary European culture.
4 units, Spr (Giraud) T 2:15–4:05

289. Methodology Course—(Same as Education 293.) Analysis and discussion of classroom practices and related pedagogical material in the context of the rationalist direct method of teaching French language.
4 units, Aut (Hester) Th 10 plus one dhr

CIVILISATION FRANÇAISE

Approches: civilisation matérielle et modes de vie; Etat et classes sociales; culture savante et traditions populaires; idéologies et mentalités.

290. Du Siècle de Louis XIV à la Révolution.
4 units (Bertrand) given 1976–77

291. De la Révolution à l’époque contemporaine.
4 units, Spr (Bertrand) TTh 11–12:15

GRADUATE COURSES

292. (A.M. Program. Open to Graduates and advanced Undergraduates) Du Classicisme
à l'Age des Lumières—Lectures et analyse
de textes de Corneille, La Fontaine, Racine;
Rousseau, Diderot, Voltaire, et autres.
4 units, Aut (Lapp) T 10–12

293. (A.M. Program. Open also to advanced Undergraduates) Du Romantisme
à nos jours—Lecture et discussion de textes
de Victor Hugo, Musset, Vigny, Baudelaire,
Rimbaud, Mallarmé, Stendhal, Flaubert,
Balzac, Gide et Proust.
4 units, Win (Newman-Gordon)

311. Studies in Medieval Literature.
4 units, given 1976–77

341. La Poésie de la Renaissance avant la
Pléiade—Les Rhétoriqueurs, Marguerite de
Navarre; les poètes de Lyon: Scève, Louise
Labé, Fontus de Tyard.
4 units (Hester) given 1976–77

342. La Renaissance en France I—Les Pro-
sateurs; Rabelais et Montaigne.
4 units, Spr (Lapp)

350. Graduate Seminars.
Medieval Fiction.
4 units, given 1976–77

Medieval Allegory.
4 units, given 1976–77

Chrétien de Troyes.
4 units, given 1976–77

Rabelais.
4 units (Hester) given 1976–77

Montaigne.
4 units (Lapp) given 1976–77

Racine.
4 units (Lapp) given 1976–77

Zola.
4 units, Win (Lapp)

Mallarmé.
4 units, Aut (Cohn) M 2:15–4:05

351. La Poésie de Malherbe à La Fontaine.
4 units (Lapp) given 1976–77

355. Les Chansons de geste—Prerequisite: 213 or equivalent.
4 units, Spr (Brostoff)

356. L'amour courtois—Prerequisite: 213 or equivalent.
4 units, Win or Spr (Brostoff)

370. Le Romantisme—Poètes et romanciers
romantiques: Chateaubriand, Lamartine,
Hugo, Vigny, Musset, Sand, et autres.
4 units (Weinstein) given 1976–77

373. La Critique littéraire au 19ème siècle
—Sainte-Beuve, Taine, Brunetière.
4 units, Aut (Weinstein) TTh 2:15–4:05

379. La doctrine de l'Art pour l'Art et la
littérature sociale au 19ème siècle.
4 units, Aut (Giraud) W 2:15–4:05

380. La “grande génération”—Proust, Gide,
Péguy, Claudel, Romain Rolland, Valéry.
4 units, Win (Newman-Gordon)
F 2:15–4:05

381. Proust.
4 units, Spr (Cohn) M 2:15–4:05

383. Le Théâtre contemporain—Sartre, Ca-
mus, Beckett, Ionesco, Adamov, Genet and
others.
4 units, Win (Giraud) W 2:15–4:05

388. Apollinaire—Alcools et Calligrammes.
4 units, Spr (Newman-Gordon)
F 2:15–4:05

390. Le Nouveau Roman—Théories et œuv-
res. Alain Robbe-Grillet, Nathalie Sarraute,
Michel Butor, Claude Simon, Robert Pinget,
Le Clézio et autres.
4 units (Bertrand) given 1976–77

398. Tutorials—Initiated by a professor, Tu-
torials are intended for at least three (but
preferably more) graduate students who
wish to study on an informal basis a sub-
ject or an area not covered by regular
courses.
4 units, Aut, Win, Spr, by arrangement

399. Individual Work — Exclusively for
graduate students in French working on
thesis or engaged in special work.
1 to 12 units, any quarter (Staff) by
arrangement

ITALIAN DIVISION COURSES

First- and Second-Year

Language Courses

Note—Students registering for the first time
in a first- or second-year course must take a
placement test if they have had any training
in Italian before entering Stanford.

1. First-Year Italian.
5 units, Aut, Win, Spr (Staff) MTWThF
plus one dhr
2. First-Year Italian—(Continuation of 1.)

5 units, Aut, Win, Spr (Staff) MTWThF
plus one dhr

2A. L'Italia d'Oggi—Introduction to Italian life. Conversation and lectures on various aspects of contemporary Italy (politics, art, cinema, press, customs). Especially designed for students who plan to go to Italy. Prerequisite: Italian 1.

3 units, Win, Spr (Staff) MWF

2. First-Year Italian—(Continuation of 2.) A grammatical and linguistical approach to Italian through contemporary readings (short stories or novels).

5 units, Aut, Win, Spr (Staff) MTWThF

5. Intensive Italian for Beginners—Equivalent to 1 and 2. Offers preparation in speaking, writing, and reading the language.

10 units, Sum (Staff) MTWThF

30. Italian Conversation—This course is geared to students returning from Florence. For those students who did not go to Florence, minimum prerequisite is Italian 3.

2 units, Aut, Win, Spr (Staff)

51. Second-Year Italian—Linguistic and literary introduction to contemporary Italian authors and review of essential linguistic and grammatical points. Prerequisite: 3 or equivalent.

3 units, Aut (Olmsted) MWF 11

52. Second-Year Italian—Logical progression of Italian 51 with more emphasis on written work. Prerequisite: 51 or consent of instructor.

3 units, Win (Napolitano) MWF 11

53. Second-Year Italian—Sequential progression of 51 and 52 with the addition of journalistic material and more emphasis on the spoken language. Prerequisite: 52 or consent of instructor.

3 units, Spr (Mussio) MWF 11

Note: Italian 51, 52, 53 are offered for 3 units. May be taken for 4 units by arrangement with instructor.

70–80–90. Intensive and Accelerated Italian—Given only at Stanford in Italy.

3 units or more, Aut, Win, Spr, Sum (Staff)

Courses taken at the Florence campus will be evaluated according to their relationship with students’ specific areas of concentration. Units earned through Italian colloquia (4 units per colloquium) will be evaluated by the departmental Italian adviser.

Literature Courses

130. Survey of Italian Literature and Civilization—From the Middle Ages to the Renaissance. In Italian.

4 units, Aut (Leone) MWF 10


4 units, Win (Leone) MWF


4 units, Aut (Leone) MWF 11

142. Dante, Petrarch and Boccaccio—Study and interpretation of the Canzoniere, the Decameron and of the secondary works of Dante. In English and/or Italian.

4 units, Spr (Leone) MWF

160. The High Renaissance—Study and interpretation of the most significant works of the 16th Century (Machiavelli, Guicciardini, Ariosto, Castiglione, Tasso, etc.). In Italian.

4 units, Spr (Leone) MWF

180. The Modern Italian Novel—Reading and discussion of important 20th century works (Verga, Svevo, Pirandello, Moravia, Pavese, etc.). In Italian.

4 units, Win (Leone) MWF

199. Individual Work—Open to all students with special permission of the Department. May be repeated for credit.

1 to 3 units, any quarter (Staff) by arrangement

GEOGRAPHY

Undergraduate courses in Geography will be offered by the Food Research Institute.

GERMAN STUDIES

Emeriti: Helmut R. Boeninger, Kurt F. Reinhardt, Gertrude L. Schuelke, F. W. Strothmann (Professors)

Chairman: Walter F. W. Lohnes

Adjunct Professor: Gertrude Mahrholz

Assistant Professors: Ann Mason, Orrin W. Robinson III, David Wellbery

Lecturers: Josef Hutschneider, Ulrike Lieder, Kathryn Strachota

Teaching / Research Fellows: Winder McConnell, J ainer Stackhouse

OFFERINGS AND FACILITIES

The Department offers a variety of programs in German language and linguistics, literature, culture, and thought. Courses are open not only to majors but to all interested students.

The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, and Doctor of Philosophy.

By carefully planning their programs, students may fulfill the A.B. requirements for both German Studies and another subject. An extended undergraduate major program in English and German literatures is available, as are co-terminal programs for the A.B. and A.M. degrees in German Studies, and joint programs for the Ph.D. degree with Graduate Humanities, Comparative Literature, Modern Thought and Literature, and Linguistics. The Department also maintains a separate program in Translation and Interpretation.

Special collections and facilities at Stanford offer possibilities for extensive research in German studies and related fields pertaining to Central Europe. Facilities include the undergraduate and graduate libraries and the Hoover Institution on War, Revolution and Peace. Special collections include the Hildebrand Collection (texts and early editions from the 16th to the 18th century), and the Austriaca Collection (with emphasis on source material of the time of Maria Theresa and Joseph II, the Napoleonic wars, and the Revolution of 1848). The Hoover Institution on War, Revolution and Peace has a unique collection of historical and political documents pertaining to Germany and Central Europe from 1870 to the present. The Department also has its own reference library. Extensive use is made of the Language Laboratory in the Undergraduate Library as well as of the Department's own audio-visual equipment, films, tapes, slides.

PROGRAMS OF STUDY

BACHELOR OF ARTS

After completion of the courses offered for first- and second-year students, majors in German normally select at least two German courses per quarter with the help of their adviser. The total requirement for the Bachelor of Arts degree in German is a minimum of 50 units of work beyond the basic courses (1 through 51 or equivalent), except in the area of German Studies, as described below.

Students have the opportunity to select any one of four areas of concentration, without, however, limiting their courses exclusively to that area.

1. German Language and Linguistics

Students choosing this area of concentration must take 203 (History of the German Language), 211 (Syntax of Modern German), 212 (Linguistics and the Analysis of German) and one linguistics colloquium (usually 219). Further coursework may fall into any one of the following fields or a combination of them: (a) Contrastive linguistics and language pedagogy (teaching methods, curricular problems, error analysis). (b) Historical German and Germanic linguistics (Old High German, Middle High German, Old Saxon, Old Norse, etc.). (c) Theoretical linguistics and the analysis of modern German (phonology, syntax, dialectology, etc.). Appropriate courses in the English and Linguistics Departments may also be taken.

2. German Literature

Students concentrating in German Literature must take 150 and the complete 160 series, in sequence if possible (or equivalent). Additional courses may be selected from the 150 series, which focuses on various genres, or from the 170 series, which provides possibilities for studying specific developments and topics of German literature and culture in depth. In addition, students are encouraged to take a seminar in literature on the 200 level.

3. German Thought

Students who are concentrating in German Thought must take the Geistesgesch-
liche series (241–243) and a seminar in the 200 group. Generally, 150 should be taken. Students may want to organize their elective courses around certain themes or sets of problems according to their own interests and choose from among the offerings of German, English, French, Philosophy, History, and other appropriate disciplines.

4. German Studies

The aim of this program, which permits maximum flexibility, is to allow students to plan a more broadly based major than is possible in the other areas of concentration. The student can combine the study of German language and literature with such fields as Art History, Musicology, Political Science, History, Economics, Anthropology, Comparative Literature, etc. The requirements are (a) at least 30 units of German courses beyond the 51-level, (b) at least 25 units of courses outside the Department, but in the Central European field, to be planned and presented to the Department by the student. Every student will normally participate in at least one Stanford Overseas Program.

Majors in German Studies formulate their plans in quarterly consultation with an undergraduate major adviser.

Honors in German

Majors with a minimum grade average of “B+” in German courses are eligible for departmental honors. In addition to requirements listed above, each honors candidate will submit an essay representing six to nine units of academic work. This essay will be on a topic chosen in consultation with a faculty member of the Department.

Extended Major in English and German Literatures

Students may enter this program with the consent of the chairmen of both departments. See description under English in this bulletin.

Co-Terminal Programs

Students may elect to combine programs for the A.B. and A.M. degrees in German Studies. For details, see statement on Degrees in this bulletin.

Overseas Studies

Detailed information on the centers in the Rems Valley, in Berlin, and in Vienna is given in the bulletin, Overseas Studies 1974–76. These programs cover a great variety of courses in language, literature, culture, and other fields of Central European Studies. Most credits earned at these centers can be applied to the undergraduate major in German Studies.

Stanford Bonn Program

The Department maintains a two-quarter program, Autumn and Winter, in Bonn, Germany, for the benefit of advanced students majoring in German or in such programs as German History, Humanities, Art History, Musicology, etc. To participate, applicants must demonstrate proficiency in German. Students can complete specific course requirements as well as a number of electives, chosen from courses offered by the University of Bonn. A.M. and Ph.D. candidates may take part in the program.

Certificates in Translation and Interpretation

Study leading to the award of a certificate in translation or interpretation may be combined with degree programs (A.B. or A.M.) in any department. The program provides students with an ancillary skill in the practice of their professions. The requirements for the Certificate in General Translation (A.B. level) may be met by completing all translating courses through the 200T series. Each student will participate in at least one Stanford Overseas Program. In the final year, the student will produce an original translation of a literary or documentary work.

The requirements for the Certificate in Advanced Translation or Interpretation (A.M. level) include the above as well as the 300T series.

Master of Arts

This program is designed for those students who do not intend to continue their studies through the Ph.D. degree. Students desiring the A.M. degree must complete a minimum of 36 units of graduate work. If students enroll for three quarters for a minimum of 12 units per quarter, they can ful-
fill the A.M. requirements in one year. The program must include:

201 and 202. Language and Style
300. Proseminar
302. Methods of Teaching German

A minimum of four courses, with at least one course in each of the three areas of concentration: language and linguistics, literature, and thought.

In addition, students must take graduate level courses in German and/or approved courses in related fields such as Linguistics, Comparative Literature, Philosophy, History, or Art History.

Students concentrating in German Studies should choose these related courses in the Central European field, in such departments as Political Science, Economics, Anthropology, or History.

All A.M. candidates must take an individual oral examination toward the end of their last quarter.

MASTER OF ARTS IN TEACHING

The degree of Master of Arts in the Teaching of German is offered jointly by the School of Education and the Department. The program includes 25 units of German in courses selected in consultation with the Department adviser. For a statement of requirements other than German see the section, School of Education, in this bulletin.

DOCTOR OF PHILOSOPHY

The requirements for the Ph.D. are: (1) a minimum of 36 graduate units during the first year of graduate study and a minimum of 9 units per quarter during the six quarters following the first year; (2) a reading knowledge of one language other than English and German, and (3) the writing of a dissertation. Students in medieval studies must also have a reading knowledge of Latin.

The first year of graduate work, which leads to the A.M. degree, is designed to introduce each student to the three major areas of study. It accommodates both those students who complete their studies with the A.M. and those who go on to the Ph.D. An individual oral examination is taken by both groups at the end of the Spring Quarter. Those who continue in the Ph.D. program should devote the summer to writing a qualifying paper, which will be evaluated by the adviser and members of the A.M. examination committee in the following Autumn Quarter. Approval of the qualifying paper constitutes departmental admission to candidacy. Students who do not qualify for the Ph.D. may continue through the second year.

The qualifying paper, although ordinarily not meant to represent an original contribution to scholarship, should demonstrate the candidate's ability to grasp a sufficiently complex subject matter with competence, to organize materials, and to present arguments in a clear and concise manner commensurate with scholarly standards. The necessary research and the writing of the paper should be completed by the beginning of the Autumn Quarter. Procedural details are available from the Department.

All students, regardless of their future field of concentration, are expected to acquire near-native proficiency in German and a thorough knowledge of the grammatical structure of German. The Department expects all Ph.D. candidates to demonstrate teaching proficiency in German; 302 (Methods of Teaching German) is required. All graduate students are also strongly advised to start developing skill in the teaching of literature by participating in the teaching of undergraduate literature courses. Students can earn up to three units of graduate credit for practice teaching in literature.

During the first year, all graduate students planning to continue through the Ph.D. take essentially the same core program, as shown in the following specific suggestions of appropriate work in Language and Linguistics, Literature, or German Thought. This flexibility permits students to change direction at some later stage, as they develop their intellectual identity on the basis of actual experience.

Under any concentration, electives chosen from graduate level courses in German or approved courses in related fields must be added to accumulate the 36 units of study required for the A.M.

Interdisciplinary Programs

The Department participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in German Studies and Humanities. For a description of that program, see the section Humanities Special Programs in this bulletin.

Also, students may work toward a Ph.D. in German Studies with minors in such areas
as Comparative Literature, Modern Thought and Literature, Medieval Studies, Linguistics. Such programs normally require more than a total of nine quarters of coursework.

AREAS OF CONCENTRATION FOR THE PH.D.

1. Language and Linguistics

Students choosing this concentration should take the general survey courses 203 (History of the Language), 311 (Syntax of Modern German), and 312 (Linguistics and the Analysis of German) or their equivalents. In their further studies, students may choose courses in contrastive English-German linguistics, methods of teaching German, historical Germanic dialects and comparative Germanic linguistics, modern German syntax, phonology and dialectology, theoretical synchronic and diachronic linguistics. Students are also encouraged to take related courses in other departments, especially in English and Linguistics.

During the first year, students normally take the following program:

- 201 and 202. Language and Style
- 208. Introductory Middle High German
- 311. Syntax of Modern German
- 203. History of the German Language or 312. Linguistics and the Analysis of German
- 313. The Transformational Grammar of German
- 304. Gothic or 305. Old Norse or 306. Old High German or 307. Old Saxon
- 300. Proseminar

Three courses in German literature and in German thought, with at least one course in each.

2. Literature

Course requirements are a minimum of two courses or seminars per quarter for at least four of the six quarters following the first year. Lecture courses and colloquia will require final examinations but not term papers. Seminars, of which the student is expected to take a minimum of two after the first year, will require research papers. Students are advised to take some electives outside the Department, related to their field of interest.

During the first year, students normally take the following program:

- 201 and 202. Language and Style
- 203. History of the German Language or 311. Syntax of Modern German or 313. The Transformational Grammar of German
- 241. Deutsche Geistesgeschichte I
- 242. Deutsche Geistesgeschichte II
- 243. Deutsche Geistesgeschichte III
- 300. Proseminar

Three courses in German literature, one of which should be from the 351-359 series, and one from the 360, 370, or 380 series. One seminar in German thought (349, 449).

COURSES

OVERVIEW OF COURSES

A. Introductory Courses (1-99)

B. Intermediate Courses (100-199)

Language (100-109)

Culture (130-139)

Literature (150-179)

C. Translation and Interpretation:

Sophomore level (51T-53T)

Junior level (121T-124T)

Senior level (221T-223T)

Graduate level (321T-326T)

D. Courses for Advanced Undergraduates and Graduates:

Language: Skills and older dialects (201-210), Special topics in linguistics (211-219; 311-319)

Culture and Civilization (230-239; 330-339)

Thought and Literary Theory (240-249; 340-349)

Literature: Literature and Culture I-IX (251-259 or 351-359), Major authors (260 or 360), Genres (270 or 370), Major works...
GERMAN STUDIES

(280 or 380), Special topics (290 or 390)
Proseminar (300)

E. Courses for Advanced Graduate Students (400–499)
Seminars and colloquia on special topics; interdepartmental courses

F. Independent Study:
Undergraduates (199)
Graduates (298)
A.M.-level qualifying paper (301)
Dissertation research (400)

GENERAL COURSES
(Given in English)

The courses in this section are given in English and do not require a knowledge of German. They are open to all students. German majors taking these courses as a part of their requirements must do the assigned readings in German.

137A. Nazism and Literature—This course will explore the cultural history of the Weimar Republic and the Nazi era, the origins of Nazi ideology and the effects of Nazi propaganda and thought on the development of literature in the postwar period. Special attention will be paid to the problems of several major writers in exile during the era (e.g., Thomas Mann, Brecht), the predicament of artists who remained in Germany during the Nazi period, dilemmas which postwar writers faced in responding to the Nazi era, and aesthetic problems of the literary portrayal of Nazism. Readings will be selected from works by such authors as Thomas Mann, Brecht, Böll, Grass, Rolf Hochhuth, Jakov Lind, Nelly Sachs, Max Frisch, and others.
3 units, Aut (Mason)

162A. Nietzsche—Reading and discussion of Nietzsche's major works in historical, philosophical, and literary contexts. Nietzsche's influence on later writers and the ways in which his ideas have been politicized and misused will also be considered.
3 units (Mason) given 1977–78

174A. The Modern German Novel—Reading and discussion of works selected from such authors as Thomas Mann, Heinrich Mann, Grass, Böll, Hesse, Frisch, Seghers, Döblin, Musil, and others.
3 units (Mason) given 1976–77

175A. The Fantastic, the Grotesque, and the Uncanny—This course traces forms and themes of the fantastic in literature and art from Romanticism to the present. Works of fantastic literature will be discussed along with selected interpretations by the artists themselves, by critics, and by psychoanalysts (e.g., Freud and Jung). Among the topics and authors to be considered: the uncanny (Ludwig Tieck, E. T. A. Hoffmann); the grotesque, the absurd, and the contradictions of existence (Kleist, Kafka); the imagination of crime (Poe); the pure fantastic (Novalis' cosmological fairy tale, Borges); painting the unconscious (Fuseli to Magritte).
3 units, Win (Wellbery)

231A. Survey of Scandinavian Civilization.
3 units (Andersson) given 1976–77

3 units (Andersson) given 1977–78

233A. Law in East and West Germany—(Same as Law 307.) Analysis of the legal systems of East versus West Germany with special emphasis on the typical ways in which a socialist state differs from a bourgeois state in the use of law as a means of social transformation. We will focus in particular on those areas of law which either directly confront the individual with state authority or require a ranking between state and individual interests.
5 units, Aut (I. Markovits)

281A. Joyce, Proust, Mann.
3 units (Gillespie) given 1976–77

291A. Literature of Decadence.
3 units (Gillespie) given 1977–78

INTRODUCTORY COURSES
(1–99)

First- and second-year language courses are under the direction of Gertrude Mahrholz.
Note—Students registering for the first time in a first- or second-year course must take a placement test if they have studied German before entering Stanford.

FIRST-YEAR COURSES

Students have a choice of several three-quarter sequences:
1R, 2R, 3R. Reading German — These courses are geared to the student who is primarily interested in developing a reading knowledge of German. Optional: one additional unit for the culture lectures of 1, 2, 3 (see below).

3 units, Aut, Win, Spr (Staff)

1C, 2C, 3C. Conversational German—The emphasis in these courses is on the spoken language; they aim to enable the student to understand, and to express himself in, simple spoken German. Optional: one additional unit for the culture lectures of 1, 2, and 3 (see below).

2 units, Aut, Win, Spr (Staff)

1, 2, 3. German Language and Culture — These comprehensive courses provide a balanced introduction to listening and speaking as well as reading and writing. One hour per week is set aside for a series of integrated lectures on German culture. The intensive approach of 1, 2, and 3 provides the best foundation for further study in the language.

5 units, Aut, Win, Spr (Staff)

1P, 2P, 3P. Individually Programmed Beginning German—These courses are particularly suited to students who wish to complete more or less than five units a quarter, or have a spotty background in German, or have scheduling conflicts, or simply prefer to work independently. Students proceed at their own pace, working on their own with the text and tapes. The instructor is available for consultation on a regular basis. Conversation classes and/or culture lectures may be attended for listening and speaking practice and cultural background.

1-15 units, Aut, Win, Spr (Staff)

1D. Beginning Dutch — Introduction to written and spoken Dutch/Flemish (Algemeen Beschaafd Nederlands).

4 units, Aut (Robinson)

5. Intensive First-Year German — Equivalent of 1, 2, and 3 combined. Enrollment limited. Summer Quarter only.

12 units, Sum (Staff) MTWThF 8:00-9:30 and 10:30-12:00

10. Elementary German for Seniors and Graduate Students—This intensive course, which covers the equivalent of 1R, 2R, and 3R, is designed for students who need to acquire reading ability in German for the Ph.D. and/or for advanced research in their own field. No auditors permitted.

4 units, Win (Staff) MTWTh 9 Sum (Staff) MTWTh 9

SECOND-YEAR COURSES

51R. Intermediate Reading — This course builds on skills developed in 3R or 3, with emphasis on non-literary reading materials. Particularly suited for students in fields such as pre-law, pre-business, political science, history, natural science. This is the final course in the introductory reading sequence. Suggested continuation: 130 series.

3 units, Aut, Win, Spr (Staff)

51C. Intermediate Conversation — This course builds on the skills developed in 3C. Students are encouraged to develop fluency in expressing their own thoughts in German. Suggested continuation: 100C.

2 units, Aut, Win, Spr (Staff)

51. Intermediate German, Comprehensive Course—Continues the balanced approach of 1, 2, and 3 and aims at improving mastery of all four skills. This is the final course in the comprehensive introductory sequence. Suggested continuations: 100C, 101, 130 series, 140 series.

5 units, Aut, Win, Spr (Staff)

51T-53T. Reading and Translation — This sequence is open to any second-year student; it is recommended for those who wish to enter the translators program. Prerequisite: 3 or consent of instructor.

51T. Reading and Translation I — Emphasis in this course is on reading comprehension and on practicing written and oral translation. Grammatical problems of German are reviewed. In preparation for interpreting, coursework includes language laboratory sessions to strengthen listening comprehension. Materials to be used include modern German short stories as well as non-literary texts.

5 units, Aut, Win, Spr (Staff)

52T. Reading and Translation II—Continuation of 51T. Emphasis shifts toward written translation of modern German fiction and of non-literary material. Discussion of grammatical problems; rendition of problematic structures in the target language. Survey of translator's
aids—dictionaries, reference works, etc.
5 units, Win (Staff)

53T. Reading and Translation III—Continuation of 52T. Coursework includes written translations, mostly of non-literary materials. Emphasis on listening comprehension, leading to interpretation of simple bilingual dialogue. Introduction to sight-translation.
5 units, Spr (Staff)

70, 80, 90. Intensive German—Given only at Overseas Studies Centers.
Aut, Win, Spr, Sum

INTERMEDIATE COURSES
(100–199)

100C. Advanced Conversation—Listening to original recorded material such as radio programs, plays, and lectures. Discussion and oral presentation of assigned topics. Course may be taken twice for credit. Prerequisite: 51, 51C, 51T, or equivalent.
2 units, Aut, Win, Spr (Staff)

101. Composition I — Prerequisite: 51 or consent of instructor.
3 units, Win (Staff)

102. Composition II—Continuation of 101.
3 units, Spr (Staff)

121T–123T. Translation of Texts in the Social Sciences—This series concentrates on the translation of current non-literary materials, selected from German newspapers, periodicals, government publications, etc. During each of the three quarters, different fields within the social sciences are emphasized. Throughout this sequence, as well as in 221T, occasional sessions are devoted to the interpretation of bilingual conversations and negotiations (Verhandlungsdolmetschen). General aspects of the theory of translation, as well as lexicography, are also discussed.
Students not participating in the Translators Program may enroll in the individual courses if space permits.

121T. Translation of Texts in the Social Sciences—Translation practice of modern non-literary materials. Texts in this course concentrate on the fields of sociology, psychology, and general technology. Prerequisite: 53T or consent of instructor.
3 units, Aut (Lieder)

122T. Translation of Texts in the Social Sciences—Continuation of 121T. Practice texts will primarily be taken from the fields of business, political science, and medicine.
3 units, Win (Lieder)

123T. Translation of Texts in the Social Sciences—Continuation of 122T. Texts will be selected predominantly from the fields of anthropology, law, and economics.
3 units, Spr (Lieder)

130. German Newspapers—Articles of current interest in German newspapers are read and discussed in German. This course may be taken twice for credit. Prerequisite: 51 or equivalent.
3 units, Aut (Staff)
Spr (Staff)

131–133. German Culture and Civilization I–III — These courses survey geography, people, and institutions of the German-speaking areas of Central Europe: the contemporary situation and its origins in history. Topics include: governmental structure in the BRD, the DDR, Austria, and Switzerland; population: stability and migration; the Gastarbeiter problem; social structure of East and West Germany; the educational system; communications systems; urbanization and its consequences since World War II; government and the arts. Extensive use of films, slides, etc.

131. Culture and Civilization I—Prerequisite: 51.
3 units, Win (Staff)

132. Culture and Civilization II — Prerequisite: 51 plus 3 units, or consent of instructor.
3 units, Spr (Staff)

133. Culture and Civilization III—Prerequisite: 51 plus 6 units, or consent of instructor.
3 units, Aut (Staff) given 1976–77

150. Introduction to German Literature—Literary terms and major themes in representative contexts: symbol, metaphor, parody, etc. Discussion of genres: lyric, poetry, novel, drama. Introduction to key concepts of major literary periods such as aesthetic man, romantic irony, the absurd. Consideration of various critical approaches
to literature. Prerequisite: 51 or equivalent.

4 units, Win (Staff)

151–155. Courses in the 150 series introduce the student to German literature in various genres. Prerequisite: 51 or equivalent.

151. Poetry from Goethe to Nietzsche — Interpretations; introduction to critical approaches. The classical and romantic traditions. Goethe, Schiller, Novalis, Eichendorff, Heine, Mörike, Meyer. The political poetry of the Vormärz movement. The German Lied from Schumann to Wolf.

4 units, Aut (Wellbery)

152. Poetry from Nietzsche to the Present — Interpretations of representative poems by modern German poets which exemplify various trends in modern poetry such as Symbolism (George, Rilke), Expressionism (Trakl, Heym, Benn), Dadaism (Arp); consideration of the poem as a political weapon (Brecht, Enzensberger). Evaluation of the development of poetry in East and West Germany since World War II (Celan, Bobrowski, Heissenbüttel, and others).

4 units (Mason) given 1977–78

153. Contemporary Drama — Examples of the theatre of the absurd, the influence of Brecht’s epic theatre in East and West, the documentary drama: Frisch, Dürenmatt, Grass, Hochhuth, Walser, Weiss, Hacks, Strittmatter; the modernist theatre of Peter Handke.

4 units (Mason) given 1976–77

154. Modern Short Prose — Study of short works of fiction by contemporary writers as well as selected essays, commentaries, and letters which document the political and cultural climate of the times. Readings by such writers as Thomas Mann, Brecht, Böll, Grass, Kafka, Peter Weiss, Jakob Lind, and others.

4 units, Win (Mason)

155. The Novelle — Interpretations and theory of the Novelle from Goethe to Heyse. Examples of the Novelle of Romanticism and Realism: Tieck, Brentano, Kleist, Grillparzer, Hofmannsthal, Thomas Mann. Discussion of genre; Kafka’s parables: Novelle or short story?

4 units (Staff) given 1977–78

161–163. These courses acquaint the student with the development of German literature from the Enlightenment to the present. Significant works of each period are studied intensively and related to their historical context. Prerequisite: 51 plus 2 additional courses or consent of instructor.

161. The Classical Period — Introduction to major authors, works, and literary movements of the 18th century in historical context. Emphasis on Lessing and the Enlightenment, the importance of Storm and Stress (e.g., Lenz, Young Goethe, Schiller) for the development of drama and poetry; the rise of Weimar Classicism (Goethe, Schiller) and its significance for German literary tradition.

4 units, Aut (Mason) given 1976–77

162. Romanticism and Realism — Introductory study of the romantic Kunstmärchen (Tieck, Hoffmann), poetic theory (Novalis), transitions from Romanticism to Realism (Kleist, Heine); prose and essays in the context of 19th-century social thought. Problems of Realism (Stifter, Keller, Meyer, Raabe, Fontane).

4 units, Win (Staff)

163. Naturalism to the Present — Introduction to major authors and literary movements from 1880 to the present (e.g., Naturalism, Expressionism, Symbolism); discussion of the impact of the Nazi period on literature and the arts; consideration of recent trends in postwar East and West German literature. Readings by such authors as Hauptmann, Hofmannsthal, Kaiser, Thomas Mann, Kafka, Brecht, Böll, Grass, Biermann, Handke, and others.

4 units, Spr (Mason)

171–174. These courses introduce the student to specific developments and topics of German literature and culture with some emphasis on methods of literary interpretation. Prerequisite: 51 plus 2 additional courses or consent of instructor.

171. Drama from Storm and Stress to Expressionism — Study of dramas representative of major authors and styles from the 18th century to the early 20th century (e.g., Storm and Stress, Classicism, Realism, Naturalism); discussion of characteristic themes, various theories of the drama, and experimental forms which influenced the development of modern drama. Read-
nings by Goethe, Schiller, Kleist, Büchner, Grabbe, Hebbel, Hauptmann, Wedekind, and others.

4 units (Staff) given 1976–77

172. Drama from Expressionism to the Present — Study of the development of German drama from the early 20th century to the present with emphasis on such topics as the importance of Expressionism for the modern drama, Brecht's theory of epic theatre and his influence on postwar dramatists, documentary drama, and recent trends in the theatre of the postwar era. Readings include plays by such dramatists as Kaiser, Toller, Brecht, Weiss, Frisch, Dürrenmatt, Handke, Hochhuth, Hacks, and others.

4 units, Spr (Mason)

173. Modern Fiction—Reading and interpretation of short stories and novels by modern writers such as Thomas Mann, Kafka, Böll, Grass, Hesse, Uwe Johnson, Christa Wolf, Thomas Bernhard, and others. Discussion of characteristic styles, themes, and heroes of modern fiction.

4 units (Mason) given 1977–78

174. Special Topics—These courses explore the possibility of interdisciplinary studies and research in areas of special interest: e.g., women authors, social satire, political speeches, Freud and literature. Topics to be announced.

Literature in East Germany.

4 units (Mason) given 1976–77

199. Individual Reading—Enrollment only by special permission of the Department. Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Prerequisite: 51 or consent of instructor.

1 to 2 units, Aut, Win, Spr (Staff)

by arrangement

COURSES FOR ADVANCED UNDERGRADUATES AND FOR GRADUATE STUDENTS

(200–299)

201. Language and Style I—Writing exercises on different levels of style; discussion of grammatical problems; introduction to literary stylistics. Prerequisite: qualifying examination.

2 units, Win (Staff)

202. Language and Style II — Continuation of 201.

2 units, Spr (Staff)

203. History of the German Language — Introductory course on the phonological and syntactic development of Modern German from the Germanic parent language. Involves both the analysis of selected texts and the consultation of linguistic works on the subject.

3–5 units (Robinson) given 1976–77

204. Gothic—(Same as 304.) Introduction to grammar and texts of the Gothic language. The grammar of Proto-Germanic will also be treated.

5 units, Win (Andersson)

205. Old Norse — (Same as 305, English 200A.) Presentation of Old Norse grammar and selected readings from E. V. Gordon's An Introduction to Old Norse. Discussion and reports on the growth of prose literature in Iceland and Norway.

5 units, Win (Andersson)

206. Old High German—(Same as 306.) Introduction to the grammar and documents of the earliest attested stage of High German.

3–5 units (Robinson) given 1977–78

207. Old Saxon — (Same as 307, English 201.) Introduction to the grammar and documents of the earliest attested stage of Low German.

3–5 units (Robinson) given 1976–77

208. Introductory Middle High German—Presentation of grammar and selected readings from the epic, lyric, and didactic writers represented in Els Oksaar's Mittelhochdeutsch.

3–5 units, Win (Andersson)

209. Early New High German.

3–5 units (Staff) given 1976–77

211. Syntax of Modern German —Same as 311.) Contrastive analysis of English and German syntax.

3–5 units (Lohnes) given 1976–77

212. Linguistics and the Analysis of German —(Same as 312, Linguistics 284.) An introduction to linguistic theory and analysis with special emphasis on the analysis of modern German.

3–5 units, Aut (Robinson)
213. The Transformational Grammar of German—(Same as 313, Linguistics 283.) Study of the syntactic mechanisms of German within the framework of transformational grammar. Prerequisite: 212 or equivalent.

3–5 units, Win (Robinson)

214. The Phonology of German—(Same as 314.) Systematic treatment of the German sound system, especially within the framework of generative phonology.

3–5 units (Robinson) given 1976–77

219. Linguistics Colloquium — (Same as 319.) Topics in German linguistics. Although specific topics are determined by student interest, the general field of study will alternate as follows: synchronic German linguistics in years when 212 is taught, diachronic German and Germanic linguistics in years when 203 is taught.

3–5 units, Spr (Robinson)

221T–223T. This sequence represents the final year of the Translators Program at the undergraduate level. Upon completion of 223T, students are eligible for the Certificate in General Translation.

A special one-unit course on a note-taking system for students interested in the interpreters courses (324T–326T) is offered as part of the 220 series upon request only.

221T. Translation of Texts in the Social Sciences—Continuation of 123T. Texts to be translated are selected largely from the fields covered in the 120 series, but will pose greater difficulty in style and content. Verhandlungsdolmetschen will be continued. Students not participating in the Translators Program may enroll in this course if space permits. Prerequisite: 123T or consent of instructor.

3 units, Aut (Staff)

222T. Translation Workshop I — During this two-quarter workshop, each student is expected to produce independently an original translation of a literary or documentary work from his or her major field of interest. The work to be translated should not exceed 100 pages and should be chosen in consultation with the student's major adviser. Open only to students enrolled in the Translators Program. Prerequisite: 221T.

3 units, Win (Staff)

223T. Translation Workshop II — Continuation of 222T. Upon completion of this course, and upon acceptance of the translation by the Department, the Certificate in General Translation is awarded.

3 units, Spr (Staff)

230–239. Culture and Civilization — These courses deal with selected topics in the field of German and Scandinavian culture and civilization.

231A. Survey of Scandinavian Civilization—(Given in English.)

3 units (Andersson) given 1976–77

241–243. The series is designed to acquaint students with the history of German thought from 1750 to the present and its significance for an understanding of modern culture. Authors to be studied include Herder, Hegel, Schiller, Marx, Nietzsche, Freud, Husserl, Wittgenstein, Marcuse, and Adorno.


3–5 units, Aut (Wellbery)


3–5 units, Win (Mueller-Vollmer)


3–5 units, Spr (Wellbery)

251–259. German Literature and Culture—Open to undergraduates by consent of instructor only. See course descriptions under 351–359.

255. German Literature and Culture V—Eighteenth Century (1750–1800). (Same as 355.)

3–5 units, Aut (Gillespie)

257. German Literature and Culture VII—Nineteenth Century (1830–1900). (Same as 357.)

3–5 units, Win (K. Mommsen)

258. German Literature and Culture VIII—Modern Period (1900–1945). (Same as 358.)

3–5 units, Spr (K. Mommsen)

260–269. Major Authors—In-depth study of a major writer in his literary creativity, relation to his age, or special achievements and significance. Courses will deal with such writers as Walther von der Vogelweide, Grimmelshausen, Wieland, Lessing, Goethe, Novalis, Tieck, Kleist, Fontane, Nietzsche, Hofmannsthal, Thomas Mann, Kafka, Brecht, etc.

261. Hartmann von Aue—(Same as 361.) Continuation of 208. Introduction to the courtly literature of medieval Germany exemplified by Hartmann's epics, lyrics, and edifying tales. Attention will be focused on the emergence of Arthurian romance and the growth of the courtly idiom. Comparison of Hartmann's Erec and Iwein with the models of Chrétien de Troyes.

3–5 units, Spr (Andersson)

262. Schiller, unter besonderer Berücksichtigung der Dramen—(Same as 362.)

3–5 units (K. Mommsen) given 1977–78

263. Günter Grass—(Same as 363.) A study of Grass' writings: his work as novelist, poet, dramatist, and essayist. Principal focus will be on Grass' major novels in the context of the literary and social climate of the postwar period. Special attention will be given to aesthetic problems central to Grass's work, such as the significance of the grotesque, the relationship between inventive fantasy and novelistic structure, and the relationship between fantasy and political didacticism.

3–4 units, Win (Mason)

270–279. Genres—These courses treat the development, contents, and formal characteristics of such kinds of writing as lyric poetry, epic, drama, novel, Novelle, tale, short story, essay, etc., in various authors or periods. Focuses on such matters as medieval drama, baroque “metaphysical” poetry, the diary as a literary form, autobiography.

271. The Medieval Period—(Same as 371.)

271A. Germanic Heroic Poetry—(Same as 371A, English 270B.) A survey of the heroic legends common to the Germanic peoples and transmitted in medieval English, German, and Scandinavian versions from the eighth to the thirteenth century. Included will be the legends of Ermanaric, Siegfried, Dietrich, Hildebrand, Walter of Aquitaine, Wayland Smith, and the fall of the Burgundians. Topics: the problem of origins, the evidence of the Latin epitomes, the social function of heroic poetry, heroic norms of behavior, the performance of heroic lays in the Migration Age court, stylistic conventions, and late mutations in epic, ballad, and saga. Knowledge of Latin, Old English, Old or Middle High German, or Old Norse is desirable, but much of the material is available in English and German translation.

3–5 units, Aut (Andersson)

271B. Readings in Eddic Poetry—(Same as 371B, English 200C.) Continuation of 205. Introduction to Icelandic poetry and readings in Ursula Dronke's The Poetic Edda. Time will be divided between the technical problems of textual interpretation and the historical problem of legendary growth, including oral transmission, the comparison of dif-
fering versions and redactions, and the analysis of narrative innovations and contaminations as illustrated by the poems of the Edda and their analogues.

3-5 units, Spr (Andersson)

271C. Middle High German Romance — (Same as 371C.)

3-5 units (Andersson) given 1977-78

272. Das Tagebuch und seine Entwicklung zur literarischen Form — (Same as 372.)

3-5 units, Win (K. Mommsen)

273. Romantic Novels — (Same as 373.)

3-5 units (Gillespie) given 1977-78

274. Balladendichtung von Bürger bis Grass — (Same as 374.)

3-5 units (K. Mommsen) given 1977-78

275. Formen der Lyrik vom 18. bis 20. Jahrhundert — (Same as 375.)

3-5 units (K. Mommsen) given 1976-77

276. Panegyrische Dichtung vom 17. bis 20. Jahrhundert — (Same as 376.)

3-5 units (K. Mommsen) given 1977-78

278. Major Works — In-depth study of a major work such as Parzival, Faust, Zaubersberg, etc., in the context of the author’s literary development and in its philosophical and literary traditions in European literature and culture.

281. Nibelungenlied — (Same as 381.)

3-5 units (Andersson) given 1976-77

282. Die Faust-Tradition und Goethes Faust. Der Tragödie Erster Teil — (Same as 382.)

3-5 units (K. Mommsen) given 1976-77

283. Goethe, Faust. Der Tragödie Zweiter Teil — (Same as 383.)

3-5 units (K. Mommsen) given 1977-78

289-299. Special Subjects and Problems — Variable topics.

292. Heine und das Junge Deutschland — (Same as 392.)

3-5 units (Mueller-Vollmer) given 1976-77

293. Realismusprobleme unter besonder-
306. Old High German—(Same as 206.) Introduction to the grammar and documents of the earliest attested stage of High German.

3-5 units (Robinson) given 1977-78

307. Old Saxon—(Same as 207, English 201.) Introduction to the grammar and documents of the earliest attested stage of Low German.

3-5 units (Robinson) given 1976-77

311. Syntax of Modern German—(Same as 211.) Contrastive analysis of English and German syntax.

3-5 units (Lohnes) given 1976-77

312. Linguistics and the Analysis of German—(Same as 212, Linguistics 284.) An introduction to linguistic theory and analysis with special emphasis on the analysis of modern German.

3-5 units, Aut (Robinson)

313. The Transformational Grammar of German—(Same as 213, Linguistics 283.) Study of the syntactic mechanisms of German within the framework of transformational grammar. Prerequisite: 312 or equivalent.

3-5 units, Win (Robinson)

314. The Phonology of German—(Same as 214.) Systematic treatment of the German sound system, especially within the framework of generative phonology.

3-5 units (Robinson) given 1976-77

319. Linguistics Colloquium—(Same as 219.) Topics in German linguistics. Although specific topics are determined by student interest, the general field of study will alternate as follows: synchronic German linguistics in years when 312 is taught, diachronic German and Germanic linguistics in years when 203 is taught.

3-5 units, Spr (Robinson)

321T-323T. Advanced Translation—This series leads, with the completion of 323T, to the Certificate in Advanced Translation. Courses include: Practice translations of difficult texts; critical comparisons of accepted translations with the originals; Verhandlungsdolmetschen.

321T. Advanced Translation—Translation of difficult texts from modern German newspapers, periodicals, etc. The areas from which texts are chosen will reflect, to the greatest extent possible, students' fields of study. Prerequisite: 223T or equivalent, or consent of instructor.

3 units, Aut (Staff) by arrangement

322T. Advanced Translation—Continuation of 321T.

3 units, Win (Staff) by arrangement

323T. Advanced Translation—Continuation of 322T. Upon successful completion of this course, students will be eligible for the Certificate in Advanced Translation.

3 units, Spr (Staff) by arrangement

324T-326T. Interpretation—This sequence introduces the student to the two principal techniques used in interpretation: simultaneous and consecutive. Various aspects of the field, such as ethics, parliamentary procedure, conference and escort interpreting, will be discussed.

324T. Interpretation—Interpretation of conversations and negotiations; introduction to consecutive and simultaneous interpretation; conference terminology; writing of reports and précis.

3 units, Aut (Staff) by arrangement

325T. Interpretation—Continuation of 324T.

3 units, Win (Lieder) by arrangement

326T. Interpretation—Continuation of 325T. Upon completion of this course, the Certificate in Interpretation is awarded.

3 units, Spr (Lieder) by arrangement

330-339. Culture and Civilization—These courses deal with selected topics in the field of German and Scandinavian culture and civilization. For medieval culture, see 351A, 351B, 351C. See also 231A. Survey of Scandinavian Culture.

350. Methods of Teaching Literature—Students may enroll for practice in literature teaching on a voluntary basis.

1 to 3 units, Aut, Win, Spr (Staff) by arrangement

351-359. German Literature and Culture I-IX—These courses treat the major periods of German literature from the early Middle Ages to the present. They are intended to convey to the student a sense of the developing traditions that have shaped German literature. By focusing on a specific period, the literary and non-literary (cultural, social, political, philosophical) contexts can be es-
established within which individual authors, works, and movements are situated.

351. German Literature and Culture I—
The Early Middle Ages.

351A. The Migration Age in Europe.
3–5 units (Andersson) given 1976–77

351B. The Viking Age in Europe.
3–5 units (Andersson) given 1977–78

351C. Carolingian Literature.
3–5 units (Andersson) given 1976–77

352. German Literature and Culture II—
A survey of political, social, and cultural life in the high Middle Ages. An incomplete list of topics: The crusades, the interaction of church and state, the importation of foreign culture (especially from France), the development of the chivalric ethos and the age of knighthood, the growth of cities and the bourgeoisie, the advent of Gothic architecture, the rise of German mysticism. Literary documents of the time include heroic and courtly epics, the Minnesang, political and social commentary, the writings of the mystics, chronicles, sermons, letters, early scientific texts. Prerequisite: 208 or equivalent.
3–5 units (Staff) given 1977–78

353. German Literature and Culture III—
Introduction to New High German literature from the waning of the Middle Ages through the Renaissance and Reformation period (circa 1350–1600). Readings in 15th- and 16th-century poetry, drama, fiction, and polemics; special attention to such topics as late medieval trends, the impact of Humanism and Protestantism, the development of genres out of national and international heritages, and Renaissance mysticism, syncretism, and nature philosophy.
3–5 units (Gillespie) given 1977–78

354. German Literature and Culture IV—
From Baroque through Enlightenment (circa 1600–1750). Readings in literary renewal, experimentation, and theorizing of the 17th century; analysis of masterworks of the lyric from Opitz to Günther, and of baroque world theatre, romance, and novel; study of themes (e.g., theodicy, reason, sentiment) and modes (e.g., metaphysical, mannerist, baroque, neo-classical, rococo) on the threshold of the Enlightenment, the establishment of Enlightenment tastes, generic expectations, and language.
3–5 units (Gillespie) given 1977–78

355. German Literature and Culture V—
Eighteenth Century (1750–1800) (Same as 255.) The course of the Enlightenment from Gottsched to Lessing and Wieland, major works of Sentimentalism from Klopstock and the young Goethe to Jean Paul. Storm and Stress from Herder to Schiller. Weimar Classicism: its ideals and main achievements. Problematic awareness of human development in the age of individualism. Formation of the modern literary language in the verse and prose, essay, lyric, drama, and novel.
3–5 units, Aut (Gillespie)

356. German Literature and Culture VI—
German and European Romanticism. (Same as 456, Comparative Literature 356.) Origins and formation. The principal theoretical statements of early German Romanticism in their historical and ideological setting (Fichte, A. W. and F. Schlegel, Schelling, and Novalis). Types of Romantic literature by authors such as Tieck, Wackenroder, Bonaventura, Arnim, and E. T. A. Hoffmann. Salient features of the European movement: Wordsworth, Blake, Coleridge, and Carlyle in England; Mme. de Staël and her group, Hugo, Nerval, and Baudelaire in France. Close attention will be paid to the problem of periodization and the establishing of valid criteria for the study of cross-cultural and cross-national phenomena.
3–5 units (Mueller-Vollmer) given 1976–77

357. German Literature and Culture VII—
Nineteenth Century (1830–1900). (Same as 257.) Classical-romantic traditions in the drama, Novelle, and novel from the Biedermeier to poetic Realism (e.g., Grillparzer, Stifter, Keller). Büchner, Heine, the Young Germans, and the Vormärz movement. Social thought in literary theory and journalism; the influence of Hegel and Feuerbach. Fontane and problems of European Realism. Developments of literary theory and the drama of Naturalism in its European context (Holz, Hauptmann).
3–5 units, Win (K. Mommsen)
358. German Literature and Culture VIII—Modern Period (1900–1945). (Same as 258.) Fin de siècle; literary theories and manifestoes. Philosophical influences (e.g., Nietzsche). Symbolism from George to Rilke; “poetic revolution” from Holz to Dadaism. Essays and diaries as reflections of the cultural-political climate of the Wilhelminian Era and the Weimar Republic. The development of Expressionist drama; Brecht and the epic theatre. Aspects of the modern novel (Mann, Kafka, Döblin). Ideology of Third Reich Schrifttum; German literature in exile.
3–5 units, Spr (K. Mommsen)

359. German Literature and Culture IX—1945 to the Present. The Group 47: antifascist traditions and problems of post-war literary language. The absurd and the grotesque in the novel (Böll, Grass) and drama; Brecht and the epic theatre in East and West (e.g., Frisch, Hacks). Classicism and Modernism: problems of DDR cultural politics and literature. Re-evaluations of socialist literary theory and political practice in documentary literature and journalism (e.g., Weiss, Enzensberger, The Group 61). Theories of media and literature from Benjamin to Heissenbüttel. Medium language: Handke and the Wiener Gruppe.
3–5 units (Mason) given 1976–77

360–369. Major Authors—In-depth study of a major writer in his literary creativity, relation to his age, or special achievements and significance. Courses will deal with such writers as Walther von der Vogelweide, Grimmelshausen, Wieland, Lessing, Goethe, Novalis, Tieck, Kleist, Fontane, Nietzsche, Hofmannsthal, Thomas Mann, Kafka, Brecht, etc.

361. Hartmann von Aue—(Same as 261.) Continuation of 208. Introduction to the courtly literature of medieval Germany exemplified by Hartmann’s epics, lyrics, and edifying tales. Attention will be focused on the emergence of Arthurian romance and the growth of the courtly idiom. Comparison of Hartmann’s Erec and Iwein with the models of Chrétien de Troyes.
3–5 units, Spr (Andersson)

362. Schiller, unter besonderer Berück-
sichtigung der Dramen—(Same as 262.)
3–5 units (K. Mommsen) given 1977–78

363. Günter Grass—(Same as 263.) A study of Grass’s writings: his work as a novelist, poet, dramatist, and essayist. Principal focus will be on his major novels in the context of the literary and social climate of the postwar period. Special attention will be given to aesthetic problems central to Grass’s work, such as the significance of the grotesque, the relationship between inventive fantasy and novelistic structure, and the relationship between fantasy and political didacticism.
3–5 units, Win (Mason)

3–5 units, Spr (K. Mommsen)

370–379. Genres—These courses treat the development, contents, and formal characteristics of such kinds of writing as lyric poetry, epic, drama, novel, Nouelle, tale, short story, essay, etc., in various authors or periods. Focuses on such matters as the following: medieval drama, baroque “metaphysical” period, the diary as a literary form, autobiography.

371. The Medieval Period—(Same as 271.)

371A. Germanic Heroic Poetry—(Same as 271A, English 270B.) A survey of the heroic legends common to the Germanic peoples and transmitted in medieval English, German, and Scandinavian versions from the eighth to the thirteenth century. Included will be the legends of Ermanaric, Siegfried, Dietrich, Hildebrand, Walter of Aquitaine, Wayland Smith, and the fall of the Burgundians. Topics: the problem of origins, the evidence of the Latin epitomes, the social function of heroic poetry, heroic norms of behavior, the performance of heroic lays in the Migration Age court, stylistic conventions, and late mutations in epic, ballad, and saga. Knowledge of Latin, Old English, Old or Middle High
German, or Old Norse is desirable, but much of the material is available in English and German translation.

3-5 units, Aut (Andersson)

371B. Readings in Eddie Poetry—
(Same as 271B, English 200C.) Continuation of 305. Introduction to Icelandic poetry and readings in Ursula Dronke's *The Poetic Edda*. Time will be divided between the technical problems of textual interpretation and the historical problem of legendary growth, including oral transmission, the comparison of differing versions and redactions, and the analysis of narrative innovations and contaminations as illustrated by the poems of the *Edda* and their analogues.

3-5 units, Spr (Andersson)

371C. Middle High German Romance
(Same as 271C.)

3-5 units (Andersson) given 1977-78

372. Das Tagebuch und seine Entwicklung zur literarischen Form—

3-5 units, Win (K. Mommsen)

373. Romantic Novels—
(Same as 273.)

3-5 units (Gillespie) given 1977-78

374. Balladendichtung von Bürger bis Grass—
(Same as 274.)

3-5 units (K. Mommsen) given 1977-78

375. Formen der Lyrik vom 18. bis 20. Jahrhundert—
(Same as 275.)

3-5 units (K. Mommsen) given 1976-77

376. Panegyrische Dichtung vom 17. bis 20. Jahrhundert—
(Same as 276.)

3-5 units (K. Mommsen) given 1977-78

377. Moderne Lyrik—
(Same as 277.)

3-5 units (Mueller-Vollmer) given 1977-78

380–389. Major Works—In-depth study of a major work such as *Parzival*, *Faust*, *Zauberberg*, etc., in the context of the author's literary development and in its philosophical and literary traditions in European literature and culture.

381. Nibelungenlied—
(Same as 281.)

3-5 units (Andersson) given 1976-77

382. Die Faust-Tradition und Goethes Faust. Der Tragödie Erster Teil—
(Same as 282.)

3-5 units (K. Mommsen) given 1976-77

383. Goethe, Faust. Der Tragödie Zweiter Teil—
(Same as 283.)

3-5 units (K. Mommsen) given 1977-78


391. Goethe, Schiller und das Problem der Weimarer Klassik.

3-5 units (Mueller-Vollmer) given 1977-78

392. Heine und das Junge Deutschland—
(Same as 292.)

3-5 units (Mueller-Vollmer) given 1976-77

393. Realismusprobleme unter besonderer Berücksichtigung der Erzählkunst Adalbert Stifters und Gottfried Kellers—
(Same as 293.)

3-5 units (K. Mommsen) given 1976-77

394. Poets of Infinity—
(Same as 294, Comparative Literature 394.) Inquiry into the vision of cosmic, evolutionary, historical, and psychological time in selected lyrics by such major romantic poets as Novalis, Hölderlin, Keats, Shelley, Leopardi, Bécquer, and Baudelaire. Readings in the original language and/or bilingual texts.

3-5 units, Win (Gillespie)

ADVANCED GRADUATE COURSES
(400-499)

400. Individual Work — Exclusively for graduate students in German working on dissertations.

1–12 units, Aut, Win, Spr, Sum (Staff)
by arrangement
449A. Seminar: Humboldt and Structuralism—(Same as Comparative Literature 449, Modern Thought and Literature 372.) A close study of Humboldt’s writings on linguistics and the nature of language and their relation to modern structuralism. It is the aim of the seminar to examine critically the notion of structure and the limits of its applicability in literary studies. Taught in English. Readings in German.

3-5 units, Aut (Mueller-Vollmer)

449B. Seminar: Language Theories of the Romantic Movement.

3-5 units (Mueller-Vollmer)
given 1976-77

449C. Seminar: Texthermeneutik.

3-5 units (Mueller-Vollmer)
given 1977-78

456. German Literature and Culture VI—German and European Romanticism—(Same as 356, Comparative Literature 356.)

3-5 units (Mueller-Vollmer)
given 1976-77

469. Kleist und Büchner—(Same as 369.)

3-5 units, Spr (K. Mommsen)

HISTORY

Emeriti: Thomas A. Bailey, William C. Bark, Carl F. Brand, Claude A. Buss, Harold H. Fisher, David Harris, George H. Knoles, Anatole G. Mazour, John C. Miller, Edgar E. Robinson (Professors). Rixford K. Snyder (Associate Professor)

Chairman: Peter Stansky


By Courtesy: Paul A. David, Wilhelm Pauck

Associate Professors: Barton J. Bernstein, Frederick P. Bowser, Peter Duus, Terence Emmons, Harold Kahn (on leave winter and spring 1975–76), David M. Kennedy (on leave 1975–76), Gavin I. Langmuir, Mark I. Mancall, Paul Robinson, Paul S. Seaver, Lyman P. Van Slyke, John D. Wirth


Lecturers: Ivo Banac, George S. Rentz, Stephen G. Vlastos

The Department of History offers to all students of the University courses of general cultural and educational value. It seeks not only to provide knowledge in special fields, but also to equip the student for duties as a citizen and to give instruction which will aid in law, journalism, library work; in local, state, and national public service; and in business where a knowledge of domestic and foreign affairs is desirable.

PROGRAMS OF STUDY

Bachelor of Arts

The Department’s program for the undergraduate major in history emphasizes breadth of training yet allows students to concentrate their studies in a selected field of history.

As a foundation requirement, each candidate for the A.B. in History: (1) should be enrolled in the Department for six quarters (counting the quarter in which the registration takes place), (2) should complete one small group course — undergraduate colloquium (reading and discussion involving an explicit historical theme) or undergraduate seminar (introduction to the principles of historical research), (3) and should complete at least ten courses in history with a minimum of three units each. Directed reading may not count toward the ten required courses in history.

To emphasize broad coverage in space and time, it is required that at least two courses must be completed in each of the following three fields: (a) Western Europe (including Britain) and North America (especially the colonial and national history of the present United States), all since 1700; (b) Africa and the Middle East, Asia, Latin America, Russia, and Eastern Europe; (c) the period before 1700, with at least one course in the field of Western Europe before 1700. No single course may be counted to fulfill more than one of these three fields.
Western Civilization courses may not be used to meet the field requirement. Colloquia and seminars may meet the field requirement. The Department issues a detailed list indicating how each specific course is classified as to field.

Also, all History majors will be expected to know a foreign language (the completion of or placement out of one of the following courses: Chinese 21 or 25; French 23 or 26; German 51 or 61T; Greek 102; Italian 52; Japanese 21, 25, or 42; Latin 102, Linguistics 186A [Hausa]; Linguistics 191A [Swahili]; Portuguese 23; Russian 51; Spanish 23, 29, or 52. Statistics 60, 61, 62 plus Computer Science 105 may be offered in place of a foreign language. There is no minor requirement for the A.B. in History.

HONORS PROGRAM IN HISTORY

For a limited number of undergraduate majors, the Department offers a special program of senior research leading to Honors in History. Students accepted for this program, in addition to fulfilling the general requirements stated above, will complete a 15-unit senior essay, the work for which will normally begin in spring quarter of the junior year and be completed by the end of winter quarter of the senior year. Much of the work of the first quarter will be of the nature of directed reading under the guidance of an essay adviser to provide an opportunity for background reading and formulation of the essay topic. To enter this program the student must be accepted by a member of the Department who will agree to advise him or her on the essay. In considering an applicant for such a project, the adviser and the director of the Honors Program will take into account the student’s general preparation in the field of the project, will normally require that the student have completed or take at the beginning of Honors a research seminar in History, and will expect at least a B average in the student’s previous work, both in history and in the University. Students satisfactorily completing the program will be eligible for Honors in History, depending upon the quality of work performed. For more detailed information, apply to Professor Barton J. Bernstein, Director of the Honors Program.

James Birdsall Weter prizes may be awarded each year to students who submit outstanding essays.

HISTORY IN THE SECONDARY TEACHER’S CREDENTIAL

Applicants for the Stanford Secondary Teacher’s Credential in the social studies may get details of the requirements by applying to the Credential Secretary, School of Education.

CO-TERMINAL A.B. AND A.M. PROGRAM IN HISTORY

The Department admits each year a limited number of undergraduate History majors to work for a co-terminal A.B. and A.M. degree in History. Applications for admission to this program should be submitted during the Spring Quarter of the student’s junior year and must be submitted no later than November 1 of his or her senior year. Applicants will be screened by a committee of three members of the History Department faculty, including the Director of Graduate Study. Students must meet all requirements for both degrees. They must complete 15 full-time quarters (or the equivalent) or 3 full quarters after completing 180 units for a total of 216 units. During their senior year they may, with the consent of the instructors, register for as many as two graduate courses. During the final year of study they must complete at least three courses that fall within a single Ph.D. field.

GRADUATE STUDY

ADMISSION TO GRADUATE STANDING

All applicants for admission to graduate work are required to take the Aptitude Test of the Graduate Record Examination. This examination may be taken at most American colleges and by arrangement may be taken in nearly all foreign countries. For details concerning this test see the Information Bulletin. Overseas applicants, who may not receive the Information Bulletin promptly, should write directly to the Educational Testing Service, Box 955, Princeton, New Jersey 08540.

Students who have been admitted to graduate standing do not automatically become candidates for a graduate degree. With the exception of students in the Terminal A.M. program, they are admitted with the expectation that they will be working toward the Doctor of Philosophy degree, and may become candidates to receive the Master of
Arts degree at the end of the first or second year of graduate study.

**Master of Arts**

The Department requires the completion of nine courses (totalling not less than 36 units) of graduate work; at least seven courses of this work must be History Department courses. Of these seven, one must be a graduate seminar, and three must be either graduate colloquia or graduate seminars. Directed reading can be counted for no more than 10 units. A candidate whose undergraduate training in history is inadequate, however, must complete nine courses of graduate work in the History Department. The Department will not recognize for credit toward the A.M. degree any work that has not received the grade of A, B, or plus.

**Terminal A.M. Program**

The Department admits applicants who do not wish to continue beyond the A.M. degree at the discretion of the individual fields (U.S., modern Europe, etc.). Students admitted to this program may not apply to enter the Ph.D. program in History during the course of their work for the A.M. degree.

**Master of Arts in Teaching (History)**

The Department cooperates with the School of Education in offering the Master of Arts in Teaching degree. For the general requirements, see description under section “School of Education” in this bulletin. For certain additional requirements made by the Department of History, inquiry should be made to the History Department Office. Note that this program is open only to those with at least one year’s teaching experience. Candidates must possess a teaching credential.

**Doctor of Philosophy**

Students planning to work for the doctorate in history should be familiar with the general degree requirements of the University outlined in the section “Degrees” in this bulletin. Upon enrollment in the graduate program in History, the students will have a member of the department designated as an adviser and should plan the Ph.D. program in consultation with this adviser. During the first two years of graduate study, the students will spend much of the time taking courses, but should be aware from the outset that the ultimate objective is not merely the completion of courses, but the preparation for general examinations and for writing a dissertation.

Admission to the History Department in the Graduate Division does not establish any rights respecting candidacy for an advanced degree, and application must be made separately for admission to candidacy for the A.M. (not later than the end of the first four weeks of the quarter preceding the one at the end of which the degree is to be awarded) and also for the Ph.D. Applicants for the doctoral program must proceed by two steps: First, students must apply for admission to (not candidacy in) the Ph.D. program. Those seeking admission to the program should file application during their third quarter of enrollment in graduate work at Stanford. (Applicants who have already received the A.M. elsewhere should apply as soon as feasible after completion of one quarter at Stanford.) A committee of the Department will then determine either that the applicants shall be admitted to the Ph.D. program or that they must terminate their work in History at Stanford.

Second, after admission to the program and after the completion of certain further requirements, students must apply for acceptance for candidacy for the doctorate in the Graduate Division of the University.

The following requirements must be met:

1. In consultation with the adviser, students will select a major field of study from the list below in which to concentrate their study and later take the University oral examination. The major fields are:
   - Europe, 300–1400
   - Europe, 1400–1789
   - Europe since 1700
   - Russia
   - Eastern Europe
   - Middle East
   - East Asia before 1600
   - East Asia since 1600
   - Africa
   - Britain and the British Empire since 1460
   - Latin America
   - The United States (including Colonial America)

2. The Department seeks to provide a core colloquium in every major field, in
which the students will normally enroll in the first year of graduate study.

(3) Students are required to take two research seminars, at least one in the major field. Normally, research seminars should be taken in the second year.

(4) Students, in consultation with the adviser, define a secondary field lying outside the major field in one of three ways: (a) a field selected from the list given below; (b) one national history from an appropriately early date to the present, but excluding countries (such as the United States) with comparatively short histories; (c) comparative study of a subject across countries or periods.

The secondary fields are as follows:
The Ancient Greek World
The Roman World
Europe, 300–1000
Europe, 1000–1400
Europe, 1400–1600
Europe, 1600–1789
Europe, 1700–1871
Europe since 1848
Russia to 1800
Eastern Europe to 1800
Russia since 1800
Eastern Europe since 1800
Middle East to 1800
Middle East since 1800
Africa
China before 1600
China since 1600
Japan before 1600
Japan since 1600
England, 450–1460
Britain and the British Empire, 1460–1714
Britain and the British Empire since 1714
Latin America to 1825
Latin America since 1810
The United States (including Colonial America) to 1865
The United States since 1850

One national history may be selected as a portion of the major field to encompass much of that country's history as a secondary field, when that history is sufficiently long to span chronologically two or more major fields. Thus, for example, students choosing Europe since 1700 as a major field may elect France from about 1000 to the present as a secondary field.

The subject matter and scope for a comparative study are to be determined by the students in consultation with the adviser.

Secondary fields (a) and (b) may be completed either by taking two graduate courses relevant to the field, or one such graduate course and a written examination. Field (c) is completed by taking one relevant graduate course and writing a 6,000 word comparative essay acceptable to the student's adviser. The secondary field must be completed before the students may take the general examination in the major field.

(5) Students should plan in consultation with the adviser a supporting program of courses outside the Department. Although the Department does not prescribe the number, subject matter, or kind of courses, the program should have coherence and either add to the students' technical competence as historians or broaden their approach to the problems of the research field.

(6) Each student, before the Ph.D. is conferred, is required to teach for one quarter a small class of undergraduates. Normally this will be done in the third graduate year, and, normally, it will consist of leading two weekly discussion sections in a course given by a faculty member.

(7) There is no university or departmental foreign language requirement for the Ph.D. degree. A reading knowledge of one or more foreign languages is required in fields where appropriate. The faculty in the major field prescribes the necessary languages. In no field will a student be required to take examinations in more than two foreign languages; and examinations, administered by the appropriate language departments, must be passed before taking the oral examination in the major field.

(8) The student is expected to take the University oral examination in the major field early in the third graduate year.

(9) The student must complete and submit a dissertation which is the result of independent work and is a contribution to knowledge. It should evidence the command of approved techniques of research, ability to organize findings, and competence in expression. For details and procedural information, please apply to the Department.

**JOINT PH.D. IN HISTORY AND HUMANITIES**

The Department of History participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in History
and the Humanities. For description of that program see the section "Humanities Special Programs" in this bulletin.

**Resources for Graduate Study**

The above section relates to formal requirements, but the success of a student's graduate program depends in large part upon the quality of the guidance which he receives from the faculty and upon the library resources available. Prospective graduate applicants are advised to study closely the list of History faculty and the course work which this faculty offers. As to library resources, no detailed statement is possible in this bulletin, but areas in which library resources are unusually strong include the following:

The rich, and in some respects unique, collections of the Hoover Institution on the causes, conduct, and results of World War I and World War II are being augmented for the post-1945 period. The materials include government documents, newspaper and serial files, and organization and party publications (especially British and German labor movements and the German Socialist parties). There are also important manuscript collections, including unpublished records of the Paris Peace Conference of 1919 and the Herbert Hoover archives, which contain the records of the Commission for Relief in Belgium; the American Relief Administration; the various technical commissions established at the close of World War I for reconstruction in Central and Eastern Europe; the personal papers of Herbert Hoover as United States Food Administrator; and the personal papers of other important individuals. Other important materials for the period since 1914 relate to revolutions and political ideologies of international importance; colonial and minority problems; propaganda and public opinion; military occupation; peace plans and movements; international relations; international organization and administration, including the publications of the League of Nations, the World Court, the International Labor Office, and the United Nations, as well as the principal international conferences.

The Hoover Institution also possesses some of the richest collections available anywhere on the British labor movement, on Eastern Europe, including the Soviet Union, on East Asia (runs of important newspapers and serials and extensive documentary collections, especially for the period of World War II) and on Africa since 1860, including especially French-speaking Africa, the former British colonies, and South Africa.

The University Library maintains strong general collections in almost all fields of history. It has a very large microtext collection, including, for instance, all items listed in Charles Evans' *American Bibliography*, and in the *Short-Title Catalogues* of English publications, 1475–1700, and virtually complete microfilmed documents of the Department of State to 1906. It also has a number of valuable special collections in the Bender Room, including the Borel Collection on the History of California, many rare items on early American and early modern European history, the Brasch Collection on Sir Isaac Newton and scientific thought during his time, and other such materials.

**Introductory Courses**

1. Modern Europe: From the Renaissance to the Enlightenment — An exploration of the birth of modern times in the Renaissance, the Reformation movement, the scientific revolution, and the beginnings of the Enlightenment. While including socioeconomic developments and political events, the emphasis will be upon the thought, religion, and culture of western man, based upon the belief that the loss of history means the loss of identity and that man attains self-knowledge and perspective only from the mirror of history. Three lectures and one two-hour section per week.
   - 5 units, Aut (Spitz, Staff) Lectures MTW 9 or 10 plus Sections

2. Modern Europe: Enlightened Despotism, Revolution, and the Age of Power and Progress—A survey of the evolution of the European state system after the Thirty Years War: political, social, and intellectual currents in the 18th century, the impact of the French Revolution and the Napoleonic wars upon politics and thought, the evolution of the industrial system in the 19th century and the social problems attendant on it, the mid-century unification movements, and the nature of international society at the zenith of European power. Three lectures and one two-hour section per week.
   - 5 units, Win (Paret, Staff) Lectures MTW 9 or 10 plus Sections
3. Modern Europe: the 20th Century — Although stress, conflict, and confusion mark the history of our time, historians go on trying to impose some structure and sense upon it, attempting to sort out the major trends in Europe’s development from about 1890 to the present. The principal focus is on political and social change in the various national societies—on a variety of efforts, both gradualist and revolutionary, to adapt to the so-called mass age. International conflict, its causes and consequences, will receive almost equal time; some attention will be given to the changing intellectual climate. Three lectures and one two-hour section per week.

5 units, Spr (Wright, Staff) Lectures
MTW 9 or 10 plus Sections

33. Urban Culture from Athens to Florence — A study in the relationship of urban environment to cultural expression in the premodern West. The course will assess the influence of the social and economic conditions prevailing in ancient Athens and Rome, medieval Paris, and Renaissance Florence upon the political, religious, artistic, and philosophical ideas emanating from these centers.

5 units (A. Bernstein) given 1976–77

35. How Nations Deal With Each Other — (See Political Science 35.)

5 units, Aut (Keohane and Staff)
MWThF 11

65. Medieval Culture: An Interdisciplinary Introduction — (See Medieval Studies.)

5 units (A. Bernstein) given 1976–77

77. The World and the West: the Impact of Europe on the Third World — A survey, through case studies that illustrate general patterns of the relations between Western civilization and those of the Third World from the Spanish and Portuguese explorations of the fifteenth century to the present. Though diplomatic and military relations will be given consideration, the emphasis will be on broader patterns of comparative development and cultural interchange.

4 to 5 units, Spr (Bower, Irwin)
MTWTh 10

91. Traditional East Asian Civilization— (Same as Asian Languages 91 and Humanities 91.) An introduction to the development of civilization in China and Japan from earliest times to the spread of Buddhism. Lectures and discussions will cover political institutions, social and political ideas, religious currents, and artistic and literary trends. Intended for the nonspecialist.

4 to 5 units, Win (Duus, Lyell, Matisoff)
MTWTh 10

92. Traditional East Asian Civilization — (Same as Asian Languages 92 and Humanities 92.) A continuation of History 91, covering the period down to 1700. Open only to students who have completed History 91.

4 to 5 units, Spr (Duus, Lyell, Matisoff)
MTWTh 10

ADVANCED COURSES

Courses numbered 100 through 199 are primarily lecture courses designed for advanced undergraduates.

103. History of Education— (See Education 200.)

3 to 4 units, Aut (Gross) W 7–10 p.m.
4 units, Sum (Gross) MTWTh 1:15

THE ANCIENT WORLD

See Classics, Ancient History Section, courses H102 (History of Greece), H103 (History of Rome), H104 (The Tradition of Hellenism), H113 (The Roman Revolution), H115 Historiography and Ancient History, all of which are accepted for credit toward a major in history.

MEDIEVAL AND RENAISSANCE EUROPE

107A. Crusade, Commerce, and Culture: Europe in the 11th and 12th Centuries.

5 units (A. Bernstein) given 1976–77


5 units, Spr (Langmuir) MTWTh 10

109A. Renaissance Society and Culture.

5 units (Spitz, Forster, Ryan) given 1976–77

109B. Renaissance Society and Culture.

5 units (Spitz, Forster, Ryan) given 1976–77

110. Age of the Reformation.

5 units, Win (Pauck) MTWTh 10

MODERN EUROPE

117A,B,C. Slavic Civilization — (Same as
Slavic Languages and Literatures 117A,B,C and Political Science 117C (Spr.) An interdisciplinary introduction to the political, social, economic, and cultural history of the Slavic peoples of Bulgaria, Czechoslovakia, Poland, Russia, and Yugoslavia from the time of the Slavic migrations to the present. Readings and lectures will stress the similarities and differences among the Slavs themselves as well as the continuing tension of their relationship to the more familiar western experience.

5 units, Aut (Banac, Staff) Lectures
MTWTh 9, Sections Th or F
5 units, Win (Atkinson, Staff) Lectures
MTWTh 9, Sections Th or F
5 units, Spr (Dallin, Triska, Staff) Lectures
TWTh 1:15, Sections M or F

5 units, Spr (Banac) MTWThF 11

120A. Russia to Peter the Great, 1700.
5 units, Aut (Atkinson) MTWTh 9

120B. Russia from Peter the Great to the Great Reforms, 1700–1861.
5 units, Win (Emmons) MTWTh 9

120C. Russia from the Great Reforms to Stalin, 1916–1930.
5 units, Spr (Emmons) MTWTh 9

122B. Soviet Foreign Policy Since 1917 —
(Same as Political Science 136.)
5 units, Aut (Dallin) MTWTh 10

123A. The Soviet Union: Politics and Society Since 1917—
(Same as Political Science 132A.)
5 units, Spr (Dallin) MTWTh 10

123B. International Communism—
(Same as Political Science 132B.)
5 units (Dallin) given 1976–77

126. Eastern Europe Since 1914.
4 to 5 units (Vucinich) given 1976–77

126B. Balkan History Since 1800.
4 to 5 units, Win (Vucinich) MTWTh 10

128A. War and Society.
5 units (Paret) given 1976–77

129. Germany in the Twentieth Century.
4 to 5 units (Craig) given 1977–78

130. France in the Age of Absolutism, 1610–1774.
4 to 5 units, Spr (Lougee) MTWThF 9

4 to 5 units, Win (Wright) MTTh 11

134A. Medieval and Early Modern Spain.
5 units, Aut (Nader) MTWThF 1:15

134B. Modern Spain.
5 units, Win (Nader) MTWThF 1:15

135. Diplomatic Revolution of Our Time—
(See Political Science 135.)
5 units, Win (George, Staff) MTWTh 11

136. The Age of Reason and Enlightenment: European Intellectual History in the 17th and 18th Centuries.
4 to 5 units, Aut (Lougee) MTWTh 10

136A. European Intellectual History in the Nineteenth Century.
5 units, Win (Robinson) MTWThF 10

136B. European Intellectual History in the Twentieth Century.
5 units, Spr (Robinson) MTWThF 10

138A,B. Arms Control and Disarmament—
(Same as Political Science 138A,B.)
5 units, Win, Spr (Lewis, L. Weiler, Barton, Staff) MTWTh 1:15

THE BRITISH COMMONWEALTH

140. England to 1460.
5 units, Aut (Langmuir) MTWTh 10

4 to 5 units, Aut (Seaver) MTWThF 11

4 to 5 units, Win (Seaver) MTWThF 11

5 units, Spr (Stansky) MTWTh 11

5 units (Stansky) given 1976–77

5 units (Stansky) given 1977–78

AFRICA

147. Kingdoms of Africa: Society and History.
5 units, Spr (Jackson) MTWTh 11
148A. The History of West Africa.  
5 units, Aut (Irwin) MTWTh 10

148B. Colonial Africa.  
5 units (Irwin) given 1976-77

THE UNITED STATES

150. Rise of the American Colonies.  
4 to 5 units (Macphail)  
alternate years, given 1976-77

152A,B. Urban History of the United States —The causes and consequences of the urbanization of America; factors affecting the location and growth of cities; trends in urban architecture and planning; urban ecology; industrialization; occupational and spatial mobility; urban government and institutions; city politics; intellectual and popular attitudes concerning cities; and racial, ethnic and class conflict in cities. The two parts of the course are related but each may be taken separately.

152A. The Historical Development of the Urban Environment.  
5 units, Aut (Carson) MTWTh 9

152B. Social, Political, Economic and Cultural Life in Cities.  
5 units, Win (Carson) MTWTh 9

4 to 5 units, Sum (Brown) MTWThF 10

158. History of Education in the United States—(See Education 201.)  
3 units, Spr (Laserson) MW 11 plus 1 hour by arrangement

4 to 5 units, Spr (Gamblle) MTWTh 9

160. The American South, 1815–1900.  
5 units, Aut (Degler) MTWTh 11

161. Civil War and Reconstruction.  
4-5 units (Fehrenbacher)  
given 1976-77

164A. The Chicano in the Southwest Before the 20th Century—17th-century exploration, 18th-century colonization and settlement, and 19th-century Indian-Spanish/Mexican-Anglo relations, the Mexican War, and the period 1848–1900.  
4 to 5 units, Aut (Camarillo)  
TWMThF 1:15

164B. The Chicano in the Southwest: 20th-Century Developments — Successive periods of immigration; social, political, and working-class organizations; economic structure.  
4 to 5 units, Win (Camarillo)  
TWMThF 1:15

165A,B,C. United States History from the Revolution to the Present—An articulated sequence, general in focus, but with special attention given to political and institutional history. The series as a whole is designed to give students a broad foundation in United States history on which to base further work in history, literature, economics, political science, religious studies, art history, etc. Though the three parts of the series are intended to form an integrated whole, any portion may be taken independently of the others.

165A. The American Revolution and Early National Period from 1740.  
4 to 5 units, Aut (Macphail) MTWTh 10

165B. 19th Century America.  
4 to 5 units, Win (Gamblle) MTWTh 10

165C. The United States in the 20th Century—1890 to the Present.  
4 to 5 units, Spr (B. Bernstein)  
MTWTh 11

169. American Social History Since 1914.  
4 to 5 units, Win (B. Bernstein)  
MTWThF 1:15

LATIN AMERICA

176. Latin America to 1825.  
4 to 5 units, Aut (Bowser) MTWTh 11

177. Modern Latin America.  
4 to 5 units, Win (Johnson)  
MTWTh 11

180B. Modern Brazil, 1750–Present.  
5 units, Spr (Wirth) MTWThF 9

182. Latin America and the African.  
4 to 5 units, Win (Bowser) MTWTh 10

MIDDLE EAST

186. Ottoman Empire.  
4 to 5 units (Vucinich) given 1976–77

3 to 5 units (Rentz) given 1977–78
3 to 5 units, Spr (Rentz) MWF 11

3 to 5 units (Rentz) given 1976–77

EAST ASIA

190. Imperialism and the International Order in Modern East Asia.
4 to 5 units (Van Slyke, Duus) given 1976–77

192A. China from Earliest Times to the 9th Century.
4 to 5 units, Aut (Kahn) MTWThF 11

192B. China from the 9th to the 19th Centuries—(192A recommended as a prerequisite)
5 units, Win (Van Slyke) MTWThF 11

192C. Modern China: 19th and 20th Centuries—(192A,B recommended as prerequisites)
4 to 5 units, Spr (Van Slyke) MTWThF 11

194A. Japanese History to 1800—Japan from earliest times to mid-Tokugawa, with the transition from a courtier-dominated system to a state and society controlled by warriors the principal concern.
5 units, Aut (Vlastos) MTWThF 1:15

194B. The Rise of Modern Japan—A survey of Japanese history from 1800 to 1945, stressing the political, social, and intellectual changes attendant upon Japan's transformation from a traditional society into a modern state.
4 to 5 units, Win (Duus) MTWTh 1:15

195. Cultural History of Central Asia—(See Asian Languages 152.)
4 units, Win (Dien) MWF 1:15
plus 1 hour by arrangement

196. Chinese Historical Literature in Translation—(See Asian Languages 151.)
4 units, Aut (Dien) MWF 1:15

UNDERGRADUATE SEMINARS AND COLLOQUIA

During 1975–76, a number of colloquia will be offered for undergraduate History majors. Each will ordinarily consist of reading and discussion involving an explicit historical theme. Short papers, reports, and a final examination may be required. A number of undergraduate seminars will also be offered during 1975–76. A seminar differs from a colloquium principally by its concentration on materials and methods of historical research rather than on reading and discussion of a given body of historical literature. The student, in writing a research paper based to a substantial degree upon original sources, will have the opportunity to learn how historians arrive at their conclusions, as well as what the results of their work are. In this sense, the subject matter handled in any given seminar is less important than the process of investigation, analysis, and writing. "How do you know?" becomes more important than "What do you know?" (See Time Schedule each quarter for a more detailed listing.)

Courses numbered 200 through 299 (undergraduate seminars and colloquia) are designed primarily for juniors and seniors majoring in history. Requests for admission to seminars and colloquia involve permission of the instructor.

Courses in senior research are intended primarily (though not exclusively) for Honors candidates engaged in writing senior theses.

206. Undergraduate Colloquium: Authority and Reason in Medieval Religions—(Same as Medieval Studies 184.)
5 units (A. Bernstein, Berman, Serene) given 1976–77

208. Undergraduate Colloquium: The Christianization of Europe.
5 units, Win (Langmuir) T 2:15–4:05

215H. Senior Honors: Research in Medieval History.
1 to 5 units (A. Bernstein, Langmuir) by arrangement

217H. Senior Honors: Research in Renaissance-Reformation History.
1 to 5 units (Nader, Spitz) by arrangement

221. Undergraduate Colloquium: Topics in Russian Social Thought: Russian Populism.
5 units, Spr (Emmons) M 2:15–4:05

223A. Undergraduate Colloquium: Authority and Dissent in Russian History.
5 units, Aut (Atkinson) Th 2:15–4:05
224A. Undergraduate Colloquium: The Comintern and Eastern Europe.
   5 units, Aut (Banac) W 2:15-4:05

224B. Undergraduate Colloquium: The Republic of Dubrovnik (Ragusa) in History.
   5 units, Win (Banac) M 2:15-4:05

224C. Undergraduate Colloquium: Pre-Marxist and Marxist Socialism in East Europe.
   5 units, Spr (Banac) M 2:15-4:05

227A. Undergraduate Colloquium: German History.
   5 units, Aut (Paret) T 2:15-4:05

233. Undergraduate Colloquium: Spanish History.
   5 units, Spr (Nader) W 2:15-4:05

234B. Undergraduate Colloquium: Women, Family and Society in Europe.
   5 units, Win (Lougee) Th 2:15-4:05

236. Undergraduate Colloquium: European Socialisms in the Nineteenth and Twentieth Centuries.
   5 units, Aut (Wright) T 2:15-4:05

236S. Undergraduate Seminar: Crime and Punishment in Modern Europe.
   5 units, Win (Wright) T 2:15-4:05

237A. Undergraduate Colloquium: Opera and History—(Same as Modern Thought and Literature 237A.)
   5 units, Aut (Robinson) W 2:15-4:05

239H. Senior Honors: Research in Modern European History.
   1 to 5 units (Atkinson, Dallin, Emmons, Lougee, Paret, Robinson, Vucinich, Wright) by arrangement

   5 units, Spr (Seaver) Th 2:15-4:05

   5 units, Win (Seaver) T 2:15-4:05

243C. Undergraduate Colloquium: Women and Children in English Society, 1850-1914.
   5 units, Aut (Behlmer) M 2:15-4:05

244C. Undergraduate Colloquium: Humanities and International Relations: The Modern Period in Europe—(Same as Modern Thought and Literature 244.)
   5 units, Aut (Stansky) T 2:15-4:05

246H. Senior Honors: Research in British History.
   1 to 5 units (Seaver, Stansky) by arrangement

   5 units, Aut (Jackson) M 2:15-4:05

   5 units, Win (Jackson) M 2:15-4:05

247W. Undergraduate Colloquium: The Political Career of Jomo Kenyatta.
   5 units, Spr (Ochieng) Th 2:15-4:05

249H. Senior Honors: Research in African History.
   1 to 5 units (Irwin, Jackson) by arrangement

250S. Undergraduate Seminar: New England Community Studies—the Agrarian Base—(Same as Economics 176S.)
   5 units, Win (Macphail) T 2:15-4:05

255. Undergraduate Colloquium: Marxism and Afro-American Thought and Politics.
   5 units, Spr (Carson) M 2:15-4:05

256. Undergraduate Colloquium: Antebellum Reform Movements.
   5 units, Aut (Gamble) Th 2:15-4:05

259. Undergraduate Colloquium: The Presidency from Washington to Lincoln.
   5 units (Fehrenbacher) given 1976-77

262. Undergraduate Colloquium: Chicano History.
   5 units (Camarillo) given 1976-77

263. Undergraduate Colloquium: Women in America.
   5 units, Spr (Degler) T 2:15-4:05

264. Undergraduate Colloquium: Student Activism in America.
   5 units, Aut (Carson) M 2:15-4:05

265S. Undergraduate Seminar: Minorities (Women, Blacks, Indians).
   5 units, Spr (Degler) Th 2:15-4:05

   5 units, Aut (B. Bernstein) W 2:15-4:05
269S. Undergraduate Seminar: The Cold War.
5 units, Win (B. Bernstein) W 2:15–4:05

275H. Senior Honors: Research in United States History.
1 to 5 units (B. Bernstein, Camarillo, Carson, Degler, Macphail) by arrangement

5 units, Aut (Johnson) T 2:15–4:05

5 units, Win (Johnson) W 2:15–4:05

278. Undergraduate Colloquium: Race Relations in Latin America.
5 units, Spr (Bowser) T 2:15–4:05

285H. Senior Honors: Research in Latin American History.
1 to 5 units (Bowser, Johnson, Wirth) by arrangement

290. Undergraduate Colloquium: China and the Theory of the Asiatic Mode of Production—An examination of Marx's theories of pre- and non-capitalist modes of production, including variants thereof, with special reference to Chinese history. Students with special interests in Africa and Latin America are welcome.
5 units, Spr (Mancall) M 2:15–4:05

5 units, Aut (Van Slyke) T 2:15–4:05

297. Undergraduate Colloquium: Comparative Feudalism: Japan and Europe.
5 units (Mass) given 1976–77

299H. Senior Honors: Research in East-Asian History.
1 to 5 units (Duus, Mancall, Van Slyke) by arrangement

GRADUATE COURSES

Courses numbered 300–399 are intended primarily for first-year graduate students, but other qualified students may be admitted by consent of the instructor.

300A. Preparation for Teaching.
3 units, Spr (Robinson) W 4:15–6:05

301. Graduate Colloquium on the Historiography of American Education—(Same as Education 301.)
3 to 5 units (Tyack) given 1976–77

302. Graduate Colloquium: History of American Urban Education—(Same as Education 302.)
4 to 5 units, Spr (Lazerson) T 7–10 p.m.

304A,B. Historiography of Colonial Latin America.
10 units, Aut, Win (Bowser)
T 2:15–4:05

307. Graduate Core Colloquium: Medieval History.
5 units, Aut (Langmuir) T 2:15–4:05

308. Graduate Colloquium: Topics in Medieval History.
5 units, Win (Langmuir) Th evening

314D. Directed Reading in Medieval History.
Units by arrangement (A. Bernstein, Langmuir)

315H. Graduate Research in Medieval History.
Units by arrangement (A. Bernstein, Langmuir)

316D. Directed Reading in Renaissance and Reformation.
Units by arrangement (Nader, Spitz)

317H. Graduate Research in Renaissance and Reformation.
Units by arrangement (Nader, Spitz)

318. Graduate Colloquium: Topics in Renaissance History.
5 units, Win (Nader) Th 2:15–4:05

319. Graduate Colloquium: Humanism and the Reformation—(Same as Religious Studies 347.)
5 units, Spr (Spitz) Th 2:15–4:05

320B. Graduate Colloquium: The Economic Base of Marxism in Russia.
5 units, Spr (Atkinson) W 2:15–4:05

322A. Graduate Colloquium: Non-Russian Peoples of the Soviet Union.
5 units (Vucinich) given 1976–77

323. Graduate Colloquium: Topics in Rus-
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sian History: Russian Contributions to the Historiography of Western Europe.
5 units, Win (Emmons) by arrangement

325. Graduate Colloquium: Eastern Europe.
5 units, Aut (Vucinich) T 2:15–4:05

326. Graduate Colloquium: Problems in Soviet History and Politics Since 1917—
(Same as Political Science 126B.)
5 units, Win (Dallin) T 2:15–4:05

327A. Graduate Colloquium: Topics in German History.
5 units, Aut (Paret) W 2:15–4:05

328A. Graduate Colloquium: Art, Politics and Society—(Same as Modern Thought
and Literature 239.)
5 units (Paret) given 1976–77

329A. Graduate Colloquium: The History of Military Thought, Institutions, and Policy.
5 units (Paret) given 1976–77

329B. Graduate Colloquium: Comparative Studies in 18th and 19th Century Europe.
5 units (Paret) given 1976–77

331. Graduate Colloquium: The French Revolution in Europe.
5 units, Spr (Paret) W 2:15–4:05

334A. Graduate Colloquium: Early Modern European Social History.
5 units, Aut (Lougee) Th 2:15–4:05

336. Graduate Colloquium: Latin Europe, 19th and 20th Centuries.
5 units (Wright) given 1976–77

337. Graduate Colloquium: European Intellectual History Since the Enlightenment—
(Same as Modern Thought and Literature 337.)
5 units, Win (Robinson) W 2:15–4:05

338D. Directed Reading in Modern European History.
Units by arrangement (Atkinson, Dallin, Emmons, Lougee, Paret, Robinson, Vucinich, Wright)

339H. Graduate Research in Modern European History.
Units by arrangement (Atkinson, Dallin, Emmons, Lougee, Paret, Robinson, Vucinich, Wright)

341B. Graduate Colloquium: Social Change in Pre-Industrial England.
5 units, Aut (Seaver) M 2:15–4:05

344A. Graduate Colloquium: Problems in Modern British Society.
5 units, Win (Stansky) T 2:15–4:05

345D. Directed Reading in British History.
Units by arrangement (Seaver, Stansky)

346H. Graduate Research in British History.
Units by arrangement (Seaver, Stansky)

347A. Graduate Colloquium: Linkages in Afro-American and African History: Common Topics.
5 units, Win (Jackson) M by arrangement

348C. Graduate Colloquium: Approaches to the Study of Colonialism.
5 units, Aut (Irwin) W 2:15–4:05

348B. Graduate Core Colloquium: The Interpretation of African History.
5 units (Jackson) given 1976–77

349D. Directed Reading in African History.
Units by arrangement (Irwin, Jackson)

349H. Graduate Research in African History.
Units by arrangement (Irwin, Jackson)

5 units, Win (Lougee, Macphail) M 2:15–4:05

351A, B, C. Joint Graduate Colloquium in American History.
30 units, Aut, Win, Spr (B. Bernstein, Camarillo, Carson, Degler, Gamble, Macphail) TF 2:15–4:05

352. Graduate Colloquium: Life of the Mind in Colonial America.
5 units (Macphail) given 1976–77

353. Graduate Colloquium: Social Structure.
5 units (B. Bernstein) given 1976–77

5 units (Carson) given 1976–77

362. Graduate Colloquium: Topics in Chicano History.
5 units, Spr (Camarillo) W 2:15–4:05
374D. Directed Reading in United States History.

Units by arrangement (B. Bernstein, Camarillo, Carson, Degler, Gamble, Macphail)

375H. Graduate Research in United States History.

Units by arrangement (B. Bernstein, Camarillo, Carson, Degler, Gamble, Macphail)

380. Graduate Colloquium: Latin American History.

5 units, Aut (Johnson) W 2:15–4:05

382. Graduate Colloquium: Brazilian History.

5 units, Spr (Wirth) Th 2:15–4:05

384D. Directed Reading in Latin American History.

Units by arrangement (Bowser, Johnson, Wirth)

385H. Graduate Research in Latin American History.

Units by arrangement (Bowser, Johnson, Wirth)

388D. Directed Reading in the Middle East and in the Islamic World.

Units by arrangement (Rentz)

390A,B. Graduate Colloquium: Topics in Modern Chinese History.

5 units, Aut, Win (Kahn, Van Slyke) by arrangement

395A. Graduate Colloquium: Early and Medieval Japan.

5 units (Mass) given 1976–77

395B. Graduate Colloquium: Early Modern Japan—Readings and discussions centering on the different facets of Tokugawa history. In what way was pre-Perry Japan becoming an increasingly complex and sophisticated society despite its feudal encasement?

5 units, Aut (Vlastos) Th 2:15–4:05

395C. Graduate Colloquium: Modern Japan—from the early 19th century to the 1930’s.

5 units, Spr (Duus) Th 2:15–4:05

398D. Directed Reading in East Asian History.

Units by arrangement (Kahn, Duus, Mancall, Van Slyke, Vlastos)

399H. Graduate Research in East Asian History.

Units by arrangement (Kahn, Duus, Mancall, Van Slyke, Vlastos)

ADVANCED GRADUATE COURSES

Courses numbered 400–499 are intended primarily for second- and third-year graduate students, but other qualified students may be admitted by consent of instructor.


4 to 5 units (Tyack) given 1976–77

412. Graduate Seminar: Topics in Renaissance History.

5 units, Spr (Nader) Th 2:15–4:05

421A,B. Graduate Seminar in Russian History.

10 units, Aut, Win (Emmons, Atkinson) by arrangement


5 units, Spr (Vucinich) T 2:15–4:05

427. Graduate Seminar: Topics in Modern European History.

5 units, Aut (Wright) M 2:15–4:05

429. Graduate Seminar: Napoleonic and Restoration Europe.

5 units (Paret) given 1976–77

447A. Graduate Seminar: Class and Stratification in Pre-Colonial African History.

5 units, Spr (Jackson) by arrangement

447W. Graduate Seminar: The Sources of Pre-World War II Kenya Nationalism.

5 units, Spr (Ochieng) Th 2:15–4:05

448A. Graduate Seminar: Colonial Africa.

5 units, Win (Irwin) Th 2:15–4:05


5 units, Win (Degler) M 2:15–4:05

462. Graduate Seminar: Research in Chicano History.

5 units, Win (Camarillo) by arrangement
490A, B. Graduate Seminar: Modern China.
10 units, Win, Spr (Van Slyke)
by arrangement

5 units (Mass) given 1976–77

495. Graduate Seminar: Research in Modern Japanese History.
5 units, Aut (Duus) by arrangement

HUMANITIES SPECIAL PROGRAMS

Emeriti: John W. Dodds, Paul H. Kocher, Philip H. Rhinelander, Jeffery Smith (Professors)
Acting Chairman: William A. Clebsch (Aut)
Chairman: Lawrence V. Ryan (Win, Spr)
Professors: William A. Clebsch (Religious Studies and Humanities), Lawrence V. Ryan (English and Humanities) on leave Autumn quarter. Visiting: Raeburne S. Heimbeck, Spring quarter
Assistant Professor: Eileen Serene (Philosophy and Humanities) on leave Winter and Spring quarters

Humanities Special Programs include:
1. Experimental Courses
2. Honors Program in Humanities
3. Graduate Program in Humanities
4. American Studies
5. Medieval Studies

EXPERIMENTAL COURSES

91. Traditional East Asian Civilization —
(Same as Asian Languages 91 and History 91.) An introduction to the development of civilization in China and Japan from earliest times to the spread of Buddhism. Lectures and discussions will cover political institutions, social and political ideas, religious currents, and artistic and literary trends. Intended for the non-specialist.
5 units, Win (Duus, Lyell, Matisoff)
MTWTh 10

92. Traditional East Asian Civilization —
(Same as Asian Languages 91 and History 91.) A continuation of Asian Languages / History / Humanities 91 covering the period down to 1700. Open only to students who have completed Asian Languages / History / Humanities 91.
5 units, Spr (Duus, Lyell, Matisoff)
MTWTh 10

109A. Renaissance Society and Culture —
(Same as Art 109A and History 109A.) Civic life and humanism from the 14th to the early 16th century in Florence, Milan, Urbino, Rome, and Nuremberg. An interdisciplinary study of the age of the Renaissance combining art, history, and literature. While 109A and 109B are designed as an integrated study of the Renaissance from 1300 to 1600, each quarter may be taken separately.
Given 1976–77

109B. Renaissance Society and Culture —
(Same as Art 109B and History 109B.) Protestant and Catholic reform in high Renaissance Germany, France, Italy, and England.
Given 1976–77

HONORS PROGRAM IN HUMANITIES

Committee in Charge: William A. Clebsch (Director, Aut), Lawrence V. Ryan (Director, Win, Spr), William Chace, Ann R. Diffenbaugh, Mark Edwards, J. Martin Evans (Aut, Win), Gerald Gillespie, Don E. Livinghouse, Eileen Serene (Aut), Lee H. Yearley (Win, Spr)

PURPOSE OF THE PROGRAM

The Humanities Honors Program aims to heighten the student’s sense of the relation between various humanistic disciplines, and to increase awareness of basic humanistic values—intellectual, aesthetic, literary, historical, social, and ethical.

ADMISSION TO THE PROGRAM

Freshmen and Sophomores interested in the Program should consult with the Director or Associate Director. The consultation should take place at the earliest opportunity, preferably during freshman year, and in every case before beginning the junior year.

The Program is open to majors in every field, and may be taken in addition to a departmental major or as a minor.

Students who are admitted to the Program may enroll as Humanities majors:
1. If they are taking the pre-medical curriculum.
2. If they choose a major in Humanities concentrating in one of the following:
(a) American Studies
(b) Comparative Literature (see p. 000)
3. If they are permitted, upon petition granted by the Honors Committee, to plan a 40-unit concentration of interdepartmental course work constituting a unified program of study.

Students who wish to major in Humanities must enter the Program and plan the concentration before registering for the first quarter of the junior year. Competence in reading a foreign language is required of Humanities majors.

Requirements of the Program
1. Western Thought and Literature—Humanities 61, 62, 63—15 units, freshman or sophomore year. (Students in Comparative Literature see p. 286.)
2. Two Humanities Seminars in the series 190-199—10 units, junior year.
3. Honors Essay — A critical essay on a topic of general importance and approved by the Committee (2 units spring, junior year; 5 units autumn and 5 units winter, senior year). A grade of at least B is required on the essay for graduation with Honors in Humanities.

Courses
61, 62, 63. Western Thought and Literature—An introduction to fundamental ideas of the past; lectures, discussions, reading of selected masterpieces.
      5 units, Aut (A. Raubitschek, Staff) MWF 11; two hours by arrangement
      5 units, Win (Gillespie, Staff) MWF 11; two hours by arrangement
   63. From the Enlightenment to the Present.
      5 units, Spr (Heimbeck) MWF 11; two hours by arrangement

175. Individual Work—for students in the Humanities Honors Program with definite objectives not met by current course offerings.
   2 to 5 units, any quarter (Staff) by arrangement

190–197. Interdepartmental Seminars on the Nature of the Humanities—Students in the Humanities Honors Program are required to complete two of these seminars; other students may enroll in them only by consent of the Director. Prerequisite: two courses in the series Hum. 61, 62, 63.

190. The Humanities in Western Thought and Literature — Prerequisites: Humanities 61, 62, and 63. Counts as Humanities 194.
   5 units, Aut (Evans) MW 4:15–6:05
191. History and the Humanities.
   5 units, Spr (Paret) T 2:15–4:05
192. The Arts and the Humanities.
   5 units, Aut (McGinn) TTh 2:15–4:05
   5 units, Spr (Bender) MW 2:15–4:05
193. Philosophy and the Humanities.
   5 units, Aut (Serene) MW 2:15–4:05
   5 units, Spr (McGinn) MW 4:15–6:05
194. Literature and the Humanities — (Same as Comparative Literature 194.) The critical study of major texts; theory and practice of criticism.
   5 units, Win (Davis) TTh 2:15–4:05
194A. Colloquium on National and International Identity—(Same as Comparative Literature 194A, Modern Thought and Literature 194A and English 194A.) Intensive study of national and international dimensions of literature, drama, and thought with emphasis on modern problems of identity in Anglo-American and European cultures. Topics will include nationalism and national revivals in the British Isles and the United States and Europe. Enrollment limited to 15.
   5 units, Spr (Halliburton) Stanford in Britain
195. American Studies: The American Character — Perception and descriptions of the American character in the 17th, 18th, 19th and 20th centuries; comparison of Alexis de Tocqueville’s analysis of the American character with R. W. Emerson’s analysis of the English character; histori-
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cal, literary, psychological, and sociological insights into national character.

5 units, Win (Clebsch) MW 2:15-4:05

197. Ethics and International Relations.

5 units, Win (Rhinelander) MW
4:15-6:05

200A, B, C. Honors Essay—A critical essay of about 15,000 words. Limited to Humanities Honors students.

200A. Submission of Essay Proposal—Preliminary planning and study. Approval of proposal by Committee in Charge required for credit and for continuation in the Program.

2 units (Staff) by arrangement

200B. Continued Study and Writing—Regular meetings with tutor. Prerequisite: 200A.

5 units (Staff) by arrangement

200C. Further Work on Essay—Regular meetings with tutor; submission of complete first draft to tutor by end of quarter. Prerequisite: 200B.

5 units (Staff) by arrangement

GRADUATE PROGRAM IN HUMANITIES


The Graduate Program in Humanities supplements the Ph.D. programs of certain Stanford students, especially in Classics, Drama, English, French and Italian, German Studies, History, Modern Thought and Literature, Philosophy, Religious Studies, Slavic Languages and Literatures, Spanish and Portuguese, with an interdepartmental program devoted to the study of the Western tradition as a whole. The degree offered is a joint Ph.D. in “Classics and Humanities,” “English and Humanities,” “German Studies and Humanities,” etc.

Because the Graduate Program in Humanities supplements, and does not substitute for, departmental specialities, its members must be students earning the Ph.D. in an academic department at Stanford.

Application for entrance into the Program should be made to the Director; selections are made to give broad representation to the participating departments. Members of the Program are given first preference in registration for all courses offered by the Program. The normal pattern of the Program involves one Humanities course in each of six successive quarters, but no particular pattern is enforced.

Graduate students who are not members of the Program may enroll, by consent of the Director, in courses whose enrollments are not filled by members of the Program. Limits: 25 in Humanities 301-305; 18 in Humanities 306.

REQUIREMENTS

1. Continued satisfactory work in the student’s major field, in accordance with Departmental requirements.

2. Completion of the five historical courses (Humanities 301-305) in the Western Tradition series, for any one or two of which equivalent academic work may be substituted, if approved by the Committee in Charge; completion of Humanities 306, unless special exemption is given by the Committee in Charge.

3. Regular attendance and active participation in the bi-weekly Humanities Colloquium (Hum. 353) for at least one academic year, for which three units of credit are required and six units may be earned.

4. At least one quarter of teaching for the Humanities Department is required, but teaching of a similar sort may be substituted for this requirement by petition to the Committee in Charge.

5. Reading knowledge of at least one foreign language, ancient or modern.

6. Passing the University Oral Examination, with one representative of the Graduate Program in Humanities designated by the Director, as a member of the examining committee.

7. Submission of a Ph.D. dissertation that is acceptable to a committee which includes one representative of the Graduate Program in Humanities, designated by the Director.

COURSES

251. Basic Humanistic Problems—Open to graduate students and to advanced undergraduates with consent of the instructor; re-
quired of M.A.T. candidates whose teaching field is Humanities.

4 units, given 1975–76

275. Directed Reading.
2 to 5 units (Staff) by arrangement

301, 302, 303, 304, 305, 306. The Western Traditions—Required of students in the Graduate Program in Humanities. Open to other graduate students only by consent of the Director.

301. The Classical Period.
4 units, Aut (Spofford) TTh 4:15–6:05

302. The Roman and Early Christian Period.
4 units, Win (G. Brown) TTh 4:15–6:05

303. The Middle Ages.
4 units, Spr (Yearky) TTh 4:15–6:05

304. The Renaissance.
4 units, Aut (Gillespie) MW 4:15–6:05

305. The Early Modern Period.
4 units, Win (Mueller-Vollmer) MW 4:15–6:05

306. Modernism and the Consciousness of the Humanities—Normally taken after completion of 301–305.
4 units, Spr (Heimbeck) MW 4:15–6:05

353. The Humanities in the University — How the humanistic disciplines bear upon one another and upon other aspects of research and higher education. A three-quarter colloquium of limited enrollment, required of students in the Graduate Program in Humanities. Prerequisite: Enrollment in or completion of one or more of the series Humanities 301–306.
1 or 2 units, Aut, Win, Spr (Clebsch) by arrangement

**AMERICAN STUDIES**

**Policy Committee:** William A. Clebsch, Chairman (Religious Studies and Humanities); Barton J. Bernstein (History); Henry S. Breitrose (Communication); William Chace (English); Wendell Cole (Drama); Lawrence M. Friedman (Law); Albert Gelpi (English); Michael R. Hammond (undergraduate); Albert H. Hastorf (Psychology); Arturo Islas (English); David M. Kennedy (History, on leave 1975–76); Harry M. Litzman (undergraduate); Hubert B. Marshall (Political Science); Robert E. McGinn (Values, Technology and Society); Anne McMahon (Sociology); Dwight Miller (Art); Nathan Rosenberg (Economics); David B. Tyack (Education, on leave 1975–76).

Members of the Humanities Honors Program may major in Humanities with a concentration in American Studies by meeting the requirements of the Honors Program, including Humanities 195 as one of the junior seminars, completing 40 units of study in approved courses in American Studies, and writing the Honors Essay on an approved topic in American Studies. Students who are not members of the Honors Program may petition through the Academic Information Center for interdepartmental majors in American Studies, utilizing a list of approved courses.

**MEDIEVAL STUDIES**

**Committee in Charge:** Phillip W. Damon, Chairman; Robert Ball, Gavin I. Langmuir, Suzanne Lewis, Lee H. Yearley.

**Affiliated Faculty:** Theodore M. Andersson (German Studies), Robert Ball (Spanish and Portuguese), Rina Benmayor (Spanish and Portuguese), Lawrence V. Bern-man (Religious Studies), David Brostoff (French and Italian), George H. Brown (English), Phillip Damon (English), Joseph C. Harris (English), Gavin I. Langmuir (History), Michael Leone (French and Italian), Suzanne Lewis (Art), William Mahrt (Music), Helen Nader (History), Eleanor Prosser (Drama), George S. Rentz (History), Eileen Serene (Philosophy and Humanities), William Todd III (Slavic Languages and Literatures), W. Wesley Trimpi (English), Wayne Vucinich (History), Lee H. Yearley (Religious Studies).

**BACHELOR OF ARTS**

The Medieval Studies Major is designed to provide students with an interdisciplinary program concentrating upon the European Middle Ages as a civilization, culture, or period in its own right. The major would normally be declared by the beginning of the student's third year. To help students develop their own syntheses and methods, the faculty will undertake to provide two types of interdisciplinary courses in Medieval Studies: first, "Medieval Culture: An Inter-
disciplinary Introduction," and second, a number of upper level courses conducted by two or more professors from different disciplines. In addition, a faculty advisor will help each student choose courses that complement the interdisciplinary core of the program, while still providing depth in one area. To that end the following guidelines are provided.

Each student will take a minimum of ten courses dealing directly with the Middle Ages and distributed as follows:

The introductory course, Medieval Studies 65, "Medieval Culture"
Two upper level interdisciplinary courses in Medieval Studies
Four courses in one of the following categories:
   I. Literature
      A. English
      B. German and Scandinavian
      C. French
      D. Spanish
      E. Italian
      F. Slavic
      G. Latin
   II. History
   III. Art History, Drama, Music
   IV. Philosophy, Religious Studies, Humanities (certain Humanities courses may fulfill requirements within other categories)

Two courses in a second category chosen from the above list.
One course in a third category chosen from the above list.

In addition to the ten courses of the major, a language proficiency equal to two years of college-level study is required in Latin or one of the following: French, German, Spanish, or Italian.

MEDIEVAL STUDIES HONORS PROGRAM

Students wishing to obtain a degree in Medieval Studies with honors, shall attain a language proficiency equal to one year of college-level study either in Latin, if they have fulfilled the first language requirement in a modern language, or in a modern language if the first requirement was met in Latin. In addition, honors candidates shall write an interdisciplinary essay under the direction of one professor and with the collaboration of a second professor from a different discipline. The research and writing will be scheduled as two courses of independent study from each of the two professors and will be equivalent to four four-unit courses.

COURSES

65. Medieval Culture: An Interdisciplinary Introduction—(Same as English 65, German Studies 21A, and History 65.) An introduction to the development of medieval culture through study of some of its salient religious, philosophical, literary, artistic, social, and political characteristics, with emphasis on the connections and tensions among them. Lectures by faculty from various departments and sections conducted by the faculty listed.

   5 units, Win (Bernstein, Benmeyor)
   Lectures MTW 1:15; Sections by arrangement

183. Colloquium on the Apocalypse in Medieval Art and Literature—(Same as Art 206A and English 266.)

   4-5 units, Spr (G. Brown, Lewis)

184. Authority and Reason in Medieval Religions—(Same as History 206, Philosophy 169.)

   5 units (Berman, Bernstein, Serene)
given 1976-77

RELATED COURSES

Current courses which are suitable for the Medieval Studies major are listed below; more detailed descriptions of the courses are to be found under the various departmental headings.

ART

104A. Medieval France
104B. Medieval Germany
105A. Medieval Italy
107. Medieval Architecture

CLASSICS

208. Post-Classical Latin

DRAMA

152. Medieval and Renaissance Drama

ENGLISH

171. Chaucer
205. Introduction to Old English
INTERNATIONAL RELATIONS

260. History of Literary Theory
270A. Beowulf

FRENCH AND ITALIAN

(French)
213. Old French
214. Old Provençal
355. Les Chansons de Geste

(Italian)
130. Survey of Italian Literature and Civilization
140. Dante, The Divine Comedy
142. Dante, Petrarch, and Boccaccio

GERMAN STUDIES

204. Gothic
205. Old Norse
206. Old High German
208. Introductory Middle High German
261. Hartman Von Aue
271. Germanic Heroic Poetry
272. Readings in Eddic Poetry

HISTORY

108. The Genesis of Antisemitism
134A. Medieval and Early Modern Spain
140. England to 1460
208. Undergraduate Colloquium: The Christianization of Europe

HUMANITIES SPECIAL PROGRAMS

62. Christian and Secular Europe: Medieval and Renaissance

MUSIC

3C. Introduction to Medieval Music
100. Music History: Medieval and Renaissance
140. Studies in Medieval and Renaissance Music

PHILOSOPHY

101. Early Christian, Medieval, and Renaissance Philosophy

RELIGIOUS STUDIES

123. Judaism
127. Islam
165. Islamic Theology and Philosophy: Averroes
172. Maimonides

SLAVIC LANGUAGES AND LITERATURES

189. Russian Literature of the Middle Ages
211. Introduction to Old Church Slavonic and Early Russian Texts

212. History of the Russian Literary Language

SPANISH AND PORTUGUESE

(Spanish)
230. Medieval Didactic Literature
329. Celestina

INTERNATIONAL RELATIONS, SPECIAL OFFERINGS FOR UNDERGRADUATES

Committee in Charge: Committee on International Relations, a subcommittee of the Advisory Committee to the Director of the Center for Research on International Studies, Robert O. Keohane (Political Science) Chairman; Frederick Bowser (History); Alexander Dallin (History); Martin Evans (English); Alexander L. George (Political Science); Harry Harding (Political Science); David Kennedy (History); Mark Mancall (History); Gerald M. Meier (Graduate School of Business); John H. Merryman (School of Law); Michael Sullivan (Art); Wayne Vucinich (History); Robert Ward (Political Science); Lee Yearley (Religious Studies).

This Program is an undergraduate major designed to encourage the interdisciplinary and humanistic study of international relations. The Program includes not only courses designed specifically for it in conjunction with the Committee, but other courses regarded by the Committee as relevant to the subject. Broadly stated, the goal of the Program is to enable students to explore the complexity and interconnectedness of relations between cultures as well as between societies and states, and to acquire sophistication in asking penetrating questions about world affairs and in evaluating evidence bearing on those questions.

The International Relations Program is the result of a sustained effort by faculty members from several departments to develop an intellectually rigorous curriculum that will be more comprehensive and focused on international relations than the offerings of any single department. A particular effort has been made, under a grant from the Na-
tional Endowment for the Humanities, to extend the program into the humanities as well as including courses in the social sciences that have to do with international affairs.

The Program seeks to enrich undergraduate course offerings in international relations for non-majors as well as for majors. All students considering either a major or extensive work in international relations are strongly encouraged first to take History/Political Science 35, "How Nations Deal with Each Other," offered in the fall quarter of each year. After that, prospective majors will develop their own programs, in conjunction with advisors, as outlined below.

The degree of Bachelor of Arts in International Relations will require at least 50 units in the major. In addition, each student will be expected to demonstrate the proficiency in a foreign language to be expected after two years of university-level language training. Precise course requirements, after completion of History/Political Science 35, will depend on which of the three clusters of courses the student chooses as a focus for his or her program. Cluster A encompasses courses that emphasize political and historical aspects of international relations; Cluster B focuses directly on the humanities; and Cluster C constitutes a set of problem-oriented courses, largely on political-economic issues. Each student in the program will be required to take at least one course in each cluster.

In each individual case, the student will develop his or her program in conjunction with an advisor, who will be a member of the Committee on International Relations or a faculty member approved by it. The Committee as a whole will periodically review all proposals. It is important to note that students may count courses not sponsored by the Committee, or listed in this section of the catalog, as part of their majors, with the agreement of their advisors and the Committee as a whole. In many cases, students may find it sensible to include work offered elsewhere in the university in their programs. Students will be encouraged to shape their own programs, so that coherent central themes will emerge around which they can organize their reading and thinking about international relations.

There is a presumption that all students majoring in international relations will spend some time overseas. However, if convincing justification is offered, this presumption may be waived by the Committee. The duration of a student's stay overseas, and the point in his or her undergraduate education at which this is undertaken, will depend on the individual's decision, in consultation with his or her advisor.

The International Relations Program offers an honors program, as well as awarding a limited number of grants for honors research, particularly in exploring relationships between the humanities and international relations. Petitions and a statement of procedures for enrolling in the honors program, which must be submitted at least three quarters before the student's graduation, are available from the office of the program in the Center for Research in International Studies (Building 460, Room 465).

Courses

It should be noted that course offerings at Stanford often change after catalogue copy is sent to the printer. Students are advised to check each quarter's Time Schedule carefully.

REQUIRED COURSE FOR ALL MAJORS

How Nations Deal with Each Other—(Enroll in History 35 or Political Science 35.) A general course in international relations, emphasizing the interaction of political, economic, social and cultural factors. Special attention will be given to problems of international conflict and distribution of wealth. A variety of analytical approaches, drawn from economics, history, political science, and moral philosophy, will be used to develop explanations of events and prescriptions for policy.

5 units, Aut (Keohane) MTWThF 11

CLUSTER A: POLITICAL HISTORICAL EMPHASIS

The World and the West: The Impact of Europe on the Third World—(Enroll in History 77.) A survey, through case studies that illustrate general patterns, of the relations between Western civilization and those of the Third World from the Spanish and Portuguese explorations of the fifteenth century to the present. Though diplomatic and
military relations will be given consideration, the emphasis will be on broader patterns of comparative development and cultural interchange.

4 to 5 units, Spr (Bowser, Irwin)
MTWTTh 10

Political Change in Tropical Africa—(Enroll in Political Science 118A.) Examines the colonial situation, the growth of nationalism, the achievement of political independence, ethnic patterns in new states, civilian and military leadership, the role of party and bureaucracy, problems in development planning, and efforts at pan-African cooperation.

5 units, Win (Abernethy) MWF 9

Southern Africa: The Domestic and International Politics of Race—(Enroll in Political Science 118B.) Examines the political histories of ten countries with special attention to South Africa, Angola, and Mozambique. Stresses the interaction of domestic and international politics, through an analysis of apartheid’s international implications, regional transport networks, African liberation movements, the pattern of foreign investment, and military trends in the region.

5 units, Spr (Abernethy) MWF 9

Russian Foreign Relations since 1917—(Enroll in History 122B.)

4 to 5 units (Lederer) given 1975–76

International Communism—(Enroll in History 123B or Political Science 132B.) A survey of the development of communism as an international movement, its organizational forms and ideology, with particular emphasis on problems of authority and control, tensions among and within its national components, and varieties of social composition, political strategies, successes and failures.

5 units (Dallin) given 1976–77

International Law—(Enroll in Political Science 130.) A broad overview of theories, development, present state and propensities of international law as a process in various critical arenas of international interaction.

4 to 5 units, Win (Triska) TWTh
2:15–3:30

The International System and Comparable Systems—(Enroll in Political Science 133.) A comparison, in terms of conflict and integration, of historical and contemporary international systems with selected inter-city systems (in ancient Greece, for example), certain inter-band and inter-tribal systems, and the like, with consideration for some possible future trends.

5 units, Win (North) given 1976–77

The Diplomatic Revolution of Our Time—(Enroll in History 135 or Political Science 135.) An investigation of the problems raised by the collapse of the traditional system of Western diplomacy as a result of two world wars, the expansion of the diplomatic community, the breakdown of its homogeneity, the emergence of new nations, tensions between great and small powers, negotiations between states with conflicting national and cultural traditions, the functions and limitations of international organizations, and the new dimensions of diplomacy that have emerged since 1945.

5 units, Win (George, Staff) MWTTh 11

Seminar on Force and Diplomacy—Student Research—(Enroll in Political Science 135R.) Prerequisite: Political Science 135.

5 units, Spr (George) W 2:15–4:05

The World of Superpowers in the Seventies—(Enroll in Political Science 137.) A comparative and interactional study of the superpowers—U.S., China, USSR, Europe, and Japan—in terms of recent major events and developments. Emphasis is on political change and formulation of theory of political dynamics.

4–5 units, Spr (Ike, North, Triska) MTWTTh 1:15–2:05

Problems of Arms Control and Disarmament—(Enroll in History 138A,B or Political Science 138A,B.) General international politics, international law and relations, stressing political, legal and technological aspects of national security problems and arms control. 138A is a prerequisite to 138B; the second quarter in 1975–76 will be a simulation of an arms control negotiation.

138A—5 units, Win (Lewis, L. Weiler, Barton, Staff) MTWTTh 1:15
138B—5 units, Spr (Lewis, L. Weiler, Barton, Staff) MWF 1:15 and tutorials by special arrangement

Strategic Doctrines and Security in East Asia—(Enroll in Political Science 138W.) Problems of security in East Asia viewed primarily within the context of strategic doctrines of the United States, with attention also to strategic thinking in Japan, China,
the USSR and those Asian nations which have been the scene of armed conflict since World War II. The course will examine the nature of conflict in the region and analyze critically the Asian application of a wide range of strategic concepts, including the open door, containment, the domino theory, nonalignment, massive retaliation, flexible response, limited war, counterinsurgency, people’s war, the Nixon Doctrine, regionalism, and neutralization. Many cases will be surveyed, but special attention will be given to the Indochina conflict, the Korean war, the U.S.-Japan alliance, and the problem of nuclear proliferation in Asia.

5 units, Spr (Weinstein) MTWF 11

Chinese Foreign Policy—(Enroll in Political Science 139.) Analysis of China’s goals and conduct in world affairs. The principal themes of the course are the historical roots of Chinese foreign policy; China’s dilemmas as a revolutionary power; and the domestic context of China’s foreign relations.

5 units, Win (Harding) MTWTh 9

Seminar: U.S. Foreign Policy Toward the Third World—(Enroll in Political Science 141.) Major themes in U.S. foreign policies—political, economic, and military—toward Asia, Africa, and Latin America since 1947, and analysis of contemporary issues in U.S.-Third World relations. Mainly for juniors and seniors.

5 units, Spr (Packenham) T 4:15-6:05

Seminar-Workshop: United States-China Relations—(Enroll in Political Science 141L.) This workshop will concentrate on major currents in U.S.-China relations. Students will complete research on selected problems and work together to develop a coherent assessment of all major issues affecting U.S.-China relations.

5 units, Spr (Lewis, Li) Th 2:15-4:05

The Dynamics of National Expansion—(Enroll in Political Science 142.) Readings and research in the processes of colonialism and other forms of national expansion.

5 units, Win (North) T 4:15-6:05

Seminar on U.S. Foreign Policy-Making Process—(Enroll in Political Science 144.) Focus on presidential-level decision-making, the organization and operation of the National Security Council and the informational and advisory role of other departments and agencies in the Executive Branch. Theoretical approaches and case studies. Enrollment limited to 15 juniors and seniors with previous courses in international relations and public administration.

5 units, Spr (George) TTh 2:15-4:05

Seminar: Dynamics of International Conflict—(Enroll in Political Science 145.) Expansion, competition, arms races, conflicts and crises.

5 units, Win (North) Th 4:15-6:05

American Foreign Policy and the Age of War: World War II and the Cold War—(Enroll in History 172.)

4 to 5 units, Win (Bernstein) MTWThF 11

Latin America and the African—(Enroll in History 182.) This course examines the economic, political and cultural ties that have existed between Latin America and Africa since the 16th century. The current prospects for cooperation and rivalry between the two areas are discussed in some detail.

4 to 5 units, Win (Bowser) MTWTh 10

Imperialism and the International Order in Modern East Asia—(Enroll in History 190.)

5 units, Aut (Duus, Van Slyke) given 1976-77

Seminar on the United States and the Pacific—(Enroll in Political Science 225.) An analysis in political, strategic, economic and cultural terms of recent and contemporary United States relationships with major states and regions bordering the Pacific Ocean. Attention will be focused on the process by which a society and polity that has always been Atlantic and European in its principal orientations has gradually acquired an increasingly important Pacific orientation, as well.

5 units, Win (Ward) T 2:15-4:05

Seminar in International Law—(Enroll in Political Science 230.) Survey of recent international law developments. Particular attention will be given to the oceans and to the Law of Sea conferences, as well as to
issues such as hijacking; terrorism; international pollution; and new states.

5 units, Spr (Triska) M 4:15-6:05
Seminar: International Relations Theory—(Enroll in Political Science 243.) Examines and compares both traditional and some of the more contemporary approaches to international relations theory from an interdisciplinary viewpoint. Realists, idealists, behavioralists, environmentalists, socio-cultural evolutionists, futurists, and others.

5 units, Aut (North) T 4:15-6:05
Undergraduate Seminar: The Cold War—(Enroll in History 269S.) This research seminar, which requires a major paper (18-25 pages) is designed to introduce students to some of the major problems and interpretations in the Cold War, and to give them an opportunity to do research in depth on a problem. Readings will be drawn from, among others, Gabriel Kolko, W. A. Williams, Arthur Schlesinger, Adam Ulam, Robert Tucker, Herbert Feis, George Kennan, and Graham Allison.

5 units, Win (Bernstein) W 2:15-4:05
CLUSTER B: HUMANITIES EMPHASIS
Race and Culture Contact in the Caribbean—(Enroll in Anthropology 104.) Types of social systems and cultural patterns in the West Indies arising from relations between Europeans, West Africans, and Asians, with implications for development and social change.

5 units, Win (Drake) MWF 1:15
Japanese-Western Literary and Cultural Interactions—(Enroll in Asian Languages 110 or Comparative Literature 110.) Discussion of cross-literary and cross-cultural topics, such as haiku in English, Marxism in Japanese prose fiction, and Zen in American literature. Graduate students may register under J257, in which case they will be required to do additional work.

4 units, Win (Ueda) M 2:15-4:05
Slavic Civilizations—(Enroll in History / Slavic 117A and B, and History / Slavic / Political Science 117C.) A three-quarter sequence, each quarter of which may be taken separately. The first quarter, led by Professor Vucinich, deals with Slavic Civilization to 1700. The second quarter, led by Professor Atkinson, covers the period from 1700 to 1914. The third, taught by Professors Dallin or Triska, deals with the contemporary period. The approach in this sequence is interdisciplinary, utilizing lecturers from the various disciplines with competence in the field and integrating readings and lectures so as to give the student an understanding of the distinct contributions made by the various Slavic peoples. The course treats the histories and cultures of Bulgaria, Czechoslovakia, Poland, Russia and Yugoslavia.

5 units each quarter, Aut, Win, Spr (Vucinich, Dallin, Atkinson, Triska and Staff)
Christianity—(Enroll in Religious Studies 124.) Ten historic types of Christian religion: martyr and monk, philosopher and prelate, mystic and theologian, pietist and moralist, apologist and activist. The main cultural crises and intercultural transactions in Europe that elicited these life-styles. Christianity as transmitter and transformer of Palestinian, Hellenistic, Germanic, Holy Roman, territorial, and modern national culture.

3 to 5 units, Spr (Clebsch) MWF 9
The Meeting of Eastern and Western Art—(Enroll in Art 126E.) The interaction between the art of the Far East, Europe, and America from the 16th Century to the present day.

4 units, Aut (Sullivan)
War and Society—(Enroll in History 128A.) An analysis of military affairs and of their interaction with intellectual, social, economic and political history since the Renaissance. The lectures are grouped around major themes such as the impact of violence on political development, ethical theories of war, the use of war as an instrument of policy.

5 units, Win (Paret) given 1976-77
European Roots of American Democratic Thought—(Enroll in Political Science 165.) This course, which will be offered this year as a seminar and later as a lecture course, will explore the connections between European and American democratic theory. We will first read those European political philosophers who have made the most important contributions to American political thought, including Machiavelli, Locke, and Montesquieu. Then we will concentrate upon colonial and constitutional American po-
tical thought, with special attention to the political theories of the Revolutionary period. We will then turn back to look for references to America in French Revolutionary materials, and deal fairly extensively with Tocqueville. There will be a final section on contemporary American democratic theory.

5 units, Spr (N. Keohane) W 2:15-4:05

Colloquium on National and International Identity—(Enroll in Comparative Literature 194A, Modern Thought and Literature 194A, or English 194A.) Intensive study of national and international dimensions of literature, drama, and thought, with emphasis on modern problems of identity in Anglo-American and European cultures. Topics will include nationalism and national revivals in the British Isles, the United States, and Europe. Enrollment limited to 15.

5 units, Spr (Halliburton) Cliveden

Ethics, Morality and International Relations—(Enroll in Humanities 197.) The purpose of this seminar is to analyze the application of ethical principles to policy decisions involving international relations. This analysis requires acquaintance with ethical principles, practice in applying these principles to situations, and critical evaluation of the application of these principles. To what extent do actual decisions of policymakers comply with ethical principles? Why is this the case? Why might one think that such decisions ought to comply with certain principles?

5 units, Spr (Rhinelander)

Politics, Society and Art in Modern European History—(Enroll in History 229.) Topics of the course vary from year to year. Such topics have included “Irony and realism in 19th century literary and graphic interpretations of European society.”

5 units, Aut (Paret) given 1976–77

Humanities and International Relations: The Twentieth Century in Europe—(Enroll in History 244C) This colloquium will consider through discussions, reports and papers, the movement of literary and artistic ideas within Europe from the end of the 19th century through the great age of the Modern Movement, against a background of political change and upheaval. The historical reasons for such developments will be sought and the readings will include a firm basis in the history of the period. Most of the course will be devoted to considering works characteristic of aspects of the twentieth century and its sensibility, as these were affected or transformed when moving from country to country, such as Oscar Wilde’s Salome, written in French by an Anglo-Irishman, illustrated by an English artist (Aubrey Beardsley) and made into an opera by a German composer (Richard Strauss). Topics to be considered include artistic styles of Glasgow as related to those of Vienna, art nouveau, the Russian ballet, cubism, as well as the historical significance and the question of international relations of ideas in selected works of Proust, Joyce, and Eliot. Some background in European history and/or literature is required.

5 units, Aut (Stansky) Th 2:15–4:05

Enlightenment Ideas of Prison: Literature, Social Order, and the Pan-European Reformers—(Enroll in English / Comparative Literature / Modern Thought and Literature 267.) Study of captivity and boundaries, escape and reform, in eighteenth-century literature, thought, and art. Emphasis on international currents in the period with concentration on England and France; reference to Italy, Germany, and America. Reading will emphasize literature and will include Voltaire, Johnson, Godwin, and Bentham.

5 units, Win (Bender) given 1976–77

CLUSTER C:
POLITICAL-ECONOMIC ISSUES
AND POLICY ANALYSIS

The World Food Economy—(Enroll in Food Research 103 or Economics 106.) This course will examine the interrelationships between food, population, and economic progress. The emphasis will be on the role of agriculture in the economic and social development of low-income nations. Attention will also be given to the economic and nutritional characteristics of the major categories of food and changes in food consumption associated with economic development.

3 units, Spr (Johnston) MWF 10

The Economics of Underdevelopment—(Enroll in Food Research 118 or Economics 118.) This course presents an analysis of development within an historical perspective. The development process is analyzed
with regard to the mechanisms of capital accumulation, technical change, and trade. Discussion is focused upon various theories and empirical evidence relevant for understanding the current structure and operation of underdeveloped countries.

5 units, Aut (Staff)

Socialism in Cuba and Chile — (Enroll in Political Science 119.) An examination of the two socialist experiences in Latin America. The interrelationships between political, economic, and cultural change will be stressed.

5 units, Aut (Eagen) T 2:15-4:05

Seminar: Latin American Dependency Theories — (Enroll in Political Science 124.) Main themes and issues in contemporary Latin American dependency theories. For both undergraduates and graduates.

5 units, Aut (Packenham) T 4:15-6:05

International Dependency—(Enroll in Political Science 131.) What is meant when we say that one state is dependent upon another, more powerful state? What are the implications of a dependency relationship for the domestic political economy of both parties? What occurs when a weak state tries to reduce its dependence on a strong state? These questions will be examined through an historical analysis of European colonialism and through contemporary case studies, including U.S.-Peru, U.S.-Canada, France-Senegal, and the Soviet Union-Czechoslovakia. Desirable prerequisite: History / Political Science 35.

5 units, Spr (Abernethy) MWF 1:15

International Organizations in World Politics—(Enroll in Political Science 134.) Analysis of the role of international organizations in contemporary world politics. Attention will be concentrated less on traditional peacekeeping activities of organizations such as the United Nations than on new issues facing international organizations, particularly arising from international and transnational interdependence in a variety of issue-areas. (Graduate students enroll in Political Science 233C.)

5 units, Win (R. Keohane) MTWTh 9

Underdevelopment and Foreign Policy — (Enroll in Political Science 137W.) An examination of the problems which the condition of underdevelopment poses for foreign policy and alternative ways of dealing with these problems. Particular attention will be given to the meaning of underdevelopment; the nature of foreign policy elites and the domestic political determinants of foreign policy; the nonaligned movement and its significance; independence and development as goals of foreign policy; foreign aid, neo-colonialism, and dependency relationships; foreign investment and problems of dealing with multinational corporations; and “resource diplomacy,” with emphasis on the experience of OPEC and its implications for development in the Third World. Illustrations will be drawn mainly from Southeast Asia.

5 units, Aut (Weinstein) MTWF 11

Seminars:

Seminar: Political Economy of U.S.—Latin American Relations — (Enroll in Political Science 143.) Limited to advanced undergraduates, knowledge of Spanish or Portuguese recommended. Consent of instructor required.

5 units, Win (Fagen) T 2:15-4:05

Cross-Discipline Seminar: Decision-Making in International Development — (Enroll in Political Science 140A,B,C, Engineering 297A,B,C, and Social Thought 197A,B,C.) Students in Political Science and several other disciplines will learn how their fields of specialization interact with problems of population, food, natural resources, energy, technology and human values. Wise decision-making in the world of tomorrow must depend upon an understanding of the meaning of interdependence—between man and man, between man and his environment, between nation and nation and between present and future generations. Autumn quarter will seek to define the global and national problems related to human survival utilizing specialists from several academic disciplines. Winter quarter will focus upon the ethics of development and strategies for change. Spring quarter will concentrate on the role and responsibility of the individual in his own society. (The course may be taken for 1 unit pass/fail or for more graded units with an individual project.)

140A. 1 to 3 units, Aut (Cooper, McWhorter, North and others)
   M 7:30-9:30

140B. 1 to 3 units, Win (Cooper, McWhorter, North and others)
   M 7:30-9:30

140C. 1 to 3 units, Spr (Cooper,
McWhorter, North and others)  
M 7:30-9:30

Trade and Development Problems of Tropical Africa — (Enroll in Economics 160 or Food Research Institute 160.) Analysis of selected international aspects of tropical African economic development. Topics include African / non-African international trade and economic relations (theoretical background, historical perspective, case studies of export-led growth and the impacts of international capital flows) and intra-African trade and economic integration (customs union theory, historical perspective, case studies of African economic integration).

3 to 5 units, Spr (Kofi) MW 2:15-4:05

International Economics I — (Enroll in Economics 165.) Comparative advantage in production and trade among nations, the international monetary mechanism; domestic monetary, fiscal and tariff policies and their relationship to foreign trade. Prerequisite: Economics 1.

5 units, Aut (——)

International Economics II — (Enroll in Economics 166.) Selected topics in international economics, with emphasis on individual study, seminar presentations, and discussions. Enrollment limited to 16. Prerequisite: Economics 165.

5 units, Win (Pearson)

Problems in International Political Economy — (Enroll in Economics 168.) This course introduces the student to the complexity and controversy of international economic policy problems through the study of a selected number of specific policy-making situations relating to international economic policy. Approximately one-third of the sessions are devoted to small group policy conferences in which students present and discuss “position papers” on specific policy problems. These problems are studied primarily through sets of specially prepared source materials on trade policy, international monetary policy, and international development policy. Lectures present some international economic principles that can be applied to the problems and place the problems in their wider context. Considerable independent study is encouraged. Prerequisite: Economics 1. Enrollment will be limited to 45 students with priority to economics and international relations majors.

5 units, Aut (Meier) TTh 4:15-6:05

Seminar: Transnational Relations — (Enroll in Political Science 241.) From the perspective of theory in international relations, this seminar will attempt a critique of traditional state-centric models of world politics. From a substantive point of view, the focus will be on the politics of international economic issues and ways in which international arrangements might be constructed to deal with them. Students will have the opportunity to investigate at least two issue-areas in depth.

5 units, Spr (R. Keohane) T 4:15-6:05

LANGUAGE LABORATORY

Director and Adjunct Professor in Spanish and Portuguese: Phillip B. Petersen
Assistant Director, Electronics Engineer and Lecturer in Language Laboratory: John Metcalfe

The Language Laboratory with one hundred and fourteen Level III (listen-respond-record) student positions offers varied programs in Amheric, Arabic, Cambodian, Cantonese, Cebuano, Czech, Dutch, English as a foreign language, French, German, Greek, Hausa, Hebrew, Indonesian, Irish, Italian, Japanese, Korean, Latin, Lithuanian, Mandarin Chinese, Norwegian, Persian, Polish, Portuguese, Quechua, Quiche, Rumanian, Russian, Spanish, Swahili, Swedish, Thai, Twi, Vietnamese, Yoruba, and Yucatec.

Whether engaged in formal language studies or not, students are invited to use the Language Laboratory for listening, repetition, recording and self-evaluation. As an additional aid, departmental monitors in the major languages taught at the University are supplied for individual work. The Language Laboratory is open daily. Current news from world capitals, recorded from short-wave radio, is available for advanced students.

215. Language Laboratory Techniques — (Same as Education 295.) All aspects of language laboratories are covered, from administration and equipment selection to operation of recording and playback equip-
ment. Assumes no prior experience in electronics or instrumentation.

2 units, Spr (Metcalfe) TTh 1:15
Sum (Metcalfe) MTWThF 11
(short term)

CENTER FOR LATIN AMERICAN STUDIES

Committee in Charge: The Committee on Latin American Studies, a subcommittee of the Presidential Commission on International Studies.

Chairman of the Committee and Director of the Center: John D. Wirth

The Center for Latin American Studies administers four principal programs. They are the graduate A.M., the Graduate Summer Grant Program, and two undergraduate programs: the A.B., and the Undergraduate Summer Research Program. The Center also cooperates with the Schools of Law and Education in offering two joint-degree programs.

Inquiries concerning all programs should be directed to the Director, Center for Latin American Studies, Bolivar House, Stanford, California 94305.

MASTER OF ARTS

The Latin American A.M. program is designed for (1) students who wish to pursue an interdisciplinary approach to the study of Latin America before continuing on to a relevant doctoral program in one of the social sciences or humanities; and (2) individuals who desire to add graduate-level expertise in Latin American Studies to other training necessary for careers in business, journalism, government, or one of the professions. The Departments of Anthropology, Economics, History, Political Science, Sociology, Spanish and Portuguese, and the Food Research Institute participate in the A.M. program.

To qualify for admission to the program, applicants must have the equivalent of an A.B. or a B.S. degree, training in at least one of the social sciences, and a working knowledge of Spanish or Portuguese. Applicants must also take the Aptitude Test of the Graduate Record Examination and have the results sent to the Office of Graduate Admissions. Deadline for submission of applications for admission and financial aid is January 15, 1976.

The student's program is worked out in consultation with the Director of the Center and with the faculty of the participating departments, within the framework of the following academic requirements:

a) Ten courses with a minimum of 38 units. At least eight of the ten courses must be basically Latin American in content. Students must receive grades of A, B, or plus in at least seven courses in order to complete the degree. Courses are distributed as follows:

1) Core Seminar (LAS 250, 251, 252)—an interdisciplinary course required of all A.M. candidates in Latin American Studies, taught by faculty from the participating disciplines. Fifteen units; 5 units per quarter.
2) Latin American Bibliography (LAS 260) required of all A.M. candidates in Latin American Studies. Two units.
3) Three or four courses that qualify as graduate level in a single base discipline.
4) Two or three courses distributed among other disciplines. (Relevant courses may be found in the listings for the participating departments.)

b) Demonstration of language competency in either Spanish or Portuguese at least equivalent to three years of university training (i.e., Spanish 113 or Portuguese 183). Students with advanced competency in Spanish may take elementary Portuguese for credit; otherwise, first- and second-year language courses may not be counted toward the degree. If Spanish or Portuguese is the student's base discipline, he or she must show ability in both languages. Courses in linguistics may be counted toward this concentration.

There is no thesis requirement for the A.M. degree in Latin American Studies. Instead, a paper that gives satisfactory evidence of methodological, analytical, research and writing skills is required from each member of the Core Seminar.

Since the University does not offer a Ph.D. in Latin American Studies, students who wish to remain in an academic program at Stanford after completing their A.M. must be accepted by one of the regular departments.
**Bachelor of Arts**

The purpose of the A.B. degree is to allow a small number of undergraduates to design individualized, interdisciplinary programs emphasizing independent study. Students must apply for admission to the major not later than the beginning of the second quarter of their junior year; exceptions will be made only in unusual circumstances.

The student must fulfill the following requirements for the major:

a) Completion of a coherent interdisciplinary program of at least 55 units, based on an individualized plan of study achieved in consultation with, and approved by, a faculty advisory committee. This program will ordinarily include:

1) At least 25 units in a single base discipline.
2) At least 40 units in 100-level courses or higher, focused directly on Latin America or closely related topics. (Relevant courses may be found in the listings for the participating departments.)

First- or second-year language courses do not count toward the 55 units.

b) Demonstration of language competency in either Spanish or Portuguese at least equivalent to three years of university training (i.e., Spanish 113 or Portuguese 183). An elementary reading knowledge of a second language of the area is recommended but not required.

c) Submission in the senior year of a substantial research paper of acceptable quality relating to Latin America on a topic approved by the student's faculty committee. Up to ten units may be given for preparation of the senior paper.

d) A grade average at least midway between "B" and "C" must be maintained for all letter-graded courses. Only 10 units of pass/no-credit work may be counted toward LAS degree requirements.

**Honors in Latin American Studies** will be recommended for students who have maintained a grade average at least midway between "A" and "B" for all area-related courses; completed a strong and well-designed program; and submitted a senior paper judged to be outstanding by the Subcommittee on the Undergraduate Major.

**Special Programs**

Each summer the Center sponsors a small number of juniors to conduct individual research projects in Latin America. Students must have demonstrated the ability to work independently and must possess the necessary language competence. A course in research design, LAS 152, is required the spring quarter before departure and an extensive written report is submitted the following autumn quarter for the independent research seminar LAS 153. Students from all departments are eligible to apply.

Advanced Stanford graduate students having an area concentration may apply to the Committee on Latin American Studies for summer grants for either pre-dissertational research or intensive language training.

**Joint-Dual Degree Programs**

LAS/Law—The Center for Latin American Studies and the Stanford Law School offer a joint program leading to the J.D. degree in Law and the A.M. degree in Latin American Studies. Students must apply to and be independently accepted by both Law and Latin American Studies.

LAS/Education—The degree of Master of Arts in Teaching with an interdisciplinary concentration in Latin American Studies is offered jointly by the Center and the School of Education. For the general requirements, see the section "School of Education" in this bulletin. Candidates must have a teaching credential. For other additional Latin American Studies requirements, inquiry should be made to the Center.

**Courses**

152. Undergraduate Seminar in Research—Restricted to students accepted for the Latin American Studies Summer Research Program.
   5 units, Spr (Staff) by arrangement

153. Undergraduate Independent Research—Restricted to students in Latin American Studies Summer Research Program.
   5 units, Aut (Staff) by arrangement

169. Directed Individual Study — For stu-
dents engaged in special interdisciplinary work that cannot be arranged by department. (Graduate students enroll in 269.)

198. Senior Thesis — Restricted to undergraduate majors.

1 to 10 units, Aut, Win, Spr (Staff)
by arrangement

250, 251, 252. Core Seminar in Latin American Studies—Introduction to methodologies and the status of research in the social sciences with relation to Latin America. Restricted to A.M. degree students.

5 units, Aut, Win, Spr (Staff) M 2:15–4:05

260. Latin American Bibliography — With emphasis on the contemporary period.

2 units, Aut (Breedlove) Th 12:00–1:15

LINGUISTICS

Chairman: Clara N. Bush

Professors: Charles A. Ferguson (on leave Autumn Quarter 1975), Joseph H. Greenberg

Associate Professors: Clara N. Bush, Elizabeth C. Traugott (on leave 1975-76)


Lecturers: Elaine Kaufman, Frieda N. Politzer.

Affiliated Faculty:

Professors: Alphonse Juilland, Robert L. Politzer

Associate Professors: Andrew M. Devine, Dorothy A. Huntington

Assistant Professors: Orrin W. Robinson III, Acting: James A. Fox

English for Foreign Students:

Director: Clara N. Bush
Lecturers: Beverley McChesney, Frieda N. Politzer

Special Language Program:

Coordinator: Staff

PROGRAMS OF STUDY

Linguistics offers degrees on both the undergraduate and graduate levels. For University regulations governing both undergraduate and graduate degrees, see the section “Degrees” in this bulletin. The student’s program should be prepared in advance in consultation with the student’s adviser.

Candidates for advanced degrees must have completed an equivalent of the training represented by an A.B. or B.S.

BACHELOR OF ARTS IN HUMAN LANGUAGE

The undergraduate program in Human Language emphasizes the role of language in man’s thinking and social behavior. It is an interdisciplinary major sponsored by Linguistics which draws not only on the courses specifically created for the major but also on areas of instruction available elsewhere in the university. This major cuts across the Humanities, Social Sciences, and Physical Sciences, and provides a solid general education as a background for advanced studies in such fields as Anthropology, Communications, Computer Science, Education (Language Arts and Language Teaching), Hearing and Speech Sciences, Languages, Linguistics, Philosophy, and Psychology.

Requirements for the A.B. include study of a foreign language, six core courses, and more advanced courses in an area of specialization.

1. Language. Majors are required to have training in one foreign language, equivalent to at least two years of college language courses. Since the language skills acquired will be used primarily to exemplify linguistic concepts, students are encouraged to learn a non-Indo-European language.

2. Courses. The six core courses are Linguistics 1, 10, 30, 45, 50, and 60 (27–30 units). Linguistics 1 (4–5 units) is a prerequisite for all the others, though it may be taken concurrently. At least three of the core courses must be taken for the full five units of credit.

A minimum of three advanced courses is required in one particular area of specialization listed below, to be planned in consultation with the student’s adviser. Courses from allied departments (Anthropology, Languages, Psychology, etc.) may also be chosen to fulfill this requirement.

a) Formal aspects of language (e.g., grammar construction; formal grammars; artificial intelligence)

b) Social aspects of language (e.g., language, culture, and society; language variation in space and time; urban lan-
c) Cognitive aspects of language (e.g., language and mind; signs and symbols; communication systems)

d) Physical aspects of language (e.g., physiology and acoustics of speech; perception and production; communicative disorders)

e) A particular language or language area, over and above the language requirement stated above (e.g., languages of Africa, History of English, Romance linguistics, Chinese, German, etc.)

3. Honors Program. Students majoring in Human Language who plan to apply for graduate studies in Linguistics should without exception seek departmental honors; students who plan to apply for graduate studies in fields related to Human Language are strongly advised to do so. An application to pursue honors work should be presented well before the end of the junior year; approval will be given only to students who have maintained an average of B or better in the courses required for the major.

In addition to fulfilling the requirements for the major, honors students will take at least three additional advanced courses (12-15 units) from any one of the five areas of specialization; students planning to apply for graduate work in Linguistics are advised to take three courses in Area A (the formal aspects of language), if they have not already done so in completion of the requirements for the major.

Every honors major will take Linguistics 198, the Honors Seminar, in the Autumn of the senior year (5 units), in which he or she will prepare a project on a topic approved by the faculty member in charge of the Honors Seminar. The honors project must be submitted in final, acceptable form no later than six weeks before the date of intended graduation.

Graduate Degrees

The following requirements are in addition to the University residency requirement for the degree sought. Candidates should review departmental Guidelines for A.M. and Ph.D. Degrees for further particulars concerning these requirements.

Master of Arts

1. Candidates must demonstrate their proficiency in reading linguistic literature in one foreign language, preferably French, German or Russian. If the candidate's area of specialization or professional goals make a different kind of proficiency more appropriate or favor a language other than these three, this requirement may be satisfied otherwise through the mechanism of a petition subject to approval by the Graduate Studies Committee.

2. Courses. Candidates must complete a minimum of 36 units of graduate work in linguistics and allied fields, including the six core graduate courses (200, 215, 220, 221, 230, 240), which total 24 units, and the option of up to 6 units for a research project or A.M. thesis; see 4 below. Courses to be counted toward the A.M. which are not in general linguistics are to be approved by the adviser. Candidates coming to the program with no previous background in linguistics may expect that the ratio of course work in linguistics to work in allied fields will be greater than for candidates with some previous preparation in linguistics. A grade point average of at least B must be maintained for all degree program course work.

3. Examination. Candidates must successfully pass a general examination, testing for synthesis of the subject matter of general linguistics, and containing, in addition, an essay question on the area of specialization of the candidate, with the choice of substituting an essay question on general linguistics.

4. Thesis. Terminal A.M. candidates are expected to present a formal A.M. thesis, fulfilling the University requirements specified in the "Degrees" section of Courses and Degrees.

Under appropriate circumstances, a Ph.D. candidate may petition the Graduate Studies Committee for a waiver of the A.M. thesis requirement. (See departmental Guidelines for details.)

Master of Arts in Teaching

The degree of Master of Arts in Teaching is offered jointly by Linguistics and the School of Education. In addition to completing a minimum of 26 units in linguistics courses, to be selected in consultation with
the Chairman of Linguistics, the candidate must pass a comprehensive examination. The general requirements for the degree are outlined by the School of Education in this Bulletin.

**MINOR IN LINGUISTICS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY**

1. **Courses.** Candidates must complete a minimum of 30 units of graduate work in linguistics and allied fields, including the six graduate core courses (24 units) and the option of up to 6 units for a research project. Courses to be counted toward the minor which are not in general linguistics are to be approved by the linguistics adviser.

2. **Research project (optional).** Candidates may elect to present a paper which integrates the subject matter of linguistics into the field of specialization of the candidate.

3. The linguistics adviser will serve on the candidate's University Oral examination committee and may request that up to one-third of the examination be devoted to the minor subject.

**DOCTOR OF PHILOSOPHY**

1. **Language:** Candidates must demonstrate their ability to read at least one foreign language with sufficient facility to understand and to interpret the linguistic research published in that language. (Particular areas of specialization may require additional research languages.)

In addition, each candidate must demonstrate an explicit in-depth knowledge of the structure of at least one language (normally neither the candidate's native language nor the language used for the reading exam).

2. **Courses.** A minimum of 80 units of graduate work beyond the A.B. or B.S. exclusive of dissertation units, at least 48 of which are in general linguistics, or, beyond the A.M., 40 units exclusive of dissertation units, at least 24 of which are in general linguistics.

3. **Examinations.** Successful passing of two examinations:
   a) A qualifying examination on the principles of general linguistics and the theory, methods, and techniques of the main linguistic disciplines. The examination will presuppose at least the kinds of materials available in 200, 215, 220, 221, 230, and 240. It will normally be taken prior to the end of the first year.
   b) A field of specialization such as anthropological linguistics, applied linguistics, computational linguistics, developmental psycholinguistics, grammatical theory, hearing and speech sciences, historical linguistics, a language or language group, sociolinguistics, or some combination of these. The examination will normally be taken prior to the end of the third year.

4. **Research.** Experience in preparing a research project other than the dissertation. May be fulfilled by 398 (up to 6 units), the A.M. thesis, or participation in an established project (see Research below).

5. **Teaching.** A minimum equivalent to one-half of one quarter during the second or third year in residence.

6. **Colloquia.** Two oral presentations exclusive of the oral presentation of thesis proposal (see 7a below). One of these two colloquia may be given in a seminar; both should be given during the first three years of study.

7. **Dissertation.**
   a) Oral presentation of thesis proposal in colloquium.
   b) Approval of dissertation topic and appointment of a dissertation committee by the Chairman.
   c) Successful passing of a University Oral examination on the Dissertation Project and related areas.
   d) Dissertation (up to 15 units).

**SPECIAL LANGUAGE COURSES**

*(80A,B,C,81A,B,C,83A)*

Students interested in studying a modern foreign language not regularly taught at Stanford, such as Arabic, Bengali, Czech or Modern Hebrew, may propose a Special Language Course. Students will be expected to give a reasonable justification for including the study of the special language in their educational experience at Stanford. If the proposal is approved and suitable arrangements for instruction and evaluation can be made, a course will be set up and students
may enroll with or without credit. The proposal should be made at least one month before the quarter in which the course is to be given.

Normally a Special Language Course will be set up for groups of three to ten students at the elementary level, but in special cases a course may be set up at an intermediate level or even for an individual student. The instructor will be a member of the Stanford community who by training or personal knowledge of the language is qualified to teach it as a special course. Special Language Courses will be arranged on a quarter to quarter basis and maximum credit for one quarter will be 5 units. Considerable variation in teaching approaches should be expected but a degree of uniformity will be accomplished by a set of guidelines given to instructors. Regular letter grades with pass/fail option will be given.

Special Language Courses supersede ad hoc language courses set up under SWOPSI, SCIRE, and Undergraduate Specials.

Address all inquiries to Coordinator, Special Language Courses, Linguistics 101B, or telephone 497-3279.

RESEARCH

The department maintains a program of basic research in linguistics and related fields. The major projects are language universals, phonological archiving, study of child language development, and sociolinguistics. A limited number of research assistantships and associateships are available, graduate and postdoctoral.

COURSES

Courses are offered in (1) grammatical theory, i.e., the general goals and history of linguistic analysis and theory (numbers 0-14); (2) phonetics and phonology (numbers 15-29); (3) syntax and semantics (numbers 30-44; (4) language variation and sociolinguistics (numbers 45-59); (5) developmental psycholinguistics (numbers 60-64); (6) computational linguistics (numbers 65-69); (7) applied linguistics (numbers 70-74); (8) methods (numbers 75-79); (9) languages (numbers 80-94).

UNDERGRADUATE


4 units, Aut (Greenberg, Huntington and Staff) MWF 10


5 units, Aut (Fox) MWF 9:00

30. Introduction to Generative Grammar. Survey of the development of generative phonology, syntax, and semantics from the fifties to the present. Includes Halle's argument against the autonomous phoneme, Chomsky's arguments for transformations, the generative-interpretive controversy in semantics, and other topics. Graduate students should enroll for Linguistics 130. Pre-requisite: Linguistics 1 or consent of instructor.

4 units, Win (Oehrle, Wasow) MWF 10


5 units, Win (Fox) MWF 9

50. Language in Use—The structure of conversation and other forms of discourse. Emphasis on the functions of language in different contexts, rhetorical strategies, and appropriateness conditions of speech acts. Pre-requisites: Linguistics 1 or consent of instructor.

4 units, Spr (Staff) by arrangement

60. Language and Mind — Language and the mental processes of individuals. Language behavior as an indicator of thought processes and emotional states, and language as a component and partial determi-
nant of such processes. Abnormal language: aphasia, schizophrenia, altered states of consciousness. Prerequisite: Linguistics 1 or consent of instructor.

4 units, Spr (Staff) by arrangement

80A,B,C. Elementary Special Language Courses. See "Special Language Courses." Aut, Win, Spr (Staff) by arrangement

81A,B,C. Intermediate Special Language Courses. See "Special Language Courses." Aut, Win, Spr (Staff) by arrangement

83A. Special Language Orientation—Arabic: An introduction to the Arabic language, designed primarily as orientation for students in the Stanford overseas program at the American University of Beirut. Includes a sketch of the structure of Arabic, basic study of the spoken Arabic of the area, and an introduction to the writing system. Special attention to aspects of Middle Eastern culture reflected in the language.

5 units, Spr (Staff) by arrangement

114. History of Linguistic Theories—(Same as Anthropology 172/372.) Historical survey of ancient, medieval, and modern theories of language mainly in the Western tradition but including medieval Arab and Jewish contributions.

5 units, Spr (Greenberg) by arrangement

130. Introduction to Generative Grammar —Content same as 30.

4 units, Win (Oehrle, Wasow) MWF 10

145. Language, Society, and Culture—Content same as 45.

5 units, Win, Spr (Fox) MWF 9

146. Bilingualism in the Chicano Community—(Same as Spanish and Portuguese 216.) An exploration of the general nature of bilingualism, focusing on its use by Chicanos. The course will examine the social and psychological effects of bilingual learning, code-switching, and language maintenance.

3 units, Spr (Hernandez-Ch.) TTh 11:00-12:30

159. Language and Culture—(Same as Anthropology 167.) The relevance of linguistic theory, semantic analysis, and the study of speech as social behavior to problems of anthropology, sociology and psychology. Prerequisite: consent of instructor.

Given alternate years

170A. Introduction to Methods of Teaching English as a Foreign Language—A practical approach to problems of teaching English to speakers of other languages, including a survey of those features of English phonology, morphology and syntax which present particular difficulties, presentation of problems, construction of exercises and lesson planning.

3 units, Win (F. Politzer) MWF 10

170B. Practicum in TEFL—Workshop for volunteers currently active in area TEFL programs; discussion of teaching problems and evaluation of effectiveness of classes. Prerequisite: 170A or equivalent.

1 unit, Spr (F. Politzer) by arrangement

170C. Overseas Practicum in TEFL — Available only by prearrangement, and to students who have the prerequisite: 170A and 170B or consent of instructor.

5 units, any quarter student is registered in absentia (F. Politzer) by arrangement

180. Structure of the English Language—(Same as English 101.) Study of what it means to be a "native speaker of English." Emphasis on the semantic, syntactic, and phonological structure of English, with some attention to the application of linguistics to literature.

5 units, Aut (Oehrle) TWThF 3:15

181. Structure of Hausa—Survey of the syntax and phonology of Hausa, with emphasis on ways in which it differs from Indo-European languages. Study of the linguistic literature on Hausa.

4 units (Leben) given on demand

182A,B,C. Spoken Quiche Maya—(Same as Anthropology 177.) Introduction to the language of the Quiche Maya Indians of Guatemala. Full set of tapes and textbook available.

5 units, Aut, Win, Spr (Fox) given 1976-77

183A,B,C. Spoken Yucatec Maya—(Same as Anthropology 172.) Introduction to the language of the Yucatec Maya Indians of Mexico. Full set of tapes and textbook available.

5 units, Aut, Win, Spr (Fox) MTWThF by arrangement

185A,B,C. Beginning Hausa.

5 units, Aut, Win, Spr (Leben) MTWThF 12
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Quarter</th>
<th>Instructor</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>186A,B,C</td>
<td>Intermediate Hausa</td>
<td>5</td>
<td>Aut, Win, Spr</td>
<td>(Staff) by arrangement</td>
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<tr>
<td>190A,B,C</td>
<td>Beginning Swahili</td>
<td>5</td>
<td>Aut, Win, Spr</td>
<td>(Kaufman) by arrangement</td>
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<tr>
<td>191A,B,C</td>
<td>Intermediate Swahili</td>
<td>5</td>
<td>Aut, Win, Spr</td>
<td>(Staff) by arrangement</td>
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<tr>
<td>193A,B,C</td>
<td>Beginning Yoruba</td>
<td>5</td>
<td>Aut, Win, Spr</td>
<td>(Kaufman) by arrangement</td>
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<tr>
<td>199.</td>
<td>Independent Study</td>
<td>1+</td>
<td>any quarter</td>
<td>(Staff) by arrangement</td>
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<td><strong>GRADUATE</strong></td>
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<tr>
<td>200.</td>
<td>The Coals of Grammar—An introduction to the kinds of assumptions linguists make in defining language and in constructing grammars; emphasis on synchronic vs. diachronic study, on competence vs. performance models, on the innateness hypothesis, and on criteria for evaluating grammars and testing hypotheses.</td>
<td>4</td>
<td>Win</td>
<td>(Staff) TTh 10:00-11:50</td>
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<tr>
<td>201.</td>
<td>Introduction to Formal Grammars—Mathematical background of transformational grammar. Elementary introduction to formal grammars as models of natural language. Properties of phrase-structure grammars, finite-state, context-free, context-sensitive. Prerequisite: consent of instructor.</td>
<td>4</td>
<td>Win (Staff)</td>
<td>TTh 10:00-11:50</td>
<td>Given alternate years</td>
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<tr>
<td>202.</td>
<td>Mathematical Linguistics—(Same as Philosophy 201.) Investigation of mathematical results relevant to empirical issues in linguistics. Special attention given to the theories of Peters and Ritchie concerning the generative capacity of transformational grammar and the work of Hamburger and Wexler on learnability of grammars.</td>
<td>3</td>
<td>Spr</td>
<td>(Wasow) TTh 2:15-3:30</td>
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<tr>
<td>205.</td>
<td>Current Issues in Linguistic Theory—In-depth examination of a subject of current controversy, chosen for its far-reaching consequences for linguistic theory. May be repeated for credit.</td>
<td>4</td>
<td>Win (Hernandez-Ch.)</td>
<td>TTh 9:00-10:50</td>
<td>Given alternate years</td>
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<tr>
<td>206.</td>
<td>Grammatical Theories—Selected topics in non-transformational grammatical theory. May be repeated for credit. Prerequisite: 200 or consent of instructor.</td>
<td>4</td>
<td>Aut (Staff)</td>
<td>TTh 10</td>
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<tr>
<td>208.</td>
<td>Typology and Universals of Language—(Same as Anthropology 174.) The methodology of structural comparisons of languages; the connection between typological analyses and generalizations about language; universals of language in phonology, grammar, and semantics; problems concerning deductive explanation of universals. Limited enrollment. Prerequisite: elementary linguistics course or consent of instructor. Seminar course.</td>
<td>4</td>
<td>Win (Staff)</td>
<td>TTh 10</td>
<td>Given 1976-77</td>
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<tr>
<td>209.</td>
<td><strong>Phonetics and Phonology</strong></td>
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<td>215.</td>
<td>Foundations of Phonetic and Phonological Analysis—Training in broad transcription; introduction to the articulatory mechanism and to the distinctive features of speech sounds. Beginning practice in phonological analysis (extracting sound patterns from limited bodies of language data).</td>
<td>4</td>
<td>Aut (Bush and Hernandez-Ch.)</td>
<td>TTh 2:15-4:05 and dhr</td>
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<td>216.</td>
<td>Phonetic Theory—(Same as Hearing and Speech Sciences 212.) Consideration of the fundamental assumptions implicit in phonetic descriptions and of the evidence available for assessing their validity; the concept of universal phonetics; the relative roles of articulatory, acoustic, and auditory parameters. Prerequisite: 215 or consent of instructor.</td>
<td>4</td>
<td>Win (Bush)</td>
<td>by arrangement</td>
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<tr>
<td>217.</td>
<td>Phonetic Analysis — Training in narrow transcription; application of phonetic analysis to spoken language data in elected fieldwork or laboratory projects. Prerequisite: 215 or consent of instructor.</td>
<td>4</td>
<td>Spr (Bush)</td>
<td>by arrangement</td>
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<tr>
<td>220.</td>
<td>Phonology—The phonological organization of speech sounds in human language. Fundamental issues in phonological theory: the phonemic principle, elements vs. relations, systems and variation. Major theoretical positions 1925 to the present. Prerequisite: 215 or consent of instructor.</td>
<td>4</td>
<td>Win (Hernandez-Ch.)</td>
<td>TTh 9:00-10:50</td>
<td></td>
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<tr>
<td>221.</td>
<td>Generative Phonology—A comprehensive description of the stress and segmental</td>
<td>4</td>
<td>Win (Staff)</td>
<td>TTh 10</td>
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</table>
rules of English within the framework of generative phonology. Prerequisite: 220 or consent of instructor.

4 units, Spr (Leben and Oehrle)
MTWTh 11

222. Phonological Theory—Coverage of the most recent literature in phonological theory, including work on markedness, rule opacity, rule ordering, abstractness of phonological representations, historical phonology, and recent experimental work. Prerequisite: 220 or consent of instructor.

4 units, Win (Leben) W 12:15-3:05

223. Problems in Phonology and Morphology — Investigation in some detail of data from a variety of languages with a view to uncovering or resolving problems in current phonological theory.

Given alternate years

227. Instrumental Phonetics — Techniques of instrumental research in speech perception and production. Theory and instrumentation for analysis and manipulation of speech signals. Laboratory course. Prerequisite: consent of instructor.

4 units, Aut, Win, Spr (Huntington)
by arrangement

Syntax and Semantics

230. Foundations of Syntactic Theory—Introduction to the transformational theory of syntactic competence. Practical experience in forming and testing linguistic hypotheses, reading and constructing rules, etc.

4 units, Aut (Wasow) MWF 10:00

231. Theory of Generative Grammar—Constraints on the form of grammars of natural languages, such as constraints on base rules and transformations, the universal base hypothesis, variables in syntax, and the structure-preserving hypothesis. Prerequisite: 230 or consent of instructor.

4 units, Win (Wasow) MW 9:00-10:50

232. Advanced Syntax—In-depth study of particular topics, e.g. relativization, complementation. Emphasis on the implications of particular analyses for linguistic theory. Prerequisite: 230 or consent of instructor.

Given alternate years

235. Syntactic and Semantic Analysis — Treatment of some aspects of language that exhibit an intimate connection between syntax and semantics, such as quantification, negation, pronominalization, reflexivization. Prerequisite: 231 or consent of instructor.

4 units, Aut (Oehrle) MF 10:00-11:50

240. Semantics—Emphasis on lexical representation, componential analysis, markedness, field meaning at the word vs. sentence levels.

4 units, Spr (Oehrle) MWF 2:15

244. Philosophy of Language — (Same as Philosophy 181.) A study of the concepts and techniques required for the syntactic and semantic analysis of natural languages, including elements of formal semantics and transformational grammar. Prerequisites: two courses in philosophy or linguistics.

4 units, Aut (Staff) MTWTh 11

Language Variation and Sociolinguistics

245. Sociolinguistics — An introduction to the field of sociolinguistics, including such topics as language and social stratification, language standardization, language and national development.

4 units, Spr (Hernandez-Ch.) TTh 9:00-10:50

247. Language and Social Interaction — (Same as Anthropology 173.) Seminar on examining ways in which people use language to signal and create social identities, relationships and meanings. We will explore a number of topics on sociolinguistics, linguistic theory, and the philosophy of language (especially the study of speech acts and performatives) in asking how language shapes and is shaped by the contexts of language use.

5 units (Staff) given 1976-77

249. Areal and Social Dialectology—(Same as Spanish and Portuguese 217.) Introduction to the principles and methods of linguistic geography. Special reference to research in Europe and the Americas. Social and linguistic parameters of dialect study.

4 units, Aut (Hernandez-Ch.) TTh 12:15-2:05

251. Language Change — Evidence for change from contemporary languages. Emphasis on acquisitional and sociolinguistic correlates of language change. Prerequisite: elementary linguistics course or consent of instructor.

Given alternate years
252. Historical and Comparative Linguistics—Introduction to the principles and methods of historical linguistics; the development of 20th century trends in historical linguistics. Prerequisite: 215 or consent of instructor.

Given alternate years

253. Introduction to Indo-European Linguistics—(Same as Classics 253.) This course is recommended for students in Classics as an introduction to the scientific study of language, especially topics such as the relationship of writing to speech and the common origins of Latin, Greek and English.

4 units (Devine) dhr

255. Topics in Bilingualism—Topics for 1975-76: Code-switching and interference phenomena, social functions of bilingualism and bilingual acquisition.

4 units, Win (Hernandez-Ch.)

TTh 11:00-12:50

Developmental Psycholinguistics

260. Child Language I—Review of present knowledge of processes of language acquisition from a linguistic point of view. Survey of recent and past literature. Prerequisite: 10 or 230, or consent of instructor.

4 units, Win (Staff) by arrangement

261. Child Language II—Variable topics selected from semantics, syntax, or phonology. May be repeated for credit.

Given 1976-77

Computational Linguistics


4 units, Aut (Winograd) TTh 10:30-12:00

266. Computational Models for the Semantics of Natural Language—(Same as Computer Science 266.) Conceptual overview of problems of meaning. Formalisms from logic, psychology, and linguistics, relevance to computer implementations. Survey and critical discussion of current computer systems for natural language.

4 units, Win (Winograd) TTh 9:30-11:00 plus 1 hr. dhr

Applied Linguistics

270. Linguistics and the Teaching of English as a Foreign/Second Language—(Same as Education 282.) Linguistic aspects of the problems of teaching English to speakers of other languages, and standard English to speakers of other dialects. Prerequisite: introductory course in linguistics or consent of instructor.

3 units, Spr (F. Politzer) MWF 10

271. Topics in Applied Linguistics—Topics for 1975-76 include: choice of medium of instruction in multilingual societies, bilingual education, problems of non-standard varieties, and language standardization. May be repeated for credit.

Given alternate years

Methods

175A. Linguistic Field Methods I—(Same as Anthropology 165A.) Seminar on rapid introduction to descriptive phonetics, and to principles of phonetic transcription and phonological analysis. Applications to the descriptive analysis of one or more languages, eliciting data in class from native speakers. Limited enrollment. May but need not be followed by Linguistic Field Methods II. Prerequisite: introductory course in linguistics or consent of instructor.

5 units (Fox) given 1976-77

175B. Linguistic Field Methods II—(Same as Anthropology 165B.) Seminar on rapid review of principles of grammatical analysis: word morphology and syntax. Introduction to correlative problems in semantic analysis and lexicographic compilation. Application to data elicited in class from native speakers. Limited enrollment. Prerequisite: Linguistic Field Methods I or equivalent satisfactory to instructor.

5 units (Fox) given 1976-77

275A. Field Research—Methods and research design for the study of language in the field.

Given alternate years

275B. Field Research—Methods and research design for the study of language in the field.

Given alternate years

276. Research Methods in Linguistics—Introduces the student to social science research methods within the context of a given
area of linguistic research. Completed or on-going studies will be used in illustration. Students will apply some of the methods discussed to individual research projects. Focus for 1976-77: Psycholinguistics.

Given alternate years

Languages

280. Languages of the Middle East—Structural sketches and sociolinguistic background information on the major contemporary languages of Southwest Asia and North Africa.

4 units (Ferguson) given on demand

281. Languages of Africa—A survey of the history of African linguistic investigation, characteristics of African languages, and sociolinguistics in Africa, including the formation of standard languages, language and educational policy, and language in connection with colonialism and national policy.

5 units, Win (Greenberg) TW 4:15–6:05

282. Languages of the Pacific.

Given 1976–77

284. Linguistics and the Analysis of German—(Same as German 212/312.) An introduction to linguistic theory and analysis with special emphasis on the analysis of Modern German.

3 to 5 units, Aut (Robinson) MWF 1:15

285. Tone Languages of Africa—Survey of the tonal systems of selected African languages, with emphasis on the diversity of the accentual phenomena involved, followed by a consideration of possible laws governing the behavior of tone. Topics considered will include downstep, downdrift, “floating” tones, syllable and mora as prosodic units, and the origin of tone languages.

4 units, Spr (Leben) dhr

Seminars/Workshops

Seminars and workshops are offered on typology and universals of language, phonological archiving, phonological theory, syntax, semantics, sociolinguistics, historical linguistics, developmental psycholinguistics, computational linguistics and philosophy of language. May be repeated for credit. Students are admitted by consent of instructor.

Offered in 1975–76 are:

305. Workshop in Current Issues—Open discussion of ongoing research and related published literature.

1–3 units, Aut (Staff) alt. Th 4:10


5 units, Win (Ferguson) TTh 1:15–3:05

359. Seminar on Language Adaptivity—(Same as Anthropology 272.) The structural response of language to functional change, with special references to pidgins, creoles, jargons, argots, baby talk, foreigner talk, rhetorical, ritual, and poetic language, and their implications for the study of linguistic universals. Critical examination of the functions of language in the speech community. Prerequisite: Linguistics 10 or equivalent, or consent of instructor.

5 units, Spr (Fox) T 2:15–5:05

360. Seminar in Developmental Psycholinguistics—Topics in the acquisition of the first language.

5 units, Spr (Staff) TTh 9–11

365. Seminar in Computational Linguistics—(Same as Computer Science 365.) Examination of unsolved problems in computational linguistics.

3 units, Spr (Winograd) Th 1:15–3:30

380. Seminar in German Linguistics—(Same as German 219.) Topics in German linguistics. Although specific topics are determined by student interest, the general field of study will alternate as follows: synchronic German linguistics in years when 212 is taught, diachronic German and German linguistics in years when 203 is taught.

3 to 5 units, Spr (Robinson) dhr

Colloquia, Directed Reading

390. Proseminar—Orientation for first-year graduate students and an introduction to different types of linguistic research ongoing at Stanford.

1 unit, Aut (Bush) Th 2:15

391. Colloquium.

1 unit, Win (Staff) Th 4:15

392. Colloquium.

1 unit, Spr (Staff) Th 4:15


1 to 6 units, any quarter (Staff) by arrangement
397. Directed Reading.
1 to 5 units, any quarter (Staff)
by arrangement

1 to 6 units, any quarter (Staff)
by arrangement

399. Dissertation Research.
1 to 15 units, any quarter (Staff)
by arrangement

OTHER COURSES

ANTHROPOLOGY
171. Seminar on the Maya: Mayan Hieroglyphic Writing.

CLASSICS

EDUCATION
383. Recent Developments in Foreign Language Education.
385. Role of Non-Standard Dialects in Education.
388. Foreign Language Education and Bilingual Education in the Elementary School.
482. Research Problems in Teaching and Learning a Second Language.

ENGLISH
102. The History of the English Language
200A. Old Norse.
205. Old English.
206. Middle English.

381. Seminar in Animal Communication.
310. Experimental Phonetics.

PHILOSOPHY
163. Modal Logic.

PSYCHOLOGY
146. Language and Thought.
214. Psycholinguistics.

SLAVICS
165. Introduction to the Structure of Russian
195. The Russian Verb
211. Introduction to Old Church Slavonic and Early Russian Texts.
212. History of the Russian Literary Language.

ENGLISH FOR FOREIGN STUDENTS

The courses below represent the basic offerings in English for Foreign Students. Each quarter, additional sections of these courses are scheduled at other hours and days as needed. Those students whose English proficiency is so limited that they are required to take 86 or 96 should normally expect to follow subsequent courses in the sequence during succeeding quarters.

During the summer, courses in spoken and written English up to a maximum of 11 units will be offered. For details, see Summer Session Bulletin.

A 10-week program in Intensive English and Academic Orientation for Foreign Graduate Students is also offered in the summer. This program is open to qualified graduate students who have been admitted to degree programs at other U.S. institutions as well as those who have been admitted to Stanford for the following autumn quarter. Academic Orientation sections will focus on the fields of engineering and science, education, business, and social sciences.

86. Spoken English I—Intermediate review and practice of grammatical patterns of spoken English with emphasis on comprehension and intelligibility. One additional hour per week required in language laboratory. Prerequisite: consent of instructor.
3 units, Aut, Win (Staff)
by arrangement

87. Spoken English II—For students with some facility in spoken English. Emphasis on
fluency, idiom and current usage, with the opportunity to make informal oral presentations. May be repeated for credit. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Staff)

90A,B,C. Pronunciation—Review and practice of pronunciation patterns of spoken English with special attention to stress, rhythm, and intonation. Prerequisite: consent of instructor.

2 units, Aut, Win, Spr (Politzer)

92A,B,C. Aural Comprehension—Graded exercises in listening to lectures, dialogs, and discussions with evaluation of comprehension. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (McChesney)

94. Academic Orientation for Foreign Students—An introduction to the system of graduate education in the U.S. and at Stanford, with emphasis on the development of effective graduate study techniques. Particular attention will be given to the skills of note-taking, preparing for and taking examinations, using special vocabularies, the reading and writing of scholarly and scientific papers, and the presentation of term papers and reports.

3 units, Aut (Staff) by arrangement

95A,B,C. Special Problems in English—Topics (such as Problems in Vocabulary, Problems in Reading Comprehension, etc.) to be determined each quarter according to need and enrollment.

2 units, Aut, Win, Spr (Staff)

96. Written English I—Intermediate work in expository writing with special attention to correct grammatical usage. Prerequisite: consent of instructor.

4 units, Aut, Win (Staff) by arrangement

97. Written English II—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Special attention given to mechanics and form appropriate to academic papers. May be repeated for credit. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Staff)

by arrangement


topics (such as Problems in Vocabulary, Problems in Reading Comprehension, etc.) to be determined each quarter according to need and enrollment.

2 units, Aut, Win, Spr (Staff)

by arrangement

96. Written English I—Intermediate work in expository writing with special attention to correct grammatical usage. Prerequisite: consent of instructor.

4 units, Aut, Win (Staff) by arrangement

97. Written English II—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Special attention given to mechanics and form appropriate to academic papers. May be repeated for credit. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Staff)

by arrangement


topics (such as Problems in Vocabulary, Problems in Reading Comprehension, etc.) to be determined each quarter according to need and enrollment.

2 units, Aut, Win, Spr (Staff)

by arrangement

96. Written English I—Intermediate work in expository writing with special attention to correct grammatical usage. Prerequisite: consent of instructor.

4 units, Aut, Win (Staff) by arrangement

97. Written English II—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Special attention given to mechanics and form appropriate to academic papers. May be repeated for credit. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Staff)

by arrangement

MATHEMATICS

Emeriti: Harold M. Bacon, Stefan Bergman, George Pólya, Gabor Szegő (Professors)

Chairman: Robert Osserman

Vice Chairman: Paul W. Berg


Associate Professors: Gregory Brumfiel, John Coates, Per Enflo, Mary V. Sunseri, Shing-Tung Yau. Visiting: Zvi Ziegler

Assistant Professors: Garo K. Kiremidjian, Marvin E. Ortel, Vladimir Scheffer, Leon M. Simon, Lawrence Washington, Peter M. Winkler, Misha Zafran. Visiting: Michael Beeson

Offerings and Facilities

The Department of Mathematics offers programs leading to the degrees Bachelor of Science, Master of Science, and Doctor of Philosophy in Mathematics, and participates in the program leading to the degree B.S. in Mathematical Sciences.

Introductory Courses

The Department of Mathematics offers two main sequences of courses in the calculus. Analytic Geometry and Calculus (41, 42, 43) is designed for students in mathematics, physics, chemistry, engineering and for other students who wish an extensive treatment of the calculus. Calculus and Probability (5, 6, 7) is designed for students in the biological or social sciences and other students who may wish a less extensive treatment of the calculus than is offered in the (41, 42, 43) courses.

In addition to these two main sequences, the Department offers the sequence (41A, 42A, 43A) which covers all of the material of (41, 42, 43) except analytic geometry, and the sequence (10, 11, 21, 22, 23) which covers the material of (41, 42, 43) in five quarters instead of three.

Algebra and Trigonometry (1) is offered for those who need or desire a better prep-
aration in these subjects before entering one of the calculus sequences. Mathematics Workshop (2) also presents a treatment of pre-calculus mathematics, but in a format in which students work at their own pace with individual consultation.

The introductory course in modern algebra is Linear Algebra and Matrix Theory (113). There are no formal prerequisites for this course, but appropriate mathematical maturity is expected.

**Advanced Placement for Freshmen**

Secondary school students of unusual ability in mathematics often pursue one or more semesters of college-equivalent courses in mathematics while they are still in high school. Under certain circumstances it is possible for such students to secure both advanced placement and credit toward the Bachelor’s degree on the basis of these courses. A decision as to placement and credit will be made by the Department after consideration of the student’s performance on the Advanced Placement Examination in Mathematics (either forms AB or BC) of the College Entrance Examination Board. This examination is the only one used for this purpose. The Department does not give its own Advanced Placement examination. Arrangements for such advanced placement and credit must be made during the first two weeks of the student’s first quarter of attendance at Stanford University, or earlier, or the privilege will lapse. For referral to an adviser on advanced placement, communicate with the Academic Secretary of the Department.

**Programs of Study**

**Bachelor of Science**

The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor’s degree:

1. Analytic Geometry and Calculus (Courses 10, 11, 21, 22, 23, 44, or 41, 42, 43, 44, or 41A, 42A, 43A, 44.) These courses should be started during the first year.

There is no language requirement, but students intending to go on to graduate work in mathematics are strongly urged to study at least one foreign language chosen from French, German, and Russian.

2. Nine courses, each carrying at least three units credit, numbered 100 or above, distributed as follows: three courses in algebra or number theory, four courses in analysis, and two courses in geometry or topology. These will typically be chosen among the following: algebra—113, 114, 120, 121, 152; analysis—106, 115, 116, 117, 130, 131, 132; geometry—142, 143, 159, 217A. Graduate courses in the same subject may be substituted for the preceding courses—for example, 206A for 106.

3. Five additional courses, each carrying at least three credits, chosen from 45 and courses numbered 100 or above. Although not required, 45 is generally recommended.

Students completing the honors sequence 54, 55, 56 may use 55, 56 either as elective courses or in place of two required analysis courses.

Students planning graduate study in mathematics are advised to include one or more 200 level courses in their programs and, to facilitate this, to complete 113, 114, 115 and 116 as early as possible.

4. One of the following options. The choice of (a) or (b) is recommended.
   a. Physics 51, 53, 55, 57 (total, 15 units).
   b. Any four quarters of Physics lecture courses, chosen from those numbered 51 or above.
   c. A series of courses, within which mathematics is applied in a significant manner. Students choosing this option must have their plans approved by the Undergraduate Affairs Committee of the Department of Mathematics.

Variations in the basic program described above are possible. In particular, students interested in applied mathematics may obtain the B.S. in Mathematics by taking a suitable program of courses in a field of application of mathematics in place of some of the courses prescribed above. Individual programs in such cases must be approved by the Departmental Committee on Undergraduate Affairs.

To receive the Departmental recommendation for graduation a student must have been enrolled as a major in the Department for at least two full quarters, including the
last full quarter before graduation, and must complete at least 15 units of 100 (or higher) level courses in the Department.

More detailed information about the preceding and other aspects of the B.S. program is contained in the publication *Handbook for Mathematics Majors*, available on request from the Academic Secretary of the Department.

**HONORS PROGRAM IN MATHEMATICS**

The department of Mathematics offers a program leading to the degree of Bachelor of Science in Mathematics with Honors. Details concerning admission to the program and a statement of the requirements of the program can be obtained from the Academic Secretary of the department.

**BACHELOR OF SCIENCE IN MATHEMATICAL SCIENCES**

The Mathematics Department participates with the Departments of Computer Science, Operations Research, and Statistics in a program leading to the degree of Bachelor of Science in Mathematical Sciences. See Program in Mathematical Sciences on page 604 of this bulletin.

**MASTER OF SCIENCE**

The University's basic requirements for the Master's degree (residence, etc.) are discussed in the section "Degrees" in this bulletin. The following are Departmental requirements:

Candidates must complete an approved course program of 36 units beyond the departmental requirement for the B.S. degree. The candidate's program must include 18 units of courses numbered 200 or above. The candidate must have a B average over all course work taken in Mathematics, and a B average in the 200 level courses considered separately.

For the degree of Master of Science in Computer Science, see the Computer Science Department material in this bulletin.

**DOCTOR OF PHILOSOPHY**

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" in this bulletin. The following are Departmental requirements:

To be admitted to candidacy for the Ph.D. degree, a student must have successfully completed 27 units of graduate courses (i.e., courses numbered 200 and above). In addition the student must pass Qualifying Examinations given by the Department.

Beyond the requirements for candidacy, the student must complete a course of study of at least 48 units approved by the Graduate Study Committee of the Department of Mathematics and submit an acceptable dissertation. The course program should display sufficient breadth in mathematics outside the student's field of specialization and may include work in a field of application of mathematics. In addition, the student must pass reading examinations in two of the languages French, German, and Russian, and pass the University oral examination. A student must receive a grade of B or better in a course to satisfy the Ph.D. requirement.

For the degree of Doctor of Philosophy in Computer Science, see the Computer Science Department material in this bulletin.

For further information concerning degree programs, requirements for a Ph.D. minor in mathematics, fellowships, and assistantships, inquire of the Academic Secretary of the Department.

**TEACHERS' CREDENTIALS**

The requirements for a teaching major in Mathematics for the Standard Teaching Credential (Secondary) are the B.S. degree with major in Mathematics (see above) or, if the candidate has a Bachelor's degree with a major in another subject, the following: Courses 10, 11, 21, 22, 23, 44 (or 41, 42, 43, 44, or 41A, 42A, 43A, 44), together with 21 units selected from courses numbered 100 or above, and in addition, 15 units selected from courses numbered 100 or above or in courses in other departments requiring extensive application of mathematics. Thirty-six quarter units must be in upper division or graduate standing. Candidates for the General Secondary Credential may count courses 45, 55 and 56 as equivalent to "courses numbered 100 or higher" for the purpose of meeting requirements listed in this paragraph. The requirements for a teaching minor in Mathematics are Courses 10, 11, 21, 22, 23, 44 (or 41, 42, 43, 44) together with 12 units as follows: 9 units in mathematics courses numbered 100 or higher; 3 units either in mathematics courses numbered 100 or higher or in courses requiring extensive application of mathematics given in other departments.
In order to receive the recommendation of the Department for a teaching major or a teaching minor, the candidate is expected to have an average grade of B in these required courses. If work in mathematics has been taken at another institution, it is expected that at least one course numbered 100 or above will be taken in the Department. Attention is called to Courses 106, 113, 114, 120, 142, 143, 152, and 159, as particularly appropriate to these programs.

MASTER OF ARTS IN TEACHING (MATHEMATICS)

In cooperation with the School of Education, the Department offers a program leading to a degree, Master of Arts in Teaching (Mathematics). This degree is intended for candidates who have a teaching credential and wish further to strengthen their academic preparation. Detailed requirements are outlined in this bulletin under "School of Education, Master of Arts in Teaching."

COURSES

INTRODUCTORY AND UNDERGRADUATE COURSES

Introductory courses will be offered only if twenty or more students enroll.

1. Precalculus Mathematics — Fundamental laws; linear and quadratic equations; inequalities; logarithms; binomial theorem; trigonometric functions, identities, and equations; solution of right and oblique triangles; complex numbers; De Moivre's theorem. (Attention is called to the fact that this course cannot be taken in partial fulfillment of the distribution requirement in Natural Science, Mathematics, and Technology.)

4 units, Aut (Staff) MTWThF 8 and 12
Win (Staff) MTWTh 12

2A, B. Mathematics Workshop — The main aim of the workshop is to have students learn that they can do mathematics, regardless of their previous experience. This course uses materials and techniques designed especially to help students master the art of solving problems. Its flexible format allows each student to build conceptual understanding in an atmosphere free of anxiety, and with as much personal attention as desired. Visualization, pattern recognition, diagramming, and systematic analysis are among the techniques emphasized to foster self-confidence in doing mathematics. The course also reviews fundamental algebra and then moves on to pre-calculus mathematics, investigating polynomials, rational, exponential, logarithmic and trigonometric functions in a highly visual treatment to develop basic mathematical intuitions.

2A. 4 units, Aut (Staff) MTWTh
3:15 and sections
Win (Staff) MTWTh
3:15 and sections

2B. 4 units, Win (Staff) MTWTh
2:15 and sections
Spr (Staff) MTWTh
2:15 and sections

5. Calculus and Probability—The sequence (5, 6, 7) is designed primarily for the general student and students in the biological and social sciences. The courses will provide the student with the basic ideas of calculus and probability theory. Applications will be chosen mainly from biology, economics and other social sciences. Topics will include the following: Algebra of sets, sample spaces, counting problems. Probability. Random variables, expectation, variance. Real number system. Functions and graphs. Tangent lines, derivatives, rules of differentiation. Derivatives of the elementary functions. Maximum-minimum problems, rates of change. Anti-derivatives, integrals, area and other applications. Special probability distributions and applications. Law of large numbers. Prerequisites: algebra and trigonometry.

3 units, Aut (Staff) MWF 8, 9, 10, 12, 1:15, and 2:15
Win (Staff) MWF 8, 10, and 2:15

6. Calculus and Probability—Continuation of 5. Prerequisite: 5.

3 units, Win (Staff) MWF 8, 9, 12, and 2:15
Spr (Staff) MWF 8 and 2:15


3 units, Aut (Staff) MWF 2:15
Spr (Staff) MWF 8, 9, and 2:15

10. Analytic Geometry and Calculus—The sequence (10, 11, 21, 22, 23) covers the same subjects as the sequence (41, 42, 43) described below. Prerequisites are the same as for 41.

3 units, Aut (Staff) MWF 8, 9, 10, 11, 12, 1:15, and 2:15
   3 units, Win (Staff) MWF 8, 9, 10, 12, 1:15, and 2:15
   Spr (Staff) MWF 10, 12, and 2:15

   3 units, Aut (Staff) MWF 8 and 2:15
   Spr (Staff) MWF 8, 9, 10, 1:15, and 2:15

   3 units, Aut (Staff) MWF 8 and 2:15
   Win (Staff) MWF 2:15

23. Analytic Geometry and Calculus—Continuation of 22. Prerequisite: 22.
   3 units, Aut (Staff) MWF 2:15
   Win (Staff) MWF 2:15
   Spr (Staff) MWF 2:15

41. Analytic Geometry and Calculus — The sequence (41, 42, 43) is intended for students
   whose major area of specialization is in mathematics, the physical sciences, or engi-
   neering, or who need a more extensive and detailed study of analytic geometry and cal-
   culus than that provided in the sequence (5, 6, 7). Principal topics included in the three
   courses are functions and graphs, limit, continuity, derivative, plane analytic geometry
   of the straight line, conics, geometrical and physical applications of the derivative, mean
   value theorem, antiderivative, integral, fundamental theorem, technique of integration,
   geometrical and physical applications of the integral, polar coordinates, parametric equa-
   tions, vectors in the plane and in space, analytic geometry of space of three dimensions,
   planes, surfaces, lines, curves, brief introduction to calculus of functions of two or more
   variables. Prerequisites: algebra and trigono-
   metry.
   5 units, Aut (Sunseri) MTWThF 8
   (Brumfiel) MTWThF 9
   Win (Staff) MTWThF 9

41A. Calculus — 41A, 42A, 43A together cover the same topics in the calculus as 41, 42, 43, but topics in plane analytic geometry
   are omitted. Requirements for admission to 41A are the same as for 10, but in addition
   the student must have had substantial course work in analytic geometry in high school or
   college. Admission to 41A will be restricted to students who pass a qualifying examination
   in analytic geometry to be given during the first week of the quarter. Details of this
   examination will be explained at the first meeting of the class. This examination will
   be waived only for those who present transfer college credit in analytic geometry.
   5 units, Aut (Sunseri) MTWThF 8

42. Analytic Geometry and Calculus—Continuation of 41. Prerequisite: 41.
   5 units, Win (Sunseri) MTWThF 8
   (Brumfiel) MTWThF 10
   Spr (Staff) MTWThF 1:15

42A. Calculus—Continuation of 41A.
   5 units, Win (Sunseri) MTWThF 9

43. Analytic Geometry and Calculus—Continuation of 42. Prerequisite: 42.
   5 units, Aut (Staff) MTWThF 1:15
   Spr (Staff) MTWThF 8
   (Staff) MTWThF 10

43A. Calculus—Continuation of 42A. Concurrent registration in 44 is permissible.
   3 units, Spr (Sunseri) TTh 9

44. Advanced Calculus—The sequence 44, 45 is a continuation of 41, 42, 43 (or equivalent
   sequence) and is concerned principally with multivariable calculus. Introductory
   topics include: review of vector operations, algebra of complex numbers; infinite series,
   convergence tests, power series; partial derivatives, Taylor's Theorem, applications in-
   cluding extremum problems; multiple integrals, line integrals; differential calculus
   of scalar and vector fields. Later topics in-
   clude: uniform convergence; functions defined by integrals; surface integrals; Green's
   and Stokes Theorems; applications. Pre-
   requisite: 43 or equivalent.
   3 units, Aut (Staff) MWF 9, 10, 12, 1:15
   and 2:15
   Win (Staff) MWF 10 and 1:15
   Spr (Staff) MWF 11

45. Advanced Calculus — Continuation of 44.
   3 units, Win (Staff) MWF 10, 12, and 2:15
   Spr (Staff) MWF 11 and 1:15

54. Honors Calculus — 54, 55, and 56 constitute an honors sequence in advanced cal-
   culus. The material covered is a more gen-
   eral version of 44, 45, together with some of the topics of 115, 116, and 117. Prerequi-
   sites: 43 (or equivalent) and 113 (or concur
rent registration in 113), and consent of instructor.

4 units, Aut (Kiremidjian) MWF 2:15

55. Honors Calculus—Continuation of 54.
4 units, Win (Kiremidjian) MWF 2:15

56. Honors Calculus — Continuation of 55.
4 units, Spr (Kiremidjian) MWF 2:15

97. Introductory Seminar in Mathematics—These seminars are intended to provide the general student with an opportunity for active involvement in learning mathematics. The subjects are topics not included in the standard curriculum. The seminars will be designed and conducted by graduate students under supervision of a faculty committee. A list of seminar offerings each quarter will be available from the Academic Secretary of the Department.

1 to 2 units, Aut, Win, Spr (Staff) by arrangement

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

Unless explicitly stated there are no prerequisites for the courses listed below. Where a prerequisite is stated it may be waived with the consent of the instructor.

106. Introduction to Theory of Functions of a Complex Variable — Complex numbers, analytic functions, Cauchy-Riemann equations, complex integration, Cauchy formula; elementary conformal mappings. Prerequisite: 44.

3 units, Aut (Staff) MWF 2:15

113. Linear Algebra and Matrix Theory—The study of the algebraic properties of matrices and their interpretation in geometric terms. The relationship between the algebraic and geometric points of view and matters that are fundamental to the study and solution of linear equations are dealt with. Topics include: linear equations, vector spaces, linear dependence, bases and coordinate systems; linear transformations and matrices; similarity and eigenvalues; reduction of quadratic forms.

3 units, Aut (Staff) MWF 9, 11, 1:15, and 2:15

Win (Staff) MWF 1:15

Spr (Staff) MWF 10 and 1:15

114. Linear Algebra and Matrix Theory—Continuation of 113: A deeper study of certain of the topics indicated as well as additional topics chosen among the following: invariant subspaces, canonical forms of matrices, minimal polynomials and elementary divisors; vector spaces over arbitrary fields; inner products; Hermitian and unitary matrices; multilinear algebra.

3 units, Aut (Staff) MWF 1:15
Win (Staff) MWF 1:15
Spr (Staff) MWF 11

115. Fundamental Concepts of Analysis—A rigorous development of real analysis in Euclidean space: basic point set topology, limits, continuous functions. Especially recommended for students who intend to take graduate work in mathematics. Prerequisite: 44. Recommended: 45.

3 units, Aut (Staff) MWF 11 and 1:15
Win (Staff) MWF 10 and 2:15


3 units, Win (Staff) MWF 11
Spr (Staff) MWF 2:15


3 units, Spr (Staff) MWF 11

120. Modern Algebra — Integral domains, fields, polynomials, divisibility theory, groups. Prerequisite: 113.

3 units, Win (Staff) MWF 3:15
Spr (Staff) MWF 1:15

121. Modern Algebra—Continuation of 120.

3 units, Spr (Staff) MWF 3:15

123. Theory of Probability—This is an introductory course to the theory of probability and some of its applications. The basic concepts of probability, random variables and their distribution functions are treated in the modern manner. Classical limit theorems for sequences of independent random variables are discussed in some detail. Prerequisite: 44.

3 units, Win (Cohen) MWF 2:15

124. Introduction to Stochastic Processes—The discussion will include types of Markov chains, branching and queuing processes, applications to order statistics, and an intro-
duction to Brownian motion. Prerequisite: 123.

3 units, Spr (Cohen) MWF 2:15

126. Models in Mathematical Biology — A series of classical and modern mathematical models pertinent to biology will be developed, including examples from population genetics and ecological structures, the dynamics of population growth, and some neuro-physiological systems, enzyme kinetics, the patterns of blood flow, elements of compartment analysis and other topics. Some aspects of computer simulation models of certain biological processes will also be considered. The mathematical level will be elementary, with prerequisites the calculus and elementary matrix theory.

3 units, Aut (Karlin, Feldman) MWF 9

130. Ordinary Differential Equations—Special equations, exact equations, linear equations; series solutions, numerical solution; Laplace transform and operational methods. Courses 130, 131, 132 form a sequence. Prerequisite: 44 or concurrent registration in 44.

3 units, Aut (Staff) MWF 10, 12, and 2:15
Win (Staff) MWF 11 and 2:15
Spr (Staff)


3 units, Win (Staff) MWF 10 and 3:15
Spr (Staff) MWF 2:15


3 units, Spr (Staff) MWF 3:15

136. Introduction to Computing — (Enroll in Computer Science 106.)

137A,B. Numerical Analysis — (Enroll in Computer Science 137A,B.)

142. Higher Geometry—A study of various geometries, including projective, affine and non-euclidean geometry. Prerequisite: 113.

3 units, Aut (Beeson) MWF 11

143. Topics in Geometry — Selected topics. Possible choices include algebraic geometry, differential geometry, and foundations of geometry.

3 units, Spr (Yau) MWF 1:15

150. Introduction to Combinatorial Theory — (Enroll in Computer Science 150.)

152. Elementary Theory of Numbers — Euclid’s algorithm, fundamental theorems on divisibility; prime numbers; congruence of numbers; theorems of Fermat, Euler, Wilson; congruence of first and higher degrees; Lagrange’s theorem, its applications; residues of power; quadratic residues; introduction to theory of binary quadratic forms.

3 units, Aut (Washington) MWF 2:15

159. Introduction to Topology—This course will cover some of the basic properties of metric and topological spaces; compactness, connectedness, and continuity. Special attention will be paid to the Euclidean spaces; and the fixed-point and degree of mapping theorems will be developed. Enrollment is limited to undergraduates.

3 units, Win (Samelson) MWF 11


161. Introduction to Set Theory—(Enroll in Philosophy 161.) Intuitive justification of the axioms. Operations on sets, relations and functions. Equivalence and ordering relations. Equipotence of sets and cardinal arithmetic. Topics on ordinal numbers and axiom of choice as time permits. Prerequisite: 160A or equivalent.

162. Theory of Automata — (Enroll in Philosophy 162.) An introduction to finite automata. Comparison of different notions of computability. Relationship to programming languages and theories of grammars.

Given 1976–77

190A,B. Perspectives in Mathematics — Some of the most impressive progress in many fields of mathematics has resulted from utilization of ideas and methods from other fields, both within and outside of mathematics. One can gain a deeper understanding even of special subjects in mathematics by learning something of such interrelationships, both historically and conceptually. It
is not possible to provide this within the separate confines of the standard course. The aim of this course is in partial compensation. Each year, several topics which reveal significant interconnections will be treated in detail. Intended for seniors and well prepared juniors; admission by consent of instructor.

3 units, Aut (Schiffer) MWF 9
Win (Schiffer) MWF 9

192A,B. Topics in the History of Mathematics.

192A. Topics from the 17th to the 19th century. Principally the rapid development of the powerful new concepts and methods in analysis and their direct connection with the physical sciences, in particular mechanics. Illustrations from the work of famous mathematicians from Descartes to Abel.

192B. Topics from the 19th to the early 20th century. The further extension and expansion of analysis and its applications. Rigorization and generality; the rise of algebra and abstract mathematics. Illustrations from the work of famous mathematicians from Fourier to Lebesgue.

Alternate years, given 1976-77

195. Mathematics Workshop Consulting—This course, together with Mathematics 2, Mathematics Workshop, form part of a continuing experiment whose aim is to create an optimal learning environment for those students having weak backgrounds in mathematics. Students enrolled in Mathematics 195 will study recent literature on mathematics education and will work together in pairs leading small groups of Mathematics 2 students.

3 units, Aut (Staff) MWF 1:15 and
Win (Staff) MWF 1:15 and
Spr (Staff) MWF 1:15 and
by arrangement

196. Undergraduate Colloquium—Based on reading and discussion of topics in history and philosophy of mathematics. Prerequisite: consent of instructor.

3 units, Spr (Staff) by arrangement

197. Undergraduate Seminars—These seminars are intended to supplement the standard curriculum, and especially to provide an opportunity for students with appropriate mathematical backgrounds, through active involvement, to share in the excitement of discovery in Mathematics. The seminars will be designed for the average student, rather than for the honors mathematics major.

The seminars will be designed and conducted by graduate students under supervision of a faculty committee. A list of seminar offerings each quarter will be available from the Academic Secretary of the Department.

1 to 3 units, Aut, Win, Spr,
by arrangement

199. Independent Work—This course provides an opportunity for any undergraduate to pursue a reading program on a topic of his choice under the direction of a faculty member of the Department of Mathematics. Credit for the course may be used toward the fulfillment of the elective requirement for the degree in mathematics. Students wishing to use credit for the course toward the fulfillment of the department's area requirements must receive the approval of the Undergraduate Affairs Committee of the Department.

Students having a topic they wish to investigate but who need help in finding a faculty member to direct their reading should consult the Academic Secretary of the Department.

(Staff) by arrangement

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS


205A. 3 units, Aut (Zafran) MWF 10
205B. 3 units, Win (Simon) MWF 10
205C. 3 units, Spr (Simon) MWF 10

206A,B,C. Theory of Functions of a Complex Variable—Complex integration. Cauchy's theorem, calculus of residues; power series, infinite products, entire functions, Picard's theorem; Riemann mapping theorem. Prerequisite: 116 or equivalent.
MATHEMATICS 423

206A. 3 units, Aut (Schiffer) MWF 11
206B. 3 units, Win (Schiffer) MWF 11
206C. 3 units, Spr (Schiffer) MWF 11

210A,B,C. Modern Algebra—Groups, rings and fields; Galois theory, ideal theory, introduction to algebraic geometry; representations of groups and algebras; multilinear algebra. Prerequisite: 120 or equivalent.

210A. 3 units, Aut (Washington) MWF 1:15
210B. 3 units, Win (Washington) MWF 1:15
210C. 3 units, Spr (Washington) MWF 1:15

217A,B. Differential Geometry — Classical differential geometry of curves and surfaces; surfaces of constant curvature, connections with non-euclidean geometry; minimal surfaces. Intrinsic geometry, parallel transport, geodesics; geometry on a surface. Prerequisite: 130 or equivalent.

217A. 3 units, Win (Hawley) MWF 2:15
217B. 3 units, Spr (Hawley) MWF 2:15

220A,B,C. Methods of Mathematical Physics—Potential theory, Green's function, integral equations; Hilbert space approach to problems of mathematical physics; elementary spectral theory; variational methods. Alternate years, given 1976-77

230A,B. Advanced Probability — Fundamental concepts, weak and strong laws of large numbers, convergence of distributions and the central limit theorem, infinitely divisible distributions and stable laws. Prerequisite: 205A.

230A. 3 units, Aut (Kiremidjian) MWF 11

232A,B,C. Topics in Stochastic Processes—An introduction to the modern theory of stochastic processes with emphasis on concrete cases such as Brownian motion and Levy increasing processes. General discussion of aspects of Markov processes and potential theory. Prerequisites: 230A,B.

233. Stochastic Differential Equations — The Ito and Stratonovich stochastic integrals and their properties will be developed. Methods for solving stochastic differential equations will be discussed. Applications to electrical system driven by white noise, biological growth processes involving random birth and death rates, and stochastic economic models will be highlighted. Prerequisites: 230A and 124 (or equivalents).

235A,B,C. Selected Topics in Ergodic Theory—Topics from: The Kolmogorow-Sinai theory of entropy; the isomorphism theorem for Bernoulli shifts and Bernoulli flow; K-automorphisms applications to mechanical systems, and automorphisms of compact groups. Alternate years, given 1976–77

237A,B,C. Advanced Numerical Analysis—(Enroll in Computer Science 237A,B,C.)


244A. 3 units, Spr (Kiremidjian) TTh 1:15–2:30


245A. 3 units, Aut (Kiremidjian) MWF 11
245B. 3 units, Win (Yau) MWF 11
245C. 3 units, Spr (Yau) MWF 11

249. Transform Methods—Selected topics from classical transform theory including Fourier, Laplace, Hankel, Mellin, Lebedeff transforms with applications to boundary value problems. Prerequisite: 206B.
3 units, Win (Levine) MWF 3:15

254A,B. Ordinary Differential Equations—Fundamental existence theorems, stability and asymptotic behavior of nonlinear systems, Poincaré-Bendixson theorem, linear systems and Sturm-Liouville eigenvalue problems; selected topics from equations in the complex domain; Hamiltonian systems, existence of periodic solutions and orbital stability.
254A. 3 units, Win (Gilbarg) TTh 11:00-12:15
254B. 3 units, Spr (Gilbarg) TTh 11:00-12:15

Alternate years, given 1976-77

Alternate years, given 1977-78

261A. 3 units, Aut (Phillips) MWF 10
261B. 3 units, Win (Phillips) MWF 10
261C. 3 units, Spr (Phillips) MWF 10

3 units, Win (Yau) TTh 1:15-2:30

Alternate years, given 1976-77

266A,B. Harmonic Analysis—Topics chosen from the following: The “L_p theory” of harmonic analysis—the singular integral theory of Calderón and Zygmund and its extensions, interpolation of operators, multiplier transformations, and smoothness properties of functions; the “L_1 theory” of harmonic analysis—sets of uniqueness for trigonometric series, spectral syntheses, thin sets, the spectral theory of convolution operators, and applications. Prerequisite: knowledge of the elements of Fourier analysis.
266A. 3 units, Win (Zafran) MWF 1:15
266B. 3 units, Spr (Zafran) MWF 1:15

271A,B. Mathematics of Wave Motion—Analytical techniques for the calculation of varied wave phenomena, with emphasis on the use of fundamental solutions (localized source functions), asymptotic integration and integral equations. Illustrative problems obtained from the subjects of elasticity, electromagnetic theory and magnetohydrodynamics.
Alternate years, given 1976-77

272A,B. Topics in Hydrodynamics—General equations of fluid mechanics will be
developed and particular cases discussed from a mathematical point of view. Included will be problems relating to potential flow, compressible flow, viscous flow and/or free boundary problems. Prerequisite: foundations of analysis. Functions of a complex variable, ordinary and partial differential equations desirable but not essential.

272A. 3 units, Win (Finn) TTh 2:15-3:30
272B. 3 units, Spr (Finn) TTh 2:15-3:30

273. Electromagnetic Theory — A systematic characterization of field equations, conservation laws and interfacial (or boundary) conditions by means of variational principles. Representation theorems for the fields due to prescribed or equivalent sources in finite and infinite domains.

Alternate years, given 1976-77

277A,B. Mathematical Theory of Relativity — Ricci calculus; variational principles and covariance properties; differential geometry of space-time; Cauchy's problem for the differential equations of gravitation and electromagnetism; relativistic hydrodynamics; unified field theories.

Alternate years, given 1976-77


281A. 3 units, Aut (Samelson) MWF 9
281B. 3 units, Win (Samelson) MWF 9
281C. 3 units, Spr (Samelson) MWF 9


3 units, Aut (Milgram) MWF 1:15

284A. Differentiable Manifolds—An introduction to the theory of differentiable manifolds, including tensors, differentiable forms, integration on manifolds, and deRham cohomology. Also elements of the theory of sheaves and Lie groups. Prerequisites: 113, 116, and 120 or the equivalent.

Alternate years, given 1976-77

290A,B,C. Mathematical Logic — Model theory: formal languages and their models; validity and definability; complete and decidable theories. Theory of recursive functions and formal systems: recursively enumerable sets; recursively unsolvable problems in mathematics and logic; Gödel's theorems. Set theory: the cumulative hierarchy; axiomatic set theory and its models, in particular the constructible sets. Prerequisites: 160 and 161 or equivalent.

290A. 3 units, Aut (Winkler) MW 2:15
290B. 3 units, Win (Winkler) MW 2:15
290C. 3 units, Spr (Feferman) MW 2:15

291A,B. Topics in Model Theory—Selected principally from: model constructions, including ultraproducts, and their properties; applications of model theory to mathematics; infinitary languages; functorial semantics. Prerequisite: 290 or equivalent.

Alternate years, given 1976-77

292A. Topics in Recursion Theory—Selected principally from: recursive ordinals, hierarchies, hyperarithmetical sets, and other generalizations of recursion theory; advanced theory of recursively enumerable sets and their degrees of undecidability. Prerequisite: 290 or equivalent.

Alternate years, given 1976-77

293A,B. Topics in Proof Theory — Selected principally from: Gentzen's theory of formal rules for finite and infinitary languages; analysis of formal proof trees by use of ordinal functions, constructive functionals of higher type. Prerequisite: 290 or equivalent.

293A. 3 units, Aut (Feferman) TTh 1:15-2:30
293B. 3 units, Spr (Feferman) TTh 1:15-2:30

294A,B. Topics in Set Theory — Selected principally from: Forcing and generic sets, Boolean valued models and independence results; mathematical consequences of large cardinal assumptions. Prerequisite: 290 or equivalent.

Alternate years, given 1976-77

296. Topics in Number Theory.
Alternate years, given 1976-77

350. Directed Reading.
Any quarter (Staff) by arrangement

351. Seminar Participation — Participation in a student-organized graduate seminar under the general supervision of a faculty member.
Any quarter (Staff) by arrangement

352. Undergraduate Seminar Leadership — Graduate students leading an undergraduate
seminar (197) may receive up to 3 units of credit.

Any quarter (Staff) by arrangement

355. Teaching Workshop — The workshop program provides guidance to those graduate students who teach courses in the calculus series. Required of all graduate students teaching for the first time.

Any quarter (Staff) by arrangement

356. Upper Division Teaching.

Any quarter, by arrangement

360. Advanced Reading and Research.

Any quarter (Staff) by arrangement

361. Seminar Participation — Participation in faculty-led seminar which has no specific course number.

Any quarter (Staff) by arrangement

360. Seminar in Applied Mathematics.

By arrangement

381. Seminar in Analysis.

By arrangement

383. Seminar in Function Theory.

By arrangement

385. Seminar in Abstract Analysis.

By arrangement

386. Seminar in Geometry and Topology.

By arrangement

387. Seminar in Algebra and Number Theory.

By arrangement


By arrangement

389. Seminar in Mathematical Biology.

By arrangement

391. Seminar in Foundations of Mathematics.

By arrangement

MODERN THOUGHT AND LITERATURE

Committee in Charge: Arnold Rampersad (English), Acting Chairperson; Paul Armstrong (Assistant Director, Modern Thought and Literature and Teaching and Research Fellow); Edward Brown (Slavic Languages and Literatures); Robert McAfee Brown (Religious Studies); Joaquim F. Coelho (Spanish and Portuguese); Rene Girard (Modern Thought and Literature); Albert Guerard (Modern Thought and Literature); David Halliburtan (English, Comparative Literature and Modern Thought and Literature, on leave to Center for Teaching and Learning); Steven Kovacs (Communication); Diane Middlebrook (English); Kurt Mueller-Vollmer (German Studies); Bridget O’Laughlin (Anthropology); Ellen Hawkes Rogat (Center for Teaching and Learning); Peter Stansky (History).

The Committee sponsors a program leading to the Ph.D. in Modern Thought and Literature. This degree is designed for students intending to teach modern literature in interdisciplinary programs or in English departments. It assumes serious interest in one or more areas of modern thought: history, psychology, philosophy, anthropology, linguistics, political and social thought, religious studies, the several arts, contemporary culture generally. The term *modern* is construed to mean, roughly, from the Enlightenment to the present. Thus a student would specialize in modern English and American literature from the Enlightenment to the present, and in addition would pursue an individual program of interdisciplinary studies involving part of the same period. The student would, that is, acquire an extensive knowledge of the literature in one language for approximately the last two hundred years. But no attempt would necessarily be made to cover aspects of non-literary thought for the full modern period.

The Committee also offers several interdisciplinary courses open to qualified undergraduates and graduates in other programs.

PROGRAMS OF STUDY

MASTER OF ARTS

Only candidates for the Ph.D. will be admitted. But students in the Ph.D. program who satisfy the committee of their progress, and who complete satisfactorily 45 units of work, may apply for an A.M. in Modern Thought and Literature.
MODERN THOUGHT AND LITERATURE

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DOCTOR OF PHILOSOPHY

University regulations regarding this degree are discussed in the section "Degrees" in this bulletin. The following Committee requirements are in addition to the basic ones established by the University.

A candidate for the Ph.D. degree in Modern Thought and Literature must complete three years (nine quarters) of full-time work, or their equivalent, in graduate study beyond the A.B. He or she will be expected to offer at least 90 units of graduate work in addition to his dissertation. At least three consecutive quarters of graduate work must be taken at Stanford. Students may spend one year of graduate study abroad.

Each student will plan his or her program with specified advisers. The exact distribution of time, between the literature of specialization and the interdisciplinary work in modern thought and literature, will depend on the nature of the undergraduate preparation. Candidates with an inadequate preparation in earlier literature may be asked to take appropriate courses.

The Committee believes that creative writing or other artistic activity contributes to the development of the teacher of modern literature. A reasonable amount of creative work (the amount to be approved by each student's advisers) may be counted among the 90 units required.

Normally, the requirements for the Ph.D. in Modern Thought and Literature would be distributed as follows:

1. An introductory seminar, Modern Thought and Literature 361 (5 units).
2. Approximately 45 units of advanced work in "modern" literature of one language, including at least two seminars in the appropriate department.
3. Approximately 40 units of advanced work in a coherent and individually arranged interdisciplinary program, including at least one further seminar. The program may include courses and reading in various areas of modern thought and culture, and individual creative work.
4. Teaching is considered an essential part of the program. During the first year a candidate is expected to act as a reader for one course, in the second year to teach two quarters of Freshman English, and in the third or fourth year to assist a faculty member as a section leader in a large survey course.

5. First-Year and Second-Year Qualifying Procedures. No later than the third quarter of the first year the student will meet with faculty members designated by the Chairman in order to discuss the student's academic performance. The faculty will recommend what further courses, if any, should be taken to correct deficiencies. The student will indicate which of the optional plans for qualification he or she has elected to pursue. These are:
   a) a written or oral examination;
   b) a monograph covering the work done;
   c) either one or both of the above combined with (for certain areas) public lectures or discussions.

Before the end of the third quarter of the first year a student electing (a) will arrange with his or her adviser a program of preparation (including, for example, the establishment of a reading list) for the examination. A student electing (b) or (c) will submit a suitable prospectus.

Students must complete their qualifying plans early in the first quarter of the second year; i.e. this is the deadline for taking the examination, for turning in the complete monograph, as in options (a) or (b), or for completing the combined activities of option (c).

6. Language Requirement. Students must demonstrate by the end of the third quarter of the first year a reading knowledge of one foreign language comparable to that required by the Department of English; and by the beginning of the first quarter of the third year, an advanced reading knowledge of one other foreign language. An "advanced" reading knowledge means the ability to make a genuine scholarly use of the language: that is, to read prose of ordinary difficulty.

7. Summary Requirement. At the termination of his or her course work, and prior to the university orals examination, each student will prepare a detailed statement of the advanced work he or she has done outside the area of his or her specialization. This statement must be approved by the student's advisers and certified by the Committee on Modern Thought and Literature.

8. University Oral Examination. This examination, covering the student's areas of concentration and dissertation proposal, will
9. Dissertation. The fourth year will be devoted to the dissertation, which shall be a substantial and original contribution acceptable to the Committee on Modern Thought and Literature. The subject may be drawn from the literature of specialization, from the area of non-literary studies, or from a combination of the two.

**Graduate Program in Humanities**

The Committee participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in Modern Thought and Literature and Humanities. For a description of the Humanities program, see the section “Humanities Special Programs.”

**Undergraduate Program**

The Committee sponsors several courses open to qualified undergraduates, but does not at present offer a major in Modern Thought and Literature. Students wishing to design their own interdisciplinary major should consult the Academic Information Office, on the third floor of the Old Union, and the Chairman of the Committee.

**Courses**

Courses are open to qualified students from any department.

122. American Literature, 1855–1917 — (Same as English 122.)
5 units, Win (Rampersad)

125. American Literature, 1917 to the Present—(Same as English 125.)
5 units, Spr (Chace)

136. The Age of Reason and Enlightenment: European Intellectual History in the 17th and 18th Centuries—(Enroll in History 136.)
4 to 5 units, Aut (Lougée) MTWTh 10

136A. European and Intellectual History in the 19th Century—(Same as History 136A.)
5 units, Win (Robinson) MTWThF 10

136B. European Intellectual History in the 20th Century—(Same as History 136B.)
5 units, Spr (Robinson) MTWThF 10

146. Readings in Russian Modernism—Selected works by Bely, Nabokov, Olesha, Pasternak, Solzhenitsyn and others. Discussions will focus on problems of literary structure with reference to the special status of culture in Soviet society and to related developments in European modernism. Open to all students, including freshmen.
4 units, Win (Todd) MWF 10

162A. Chicano Literature—(Same as Comparative Literature 162A, English 162A, and Spanish and Portuguese 278.) Study of the emergence of a literature. Novels, poems, journals, unpublished works will be read and discussed. Knowledge of Spanish helpful but not essential. (Open to graduate students but not to freshmen.)
5 units, Aut (Islas) MTWTh 11:00

163B. Studies in Women’s Consciousness—(Same as English 163B.) An interdisciplinary approach to the relationship between women novelists’ positions as women and their ways of interpreting and expressing reality. Concentration on George Eliot and Virginia Woolf, but including Jane Austen, Charlotte Brontë and Doris Lessing as well.
5 units, Aut (E. Rogat) MTWTh 1:15

167. The Literature of Fantasy—(Same as English 167.) Major forms of fantasy in literature and other arts. Examining science fiction, pornography, gothicism, and religious and romantic adventure, we will attempt to formulate a theory of the nature and uses of fantasy.
5 units, Aut (Friedlander)

168. American Indian Mythology, Legend, and Lore—(Same as English 168 and Comparative Literature 168.)
5 units, Aut (Momaday) MWFTh 1:15

195. Ad Hoc Undergraduate Seminars—In a given quarter a group of undergraduates (at least 3 but preferably more) who wish in the following quarter to study a subject or an area not covered by regular courses may plan an informal seminar and approach a faculty member to supervise it. A syllabus for the course should be submitted to the Chairman of the Committee at least 2 weeks before the end of the previous quarter. No more than 5 units of credit will be given for Modern Thought and Literature 195 and/or 198 in any one quarter.

Any quarter, by arrangement
198. Individual Work—Advanced undergraduates who wish to study a subject or an area not covered by regular courses may, with permission, enroll for individual work under the supervision of some member of the faculty. No more than five units of credit will be given for Modern Thought and Literature 198 and/or 195 in any one quarter.

Any quarter, by arrangement

202. Philosophy of Nietzsche—(Same as Philosophy 148.)
4 units, Aut (Strasnick) MWF 3:15

203. Ethical Theories—(Same as Philosophy 170.)
4 units, Win (Bratman) MTWTh 2:15

207. Sartre: Literature and Politics—(Same as French 207.) Study of Sartre’s view of the purpose and function of literature in the context of his philosophical and political thought, and also his own imaginative writing. (Reading and discussion in English.)
4 units, Win (Giraud) TTh 2:15

210A. Contemporary Eastern European Film—(Same as Communications 210A.) The evolution of Eastern European cinema from the dogma of socialist realism. Readings will focus on the role of the arts in Communist society as articulated by Hegel, Marx, Engels, Lenin, Stalin, Mao, Trotsky, Lukacs and others. An attempt will be made to establish the tenets of socialist realism and examine its dialectical relationship to recent developments in Soviet, Polish, Hungarian, Czech, and Yugoslav cinema. Weekly screenings will feature highlights from the works of contemporary Eastern European directors.
4 units, Aut (Kovacs) MW 1:15-2:05

210B. Japanese Cinema—(Same as Communication 210B.) A survey of Japanese film, including the work of Mizoguchi, Kurosawa, Ozu, Hani, Oshima, and Ichikawa. Through a selection of films and readings the course will attempt to explore the significance of Japanese films in terms of their social and cultural background. Weekly screenings.
4 units, Win (Kovacs) by arrangement

210C. Five American Directors—(Same as Communication 210C.) The work of John Ford, Howard Hawks, Orson Welles, Alfred Hitchcock and Stanley Kubrick will be examined in light of the auteur theory. Weekly screenings.
4 units, Spr (Kovacs) by arrangement

220. Film Aesthetics—(Same as Communication 101.) A systematic examination of the nature of the film medium, and of attempts to construct theories of film. Attention is given to the problems of aesthetics and communication from the viewpoints of practitioner, critic, and audience.
4 units, Aut (Kovacs) MWF 10, with evening screening

221. History of Film—(Same as Communication 141.) Studies in the development of the motion picture as an art form and a means of communication. Lab.: screenings of films announced in class.
4 units, Win (Mayer) MWF 9

4 units, Win (Elsen)

223A. Modern Sculpture—(Same as Art 123A.) Modern sculpture from Rodin to David Smith. The course focuses on major changes in sculpture and the art of Brancusi, Matisse, Picasso, Lipchitz, Art, Giacometti, Gonzalez, Moore, and others.
5 units, Spr (Elsen)

224. Colloquium on Picasso, His Life’s Work in All Media—(Same as Art 224.)
4 units, Aut (Elsen) MW 2:15-4:05

226. Undergraduate Colloquium: European Socialisms in the 19th and 20th Centuries—(Same as History 236.)
5 units, Aut (Wright) T 2:15-4:05

226E. Studies of the Meeting of Eastern and Western Art—(Same as Art 226E.)
4 units, Aut (Sullivan) MWF 10:00

232. The English Novel in the Nineteenth Century—(Same as English 232.) Study of the most significant novels, with emphasis on development of the form.
5 units, Spr (Polhemus)

233. The Twentieth-Century English Novel—(Same as English 233.)
5 units, Aut (Stone) MTWTh 10:00

234B. Women, Family, Society in Europe (Undergraduate Colloquium)—(Same as History 234B.)
5 units, Win (Lougee) Th 2:15-4:05
234C. Undergraduate Colloquium: Humanities and International Relations: The Modern Period in Europe—(Same as History 244C.)

5 units, Aut (Stansky) T 2:15–4:05


5 units, Win (Dekker)

235. Undergraduate Colloquium: Realism, Romanticism and the African Intellectual—(Same as History 247.)

5 units, Aut (Jackson) M 2:15–4:05

235A. Undergraduate Colloquium: Marxism and Afro-American Thought and Politics. (Same as History 255.)

5 units, Spr (Carson) M 2:15–4:05

236. Forms of the Modern Novel—(Same as English 236; same as Comparative Literature 236.) An advanced course in the interpretation and criticism of novels, but open to any student with a serious interest in the art of fiction. Stendhal, Dickens, Dostoevsky, Conrad, Gide, Faulkner, and one or two living writers.

5 units, Win (Guerard)

237A. Undergraduate Colloquium: Opera and History—(Same as History 237A.)

5 units, Aut (Robinson) W 2:15–4:05

240. Modern British Drama—(Same as English 248.) Survey of major writers and trends—from Shaw through the present.

5 units, Win (Friedlander)

242. Symbolic Anthropology—(Same as Anthropology 152.) Seminar on the past and current trends in the analysis of symbolism and symbolic action in primitive ritual, myth, and social organization. General theories of the symbolic process will be covered as well as particular methods of analysis and interpretation.

5 units, Aut (R. Paul) MWF 10

244. Mythology and Folklore—(Same as Anthropology 144.) Seminar on the Narrative Pattern in Oral Literature. Problems and theories of origin, form, transmission and function of folktales and myths will be reviewed. Students will examine cross-culturally or from some other specific perspective patterns or collections of patterns primarily from native America, Africa and the Pacific region. Reports on their findings will form the basis of discussion in the latter half of the quarter. (Graduate students enroll in 344.)

5 units, Aut (Gerow) T 2:15

248. Women in Cross-Cultural Perspective—(Same as Anthropology 9.) A lecture course on various traditional anthropological concerns, as these are illuminated by a study of the position and behavior of women. Topics of discussion will include the place of women in kinship, political, economic, and ritual systems.

5 units, Win (J. Collier) MWF 11

252. Political Thought: The Modern Period—(Same as Political Science 153.) Democratic theory, liberalism, socialism, communism and anarchism since 1785. The course will undertake critical analysis of attempts to adapt the ideals of democracy and social justice to the large modern state. The Federalist papers, Tocqueville, J. S. Mill, Marx and Lenin will be considered.

5 units, Spr (N. Keohane) MWTh 10

253B. Poetry and Ideas: Johnson to Blake—(Same as English 253B.)

5 units, Win (Davie)

254C. Victorian and Early Modern Poetry—(Same as English 254C.)

5 units, Spr (Davie)

255. Twentieth-Century British Poetry—(Same as English 255.) Hardy to Larkin.

5 units, Aut (Dekker) MTWTh

256A. American Poetry, 1900–1945—(Same as English 256A.)

5 units, Aut (A. Gelpi)

257. American Drama from 1920—(Same as Drama 257.)

4 units, Aut (Cole) MWF 11

258. Twentieth-Century Neo-Romantic British and American Poetry—(Same as English 258.) Extensive readings of a few poets, including Wallace Stevens, Theodore Roethke, Hart Crane, W. H. Auden, Dylan Thomas, Kathleen Raine, and Charles Tomlinson.

5 units, Win (Middlebrook)

260A,B. "Modernisms"—(Same as Political Science 160A, B/260A, B.)

5 units each, Win and Spr (Y. Rogat) M 2:15–4:05
261A. Afro-American Fiction—(Same as English 261A.) A survey of the principal works of black novelists and short story writers in America, especially those of the twentieth century.

5 units, Spr (Rampersad)

261B. Afro-American Poetry—(Same as English 261B.) A chronological survey of poetic expression in black America, with emphasis on the work of Paul Laurence Dunbar, Langston Hughes, Gwendolyn Brooks, and LeRoi Jones (Imamu Amiri Baraka).

5 units, Aut (Rampersad)

262A, B. Seminar: Theory, Power, and Social Science—(Same as Political Science 158 A, B.)

262A. The development of modern social science and social philosophy: discussions of value, the nature of man, human interaction, the organization of power, belief systems, social change, and related themes in the different idealist, formalist, and positivist schools of thought. No prerequisite, but 153 or a course in modern philosophy or intellectual history will be helpful. This course provides the historical and philosophical background for 158B.

5 units, Win (Drekmeier)

262B. The theory of political structure and process: typology of social relationships, organization and leadership, social class and ideology, alienation and participation, etc. Political sociologies of elites, bureaucracy, and class in the writings of Marx, Toennies, Simmel, Weber, Mannheim, Durkheim, Michels, and contemporary theorists. Psychoanalytic, phenomenological, and other conceptions of the nature of consciousness and experience will be considered in the analysis of behavioral aspects of the subject. 262A strongly recommended.

5 units, Spr (Drekmeier)

263. Seminar on Freedom and Equality—(Same as Political Science 163.) An analysis of varied treatments of these two concepts, and supposed tensions between them, in modern social thought. Attention will be given to the differences between “negative” and “positive” liberty, and to different ways of thinking about equality, including equality of opportunity and equality between the sexes. Readings will be drawn from contemporary political theorists as well as earlier philosophers.

5 units, Aut (N. Keohane)

264. Undergraduate Colloquium: Student Activism in America—(Same as History 264.)

5 units, Aut (Carson)

267. Russian Formalist and American “New” Criticism—(Enroll in Slavic Languages and Literature 230, same as Comparative Literature 230 and English 267.) Readings in the works of Russian Formalists and certain American “New Critics.” A knowledge of French, German or Russian is highly desirable.

4 units, Aut (Brown)


4 units, Aut (Franco)

272. Spanish Literature in a Social Context II—(Same as Spanish 272 and Comparative Literature 272.) The poet and the people in the 1930s—Lorca, Alberti and Cernuda.

4 units, Win (Franco)

273. The Poem Itself—(Same as Portuguese and Comparative Literature 291.) A course on practical criticism based on the famous poems of Spain, Portugal, Brazil, and Spanish America. Students will be expected to write short papers on the texts discussed. Classroom debates as well as poetry readings will be encouraged. Reading knowledge of Spanish and/or Portuguese required.

3 to 5 units (Coelho)


4 units, Spr (Franco)


5 units, Win (Mellor)

280. Broadcasting and Film Criticism—(Same as Communication 180.) An attempt to develop a critical view of film. Readings and discussion will consider models of artistic and literary criticism as points of comparison. The student will be introduced to
journalistic, psychoanalytical, Marxist, structuralist and semiological approaches. Weekly reviews will stress the meaning of the films and a lucid writing style. Prerequisites: 101, 141, or 142.

4 units, Spr (Kovács) MWF 9

288A. Joyce—(Same as English 288A.) Joyce’s essential work up to Finnegans Wake.

5 units, Aut (W. Chace) MWF 10:00

291. The Idea of Revolution in Modern French Literature—(Same as French 191.) A study of the representation of revolution and attitudes toward it in French texts from the Romantic period to the twentieth century. Most readings in French. Discussion in English.

4 units, Aut (Giraud) TTh 2:15-4:05

300. Theory of the Novel—(Enroll in Slavic 300. Same as Comparative Literature 300.)

4 units, Spr (Todd)

315G. Seminar: Eighteenth-Century Literature of Travel—(Same as English 315G.) Fictional and non-fictional travel literature by such writers as Swift, Johnson, Sterne and Smollett.

5 units, Spr (Fifer)

316C. Seminar: Romantic Irony—(Same as English 316C and Comparative Literature 316C.)

5 units, Aut (Mellor) T 7-10:30 p.m.

317. Seminar: Approaches to Research in English and American Literature Since 1700—(Same as English 317.) A course for second-year graduate students on standard research methods and the presentation of research findings.

5 units, Aut (Dekker) TTh 2:15-4:05

326. Seminar: American Literature of the 1930’s—(Same as English 326.) An examination of writers in a political context and of later writers who took their bearings from them: e.g. Dos Passos, Steinbeck, Lionel Trilling, Edmund Wilson, Mary McCarthy, E. L. Doctorow.

5 units, Aut (Chace) MW 2:15-4:05

327. Graduate Seminar: Topics in Modern European History—(Same as History 427.)

5 units, Aut (Wright) M 2:15-4:05

334. Early Modern European Social History—(Same as History 334.)

5 units, Aut (Lougee) Th 2:15-4:05

337. European Intellectual History Since the Enlightenment—(Same as History 337.) Graduate Colloquium.

5 units, Win (Robinson) W 2:15-4:05

361. The Modern Tradition—(Same as English 361 and Comparative Literature 361.)

5 units, Spr (Staff)

362A. Seminar: Literature and Psychology—(Same as English 362A and Comparative Literature 362A.) Studies in the dynamics of literary creation, with special attention to conscious and unconscious psychological constructs in Dickens and Dostoevsky.

5 units, Spr (Guerard)

369. Seminar: Major Modern Critics—(Same as English 309 and Comparative Literature 309 and Drama 302.)

5 units, Aut (Lyons) MW 2:15-4:05

372. Seminar: Humboldt and Structuralism—(Same as German Studies 449 and Comparative Literature 449.) A close study of Humboldt’s writings on linguistics and the nature of language and their relation to modern structuralism. It is the aim of the seminar to examine critically the notion of structure and the limits of its applicability in literary studies. Taught in English. Readings in German.

3 to 5 units, Aut (Mueller-Vollmer) Th 4:15-6:05


4 units, Win (Giraud) W 2:15-4:05

388A. Seminar: James, Conrad, and Ford—(Same as English 388A.)

5 units, Win (Moser)

395. Ad Hoc Graduate Seminars—In a given quarter, a group of graduate students (at least three but preferably more) who wish in the following quarter to study a subject or an area not covered by regular courses and seminars may plan an informal seminar and approach a suitable member of the faculty to supervise it, either on a graded or pass/no credit basis.

Any quarter, by arrangement

398. Research Course—The student pursues a special subject of investigation under supervision of some member of the Committee or another faculty member. Thesis work not to be registered under this course.

Any quarter, by arrangement
Students of Modern Thought and Literature are referred to the offerings of the following departments: Anthropology, Art, Asian Languages, Communication, Comparative Literature, Drama, English, German Studies, History, Humanities Special Programs, Linguistics, Philosophy, Political Science, Psychology, Sociology, and Slavic Languages and Literatures. Consent of the instructor is required for most courses offered in these departments.

**MUSIC**


*Chairman:* Albert Cohen


*Associate Professor:* William H. Ramsey

*Adjunct Professors:* Arthur B. Barnes (Director of Bands), Marie Gibson (Voice) (on leave autumn quarter 1975)

*Assistant Professors:* William P. Mahrt, Mark F. Starr

*Lecturers:* Michael J. Andrews (Theory); Meredith Ellis Little (Early Music Performance); Nathan Schwartz,* Naomi Sparrow (Piano); David Abel,* Anne W. P. Crowden (Violin); Rolf Persinger (Viola); Bonnie Hampton* (Violoncello); Frances Blaisdell, Lupe Duran, Alexandra W. Hawley (Flute); Raymond H. Duste (Oboe); David B. Breeden (Clarinet); Susan Willoughby (Bassoon); Charles Bubb (Trumpet); Robert Szabo (Trombone); Earl Saxton (French Horn); Floyd O. Cooley (Tuba); Danny Montoro (Percussion); Marjorie Chauvel (Harp); Charles A. Ferguson (Guitar); Stanley Buetens (Lute); Martha Blackman (Viola da Gamba); Margaret Fabrizio (Harpichord and Early Piano); Joan Benson (Clavichord and Early Piano); Robert Bernard (Voice); Herbert Myers (Early Winds).

* Members of the Francesco Chamber Trio.

**Music Librarian:** Edward E. Colby

**Director of Glee Club:** Robert R. MacKinnon

**Offerings and Facilities**

The Department's aims are to promote understanding and enjoyment of music in the University at large and to provide specialized training for those who plan careers in music as composers, performers, teachers, or research scholars.

Practice facilities are available in the Knoll, the Music Annex, and the Dinkelspiel Auditorium Building, which also includes a theater for concert and operatic productions. In addition to pianos, organs, harpsichords, and a variety of early stringed and wind instruments, students may use rare instruments from the Harry R. Lange Historical Collection.

The Departmental library contains a comprehensive collection of complete editions, scores, books, and records. Supplementing this is the Stanford Memorial Library of Music, which is an invaluable collection of musical manuscripts and first editions.

The Music Department has access to large digital computers on which work is being done in sound synthesis, acoustical analysis, and composition. Advanced composition students interested in electronic music and use of the computer in composition, and students with a particular interest in acoustics are encouraged to make use of this facility.

**Programs of Study**

**Bachelor of Arts**

*Undergraduate major* — May be planned in one of three ways depending on whether the student wishes:

1. A concentration in composition, performance, or music history.
2. Preparation for secondary school teaching by way of the Stanford Internship Program.
3. A general program of studies without special emphasis on any particular branch of music.

The plan in each case will be drafted by the student and his or her adviser to include certain required work as outlined below plus electives which take into account the individual's particular talent and interest.

To insure a strong foundation for the in-
individual concentrations, all students are required:

A. To include the following courses in their programs:

1. Music 21–22 (Elements of Music)
2. Music 23 (Functional Harmony)
3. Music 100, 101, 102, 103, 104 (Music History and Theory)
4. Individual studies in performance: six quarters
5. Ensemble: six quarters of work in one or more departmental organizations or in chamber music, excluding Music 161C (Sports Activity Band) and Music 167 (Glee Club)

B. To demonstrate a minimum proficiency in piano, which will include sight-reading of works at the level of Clementi sonatinas as well as playing two prepared pieces comparable in difficulty to Bartok's Mikrokosmos, Book 4. This requirement should be fulfilled as early as possible and not later than the beginning of the junior year.

C. To demonstrate ability to hear music accurately and to perform it at sight. These skills will be checked by two examinations, the first to be taken upon completing Music 22, the second to be taken in the first quarter of the senior year.

Independent work by advanced students is encouraged as indicated under Music 199.

Students who have completed the major and have demonstrated marked ability in composition, performance, or music history are invited to apply for admission to the departmental Honors Program. The latter involves working out a substantial project in the individual's main field of interest.

Prospective music majors should consult one of the advisers in the Music Department as early as possible in order to plan a program that allows sufficient time for practice as well as for other study. This applies especially to freshmen and to those who wish to concentrate in performance.

The sample schedule given below shows how the University Distribution Requirements may be fulfilled so as to permit substantial work in music during the Freshman and Sophomore years. Note the inclusion of foreign language study which is strongly recommended for all music majors and especially for those expecting to continue into graduate work.

**Recommended Schedule for Completing the Music Major Program**

**First Year**

<table>
<thead>
<tr>
<th>Courses</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>English* (2 quarters writing)</td>
<td>3</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Music 21, 22, 23</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Music 100</td>
<td>—</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>Individual Instruction and/or Ensemble</td>
<td>1-4</td>
<td>1-4</td>
<td>1-4</td>
</tr>
<tr>
<td>Choice of Foreign Language, Freshman Seminar, or University Distribution requirement</td>
<td>3-5</td>
<td>3-5</td>
<td>3-5</td>
</tr>
</tbody>
</table>

* (English or Music 21 may begin winter quarter. If Music 21 and 22 are taken in winter and spring quarters of first year, Music 23 must be taken in autumn quarter of second year.)

**Second Year**

<table>
<thead>
<tr>
<th>Courses</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music 101, 102, 103</td>
<td>4</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Individual Instruction and/or Ensemble</td>
<td>1-4</td>
<td>1-4</td>
<td>1-4</td>
</tr>
<tr>
<td>University Distribution Requirement in Science or Social Science</td>
<td>3-5</td>
<td>3-5</td>
<td>3-5</td>
</tr>
<tr>
<td>Elective (or Music 23 in autumn if not taken previously)</td>
<td>3-5</td>
<td>(3)*</td>
<td>(3)*</td>
</tr>
</tbody>
</table>

* (Optional)

**Third Year**

<table>
<thead>
<tr>
<th>Courses</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music 104</td>
<td>6</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

**TEACHING CREDENTIAL (SECONDARY)—INTERNERSHIP PROGRAM IN MUSIC**

Students in the Department may prepare themselves for work toward the Standard Teaching Credential (Secondary) in music.

This work at Stanford is organized in an Internship Program consisting of four quarters of graduate study at the University combined with half-time teaching on salary from September to June as an intern in secondary schools near Stanford.

The program begins only in the Summer quarter of each year. Students are admitted to it on recommendation of the Music Department and the School of Education. Applicants must have a bachelor's degree with a major in music. Undergraduate preparation should include foundation courses comparable to those listed above under A.B. major, plus the following:

- Music 127. Orchestration
- Music 130, 131. Conducting (9 units)
Music 65A, B, C. Vocal and instrumental classes (3 to 5 units)

GRADUATE DEGREES IN MUSIC

The following statements apply to all the graduate degrees described below, unless otherwise indicated.

Applicants for admission to graduate study should arrange to take the Graduate Record Examination, including the Advanced Music sections. Prior to initial registration, the student should be prepared: (a) to demonstrate proficiency in piano equal to that specified in the A.B. program; (b) to demonstrate a reading knowledge of one foreign language chosen from French, German, or Italian, and a knowledge of the common musical terms in all three of the above languages; (c) to take placement tests in theory and music history.

Students whose previous preparation proves insufficient must expect to spend more than the minimum time in residence.

None of Stanford’s required undergraduate courses in music may be credited toward an advanced degree.

Only work that receives a grade of A, B, or plus will be recognized as fulfilling the advanced degree requirements in music.

Doctoral candidates working in absentia on Ph.D. dissertations or D.M.A. final projects which require consultation with faculty members must continue enrollment in the University under the heading of Terminal Graduate Registration.

Teaching assistantships—It is the policy of the Department to appoint each Doctoral candidate to a teaching assistantship for at least one quarter.

MASTER OF ARTS

Residence—A minimum of three quarters of full-time study in residence is required.

Study program—Students may concentrate in composition, performance (including conducting), or music education. To be recommended for the A.M. degree, a candidate must complete a program of 36 units of graduate course work, including Music 200 and 299 plus three quarters of ensemble performance. Depending on the concentration, the Master of Arts Project will be an investigative essay, a composition, or a demonstration of performance supported by a written commentary on the performance practices that are involved.

DOCTOR OF MUSICAL ARTS

The purpose of the Doctor of Musical Arts program is to offer advanced training in the practice and pedagogy of music. Students may concentrate in composition, music education, or performance (including conducting)—the latter concentration to be centered on the investigation of performance practices from medieval to modern times. Each concentration will be given breadth through collateral studies in other branches of music and in relevant fields outside music as seems desirable.

Admission—In addition to completing entrance tests, an applicant will be asked to submit evidence of accomplishment in the proposed field of concentration. Applicants in music education must have had at least two years of successful teaching experience.

Residence—If there are no deficiencies to be made up, this program may be completed in a minimum of two years of full-time study following the Master’s degree. The candidate must spend at least three consecutive quarters in residence and must devote at least one quarter in residence to work on his or her final project.

Study program — The candidate must complete, beyond the Master’s degree, a minimum of two years of full-time work which will be planned individually for each concentration. It must be emphasized, however, that the degree will be awarded on the basis of demonstrated achievement rather than on the accumulation of units.

In addition to such independent study and formal course work as may be done, each program will include: (a) four term projects; (b) a final project; and (c) a public lecture-demonstration.

Candidates in performance will make an extensive study of repertoire, leading to four demonstrations of their ability to give stylistically acceptable performances of music from different historical periods. Each demonstration is to be supported by a written report containing analysis of the music in question, discussion of the special performance problems that are involved, and detailed proposals for the solution of those problems.

Candidates in music education will do extensive reading and research in both the philosophy and practice of their field, each candidate ultimately focusing on a special branch according to his or her particular in-
terest. The students in this area will also complete a minor of at least 12 units in composition, music history, or performance.

Candidates in composition will be expected to produce a number of original works demonstrating their ability to compose in a variety of forms and for the common media of vocal and instrumental music. Insofar as possible, the works submitted will be presented in public performance prepared by the composer.

**Final project** — (1) composition: an extended work for instruments, voices, or electronic media; (2) music education: a dissertation based on independent research in the candidate's field of specialization; (3) performance: possibilities open to the candidate include (a) preparing a modern performing edition of an early score; and (b) writing an extended critical or historical essay on a selected problem or phase of performance practice.

**Public lecture-demonstration** — This is to be given during the last quarter of residence. It should be about one hour in length, dealing with some aspect(s) of the candidate's final work.

**Foreign language requirements** — All students are required to demonstrate knowledge of the common musical terms in French, German, and Italian, and, with possible exception at discretion of the adviser for concentrators in music education, a reading knowledge of one of the above languages. Concentrators in performance are further required by the end of their first year of doctoral study to demonstrate reading ability in a second language chosen from the three listed above.

**Departmental examinations** — (1) a qualifying examination consisting of written and oral tests in the general field of music history, no later than the fifth quarter of full-time residence; (2) a written examination in the candidate's special area of concentration, no later than the third quarter after passing the qualifying examination; (3) the University Oral Examination, to be taken prior to the actual writing of the dissertation at the beginning of the fourth year of residence.

**Admission** — In addition to completing entrance tests, an applicant is asked to submit some evidence of his or her work in the field of music history such as a term paper or a Master's thesis.

**Basic requirements** — Each candidate must complete a minimum of three years of full-time work. The student may proceed directly to the Ph.D. without taking the A.M. en route. The program will normally include: (1) seminars in musical notation, analysis and performance practice; (2) readings in music theory; (3) independent research culminating in a dissertation; (4) dissertation research to be taken in the third year of residence.

**Public lecture-demonstration** — This is to be given during the last quarter of residence. It should be about one hour in length, dealing with some aspect(s) of the candidate's final work.

**Foreign language requirements** — A reading knowledge of French or Italian, and German, plus any other language necessary to research in the candidate's field of specialization. The examination will consist of the translation into idiomatic English of excerpts in prose and poetry. The examination in one language must be taken prior to the student's first registration. The second language must be certified before the beginning of the second year of residence.

**Departmental examinations** — (1) a qualifying examination consisting of written and oral tests in the general field of music history, no later than the fifth quarter of full-time residence; (2) a written examination in the candidate's special area of concentration, no later than the third quarter after passing the qualifying examination; (3) the University Oral Examination, to be taken prior to the actual writing of the dissertation at the beginning of the fourth year of residence.

**COURSES**

**FOR THE GENERAL STUDENT**

Any of the following courses may be used in partial fulfillment of the University's distribution requirement in the Humanities:

1. **Introduction to Music** — Musical expression, style, structure explained, illustrated for the listener.
   
   3 units, Aut (Kuhn)

2A. **The Symphony**.
   
   3 units, Spr (Barnes)

2B. **The Concerto**.
   
   3 units, Win (Kuhn)
2C. Opera.
   3 units, Spr (Kuhn)

2D. Listener's Introduction to Chamber Music.
   3 units (Schwartz)

2E. Piano Music: Beethoven to Debussy.
   3 units (Schwartz)

3A. Renaissance and Baroque Music.
   3 units (Houle)

3B. New Music — Instrumental, vocal and electronic music since 1950. New forms and performing media in relation to contemporary aesthetics.
   3 units (Staff)

3C. Medieval Music.
   3 units (Mahrt)

3D. Music of the Early 20th Century.
   3 units (Starr)

3E. Music of Elizabethan and Jacobean England.
   3 units, Win (Houle)

4A. The Music of J. S. Bach.
   3 units (Nanney)

4B. The Music of Mozart.
   3 units, Spr (Nanney)

4C. The Music of Beethoven.
   3 units (Staff)

4D. The Music of Stravinsky.
   3 units (Barnes)

5A. Music in America.
   3 units, Win (Cohen)

**FOUNDATION COURSES FOR A.B. MAJOR**

20. Introduction to Music Theory—A preparatory course in basic sight reading, ear training, keyboard harmony, and melodic, rhythmic, and harmonic dictation. This is a skills course using the piano and voice as basic tools to develop listening and reading skills. Enrollment is limited to music majors who are unable to pass the proficiency test for entry to 21.
   4 units, Aut (Barnes)

21, 22. Elements of Music—Exploration of the elements of sound and time and their organization into musical forms. Development of notation as a means of representing and controlling sound in various media. Ear-training, beginning with acoustical phenomena, will underlie all written work. Lectures and laboratory sections. Open to all students desiring basic technical knowledge of musical composition. Prerequisite: ability to pass proficiency examination given on the first day of class.
   21. 4 units, Aut (Staff)
      Win (Staff)
   22. 4 units, Win (Staff)
      Spr (Staff)

23. Functional Harmony—Prerequisite: 21, 22.
   4 units, Aut (Staff)
   Spr (Staff)

27. Solfege and Ear Training—Prerequisite: 21, 22, 23.
   3 units, Aut, Win, Spr (Staff)

100. Music History: Medieval and Renaissance—Prerequisites: 21, 22.
   4 units, Spr (Mahrt)

101. Music History: Baroque — Prerequisites: 21, 22, 100.
   4 units, Aut (Horsley)

102. Music History and Theory: Classic—Prerequisite: 23.
   6 units, Win (Ratner)

103. Music History and Theory: Romantic —Prerequisite: 102.
   6 units, Spr (Ratner)

104A. Music History and Theory: Modern —Prerequisite: 103.
   6 units, Aut (Smith)

**MUSIC THEORY AND COMPOSITION**

123. Composition — Individual projects in creative work. May be repeated for credit. Prerequisite: consent of instructor.
   3 units, Aut, Win, Spr (Smith)

125. Modal Counterpoint.
   3 units, Spr (Horsley)

126. Tonal Counterpoint—Prerequisite: 103.
   3 units, Aut (Ratner)

127. Orchestration—Prerequisite: 23.
   3 units, Aut (Barnes)

223. Seminar in Composition—May be repeated for credit.
   4 units, Aut, Win, Spr (Smith)
224, 225. Solfege and Score Reading.
224. 4 units, Win (Barnes)
225. 4 units, Spr (Barnes)

228A. 4 units, Aut (Horsley)
228B. 4 units, Win (Horsley)

229. Tonality and Structure—Graduate review of harmonic functions; relation between details of progression and total structure.
4 units (Smith)

HISTORY AND LITERATURE OF MUSIC

Unless otherwise stated, prerequisite for any course in this section is 103.

140. Studies in Medieval and Renaissance Music—Prerequisite: 100.
140A. The Italian Madrigal.
4 units (Horsley)
140C. 1492: Music and Its Background in the Late Fifteenth Century.
4 units, Aut (Houle)

141A. The Music of Handel.
4 units (Horsley)
4 units, Win (Houle)

142A. String Quartets of Beethoven.
4 units (Ratner)
142C. Chamber Music of the Classic Period.
4 units (Ratner)
142D. The Piano Sonatas of Beethoven.
4 units, Aut (Schwartz)
142E. The Symphonies of Beethoven.
4 units (Starr)
142F. The Operas of Mozart.
4 units, Spr (Ratner)

143B. The Music of Brahms.
4 units, Spr (Mahrt)

144. Studies in Modern Music—Prerequisite: 104.
144A. Twelve-Tone and Serial Music.
4 units, Win (Smith)
144B. Innovations in Contemporary Music.
4 units (Smith)

150A. History of Musical Instruments.
4 units (Houle)

150B. History of Fugue.
4 units, Spr (Horsley)

150C. History of Musical Esthetics.
4 units, Spr (Houle)

151. Analysis of Opera—Prerequisite: 23.
4 units, Aut (Starr)

153. Organ Literature.
153A. Organ Music (Cabezón to Bach).
4 units (Nanney) given 1976-77
153B. Organ Music (Bach to Ligeti).
4 units (Nanney) given 1976-77

198. Senior Honors Project.
4 units (Staff)

199. Independent Study—For advanced undergraduates who wish to do work outside the regular curriculum. Before registering for this, a student must present a specific project and must enlist a faculty sponsor. Credit up to 4 units per quarter.

PERFORMANCE

12. Introductory Piano — Class for music majors only.
1 unit, Aut, Win, Spr (Blew)

65A. Stringed Instruments Class—For Credential candidates.
1 unit, Aut, Win, Spr (Kuhn)

65B. Wind Instruments Class—For Credential candidates.
1 unit, Aut, Win, Spr (Barnes)

65C. Voice Class — For Credential candidates, music majors, and non-majors who are members of departmental performing organizations.
1 unit, Aut, Win, Spr (Gibson, Bernard)

73, 74, 75, 76, 77. Small Group Instruction—A special fee of $30 per quarter is charged for enrollment in any of these groups.
1 unit, Aut, Win, Spr (Staff)

73. Voice Class.
(Gibson, Bernard)

74A. Stringed Instruments Classes.
(Staff)
74B. Viola da Gamba Class.  
(Blackman)

74C. Lute and Classical Guitar Class.  
(Ferguson)

74D. Baroque String Performance Class.  
(Blackman)

75A. Wind Instruments Classes.  
(Staff)

75B. Renaissance Wind Instruments Class.  
(Staff)

76. Brass Instruments Classes.  
(Staff)

77. Percussion Class.  
(Montoro)

172, 173, 174, 175, 176, 272, 273, 274, 275, 276, 277. Individual Vocal and Instrumental Instruction—A special fee of $60 per quarter for majors and $120 for non-majors is charged for enrollment in these courses. Students who wish to enroll in individual instruction must demonstrate, by audition with the appropriate teacher, a minimum proficiency on his instrument. Minimum repertory lists for each instrument are available at the Music Department office.

3 units, Aut, Win, Spr


172A, 272A. Piano.  
(Baller, Blew, Schwartz, Sparrow)

172B, 272B. Organ.  
(Nanney)

172C, 272C. Harpsichord.  
(Fabrizio)

172D, 272D. Clavichord.  
(Benson)

172E, 272E. Early Piano.  
(Benson, Fabrizio)

(Gibson, Bernard)

174, 274. Stringed Instruments.

174A, 274A. Violin.  
(Abel, Crowden)

174B, 274B. Viola.  
(Persinger)

174C, 274C. Violoncello.  
(Hampton)

174D, 274D. Contrabass.  
(Staff)

174E, 274E. Viola da Gamba.  
(Blackman)

(Buetens, Ferguson)

(Chauvel)

(Blackman)

175, 275. Woodwind Instruments.

175A, 275A. Flute.  
(Blaisdell, Duran, Hawley)

175B, 275B. Oboe.  
(Duste)

175C, 275C. Clarinet.  
(Breeden)

175D, 275D. Bassoon.  
(Willoughby)

175E, 275E. Renaissance Wind Instruments.  
(Myers)

176, 276. Brass Instruments.

176A, 276A. French Horn.  
(Saxton)

176B, 276B. Trumpet.  
(Bubb)

176C, 276C. Trombone.  
(Szabo)

176D, 276D. Tuba.  
(Cooley)

177, 277. Percussion.  
(Montoro)

130. Orchestral Conducting—Prerequisite: 127.

130A. 3 units, Win (Starr)

130B. 3 units, Spr (Starr)

131. Choral Conducting.

4 units (Ramsey) given 1976–77


4 units, Aut (Houle)

230. Advanced Orchestral Conducting.

230A. 4 units, Win (Starr)

230B. 4 units, Spr (Starr)

231. Advanced Choral Conducting.

231A. 4 units (Ramsey)

231B. 4 units (Ramsey)

251. Choral Repertory (1500–1750).  
4 units (Ramsey)

252. Choral Repertory (1750 to Present).  
4 units (Ramsey)
268. Thorough-Bass Realization.
   1 unit, Aut, Win, Spr (Fabrizio)

269. Studies in Performance Practices — Performance studied in the light of musical resources, aesthetic attitudes, and theoretical principles of the various historical periods. Lectures, individual research, and practice sessions leading to concert performances. May be repeated for credit. Prerequisite: 169.

269A. Medieval.
   4 units, Aut (Mahrt)

269B. Renaissance.
   4 units, Win (Mahrt)

269C. Baroque.
   4 units, Spr (Houle)

269D. Classic.
   4 units, Win (Ratner)

   1 to 4 units, Win, Spr (Starr, Gibson, Staff)

ENSEMBLE

All courses listed in this section may be repeated for credit, with a maximum of 24 units allowed toward graduation. Membership in these organizations is not limited to students who register in the courses for credit and is open to both men and women. An audition, however, is required for admission to any University musical organization. Audition schedules will be announced in advance of each registration period.

156. Early Music Singers.
   1 unit, Aut, Win, Spr (Mahrt)

   1 unit, Aut, Win, Spr (Montoro)

158. Contemporary Performance Ensemble.
   1 unit, Aut, Win, Spr (Andrews)
   T 4:15–6:05

159. Renaissance Wind Band.
   1 unit, Aut, Win, Spr (Houle, Mahrt, Myers) M 2:15–5:05

160. University Orchestra.
   1 unit, Aut, Win, Spr (Starr) M 7:30 p.m. and Th 7:15 p.m.

161. University Bands.
   161A. Concert Band.
      1 unit, Aut (Barnes) T 7:15 p.m.
      Win (Barnes) MWF 4:15–5:30 p.m.
      Spr (Barnes) MWF 4:15–5:30 p.m.

161B. Studio Band.
   1 unit, Aut, Win, Spr (Barnes) by arrangement

161C. Sports Activity Bands.
   1 unit, Aut (Barnes) MWF 4:15–5:30
   1 unit, Win, Spr (Barnes) by arrangement

162. University Chorus.
   1 unit, Aut, Win, Spr (Ramsey)
   M 7:30–9:30 p.m. and W 4:00–5:30

163. University Choir — Official choir of Memorial Church, which furnishes music for Sunday services and special occasions in the Church calendar. Eight members chosen by audition may receive an honorarium for performing duties other than those required of the regular Choir.
   2 units, any quarter (Ramsey) T 4:15–5:30 and Th 7:00–8:30 p.m. and Sunday 10–12

   1 unit, Aut, Win, Spr (Ramsey) MTh 12

166. Chamber Orchestra — Open to advanced players who have had orchestral experience.
   1 unit, Aut, Win, Spr (Starr) TThF 12

   1 unit, Aut, Win, Spr (MacKinnon)
   T 7:15–8:45 p.m. and Th 4:15–5:45

168A. University Wind Ensemble.
   1 unit, Aut, Win, Spr (Barnes)
   M 12 and W 7:30

168B. Brass Choir.
   1 unit, Aut, Win, Spr (Barnes)
   T 4:15 and Th 12

170. Piano Accompanying.
   2 units, Spr (Schwartz)

171. Chamber Music—Open to any student with sufficient technical ability to play in small combinations for strings, winds, and keyboard instruments.
   1 unit, Aut, Win, Spr (Hampton, Staff)

271. Performance Special — For students who take part in performances organized in
Music 269 or 279 while not enrolled in either of those classes.

1 unit, Aut, Win, Spr (Staff)

**MUSIC EDUCATION**


265A. 3 units, Sum (Kuhn) MTWTh 3:15
265B. 2 units, Aut (Kuhn) T 4:15–6:05
265C. 2 units, Win (Kuhn) T 4:15–6:05
265D. 1 unit, Spr (Kuhn) T 4:15–6:05

280. Seminar in Music Education.
4 units, Aut (Kuhn)

281. Administration and Supervision of Public School Music.
4 units, Spr (Kuhn)

282. Teaching Music in the Elementary School—(Same as Education 165.) Teaching methods and techniques. Examination and evaluation of new curricular trends such as the Kodaly Singing School, the Orff Music for Children, and Suzuki Talent Education.

3 units, Spr (Kuhn) by arrangement

283. Practice Teaching in Elementary School Music. Prerequisite: 282.
1 to 2 units, any quarter (Kuhn)

**GRADUATE RESEARCH AND SPECIAL STUDIES**

200. Music Bibliography — Use of bibliographical materials in graduate study; introduction to methods of research.
4 units, Aut (Colby)

201. Graduate Review in Musical Analysis.
4 units, Aut (Cohen)

221. History of Music Theory.

221A. Ancient through Renaissance
4 units (Cohen) given 1976–77

221B. Baroque through Modern
4 units (Cohen) given 1976–77

299. Master of Arts Project.
4 units, any quarter (Staff)

300. Seminar in Musical Notation.

300A. 4 units (Horsley) given 1976–77
300B. 4 units (Horsley) given 1976–77
300C. 4 units (Mahrt) given 1976–77

301. Seminar in Music History and Analysis.
4 units, Aut, Win, Spr (Staff, Smith, Horsley, Ratner)

302. Research in Musicology.
Aut, Win, Spr (Cohen, Horsley, Ratner) by arrangement

303. Research in Music Education.
Any quarter (Kuhn) by arrangement

321. Readings in Music Theory.
3 units, any quarter (Horsley, Ratner)

323. D.M.A. Term Projects in Composition.
4 units, Aut, Win, Spr (Smith)

330. D.M.A. Term Projects in Conducting.
4 units, Aut, Win, Spr (Ramsey, Stor)

Any quarter (Staff) by arrangement

369. D.M.A. Term Projects in Performance.

369A. Early Music to 1800.
4 units, Aut, Win, Spr (Staff)

369B. Music from 1800 to the Present.
4 units, Aut, Win, Spr (Staff)

380. D.M.A. Term Projects in Music Education.
4 units, any quarter (Kuhn)

399. D.M.A. Final Project.
Any quarter (Staff) by arrangement

**PHILOSOPHY**

Emeriti: John D. Goheen, John L. Mothershead, Philip H. Rhinelander, Jeffrey Smith (Professors)

Acting Chairman: David S. Nivison

Director of Graduate Study: Ian Hacking

Director of Undergraduate Study: Nancy Cartwright

Professors: Solomon Feferman, Dagfinn Føllesdal (Summer), Ian Hacking, K. Jaakko Hintikka (Winter), George Kreisel, Julius Moravcsik, David S. Nivison, Patrick Suppes, James Urmson

Associate Professor: John Perry

Assistant Professors: Michael Bratman, Nancy Cartwright, Leonard Monk, Eilene Serene, Steven Strasnick, Thomas Wasow
OFFERINGS AND FACILITIES

Philosophy attempts to explain the grounds of knowledge, the limits of reality and the nature of value, justice, and morality. It asks fundamental questions about how we reason and how we ought to reason. Its subject matter encompasses all the other academic disciplines, indeed all areas of human experience—society, values, mind, language, art, science.

Philosophy seeks clarity and depth of understanding. Philosophic thinking is rigorous, systematic, abstract thinking. Though one of the humanities, philosophy is as relevant to the natural and social sciences and mathematics as it is to literature and history. And though philosophy puts a premium on verbal skills, it puts no less a premium on the kinds of intellectual skill needed for good work in the sciences.

The Tanner Memorial Library of Philosophy, situated in the Philosophy Building, contains an excellent working library and ideal conditions for study.

Both the graduate students and the undergraduate majors in philosophy have associations for discussion of philosophical issues and reading of papers by students, faculty, and visitors. These associations nominate the Directors of Graduate and Undergraduate Study and elect student representatives to Department meetings.

A number of scholarships are available preferentially for undergraduate majors in Philosophy. Students in the Department seeking University support should identify their major field when making application.

PROGRAMS OF STUDY

BACHELOR OF ARTS

The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor’s degree:

At least 48 units in the Department of Philosophy, including:

1. At least one course approved by the student’s departmental adviser from each of these four areas:
   a) Logic, philosophy of science, philosophy of language; e.g., 10, 57, 117, 181, 186.
   b) Ethics, aesthetics, social philosophy, value theory; e.g., 2, 7, 30, 79, 170, 171.
   c) Epistemology, metaphysics; e.g., 182, 184, 185, 189.
   d) History of philosophy; e.g., History series.

Normally these are to be lecture courses of at least 3 units each. (Not all courses are offered every year).

2. At least six courses in which the student receives a grade of B or better. Units of Directed Reading (Phil. 197) may not be counted in the 48 unit requirement. No more than 10 units completed with grades of Pass may be counted in the 48 unit requirement.

3. Transfer units must be approved by the Director of Undergraduate Studies at the time of declaring a major.

HONORS PROGRAM IN PHILOSOPHY

The Honors Program in Philosophy is an integral part of the Tutorial Program. To be accepted for Senior Tutorial, normally a student must have demonstrated superior ability in undergraduate philosophy courses.

Tutorial in the senior year will occupy 15 units (5 units each quarter) of the student’s academic program, and will be devoted to research on a topic resulting in a Senior Tutorial Essay. All students accepted for Senior Tutorial automatically become candidates for Departmental Honors. To achieve Departmental Honors, the Senior Essay must be distinguished. Failing to attain Departmental Honors, a student may nevertheless qualify for Senior Tutorial credit.

Group tutorials or colloquia may be proposed by the undergraduate students organization. The Department will assist the students in the design of these courses and seek to secure instructors for them.

COMBINED MAJOR IN CLASSICS AND PHILOSOPHY

Students may, with the consent of the Chairmen of departments concerned, offer for the degree of Bachelor of Arts a combined major in Classics (Latin and/or Greek) and Philosophy. Students interested in such a major should consult the Chairman of each of the departments concerned.

HONORS PROGRAM IN HUMANITIES

The Department of Philosophy participates in the Graduate Program in Humani-
ties leading to the joint Ph.D. degree in Philosophy and Humanities. For description of that program, see the section "Humanities Special Programs" in this Bulletin.

ADVANCED DEGREES

The members of the Department are prepared to direct and supervise individual study and research to supplement instruction offered in courses listed below. In addition, advanced seminars, unlisted in the catalog, are frequently organized in response to student interest. Candidates for advanced degrees are urged to discuss their entire program of study with their Departmental adviser as early as possible.

Applicants for admission to graduate standing in the Department of Philosophy should apply to the Director of Admissions. Applicants are required to take, in their senior year or later, the Graduate Record Aptitude Test.

The Department will not ordinarily admit students who wish to become candidates for the Master's degree only. A student will, however, be welcomed as a candidate for the Master's degree if he or she has been admitted as a candidate for a higher degree in some other appropriate department or school of the University.

MASTER OF ARTS

The University's basic requirements for the Master's degree (residence, thesis, etc.) are discussed in the section "Degrees" in this bulletin. The following are Departmental requirements:

1. Normally a student will be admitted to and allowed to continue in the A.M. program only if he or she is a matriculated Stanford graduate student working for some other Stanford degree. The student must petition the department.

2. Each A.M. candidacy is subject to the five-year time limit established by the University.

3. Unit requirements: at least 36 philosophy units taken as a graduate student at Stanford.

4. Up to 9 units taken as a graduate at Stanford may be taken as directed reading. Normally at least six Stanford graduate units should be taken in each of the four fields in which the Department sets "proficiency requirements" in the General Program for the Ph.D.

5. The student must satisfy three of the proficiency requirements for the General Program for the Ph.D. in Philosophy, at least one of which should be by examination or the writing of a research paper.

6. A thesis is not required. The student is expected to complete the A.M. within three years.

MINOR IN PHILOSOPHY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Each student shall take 30 units of course work within the Philosophy Department, no more than six of which may be directed reading and shall satisfy one proficiency requirement, not necessarily by taking an examination. (See item two under Proficiency Requirements). The choice of courses and satisfaction of a proficiency requirement must be recommended by a faculty member who agrees to serve as the student's adviser with the general restriction that at least one course must be taken in three of the areas in which the Ph.D. candidates are expected to satisfy the proficiency requirements. All programs must be approved by the Department Committee on Graduate Study. A faculty member from the Philosophy Department (usually the student's adviser) will serve on the student's doctoral oral examination committee and may request that up to one-third of this examination be devoted to the minor subject.

DOCTOR OF PHILOSOPHY

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" of this bulletin. The following are Departmental requirements:

Courses—There are no fixed course requirements, but the Department reserves the right to prescribe the courses a student takes in preparation for the preliminary examinations. The program of courses for this purpose will depend on the preparation of the individual student and is decided in consultation with his or her Departmental adviser.

GENERAL GRADUATE PROGRAM

Proficiency Requirements

1. Every student is expected to satisfy a proficiency requirement in each of the following areas:
a) History of Philosophy
b) Logic and Philosophy of Science
c) Epistemology and Metaphysics
d) Value Theory

2. Written preliminary examinations, four hours in duration, will be given in each of these areas during the first week of the spring quarter. The scope of each examination is described below.

a) Four sections:
   1) Pre-Socratics, Plato, Aristotle, and Chinese
   2) Descartes, Spinoza, Leibniz, and Medieval
   3) Locke, Berkeley, Hume
   4) Kant and two major 19th and 20th century philosophers such as Hegel, Nietzsche, Mill, Bradley, Bergson, and Husserl. (Some comparative questions will be asked.)

Those examined will answer questions on three philosophers from different groups and one question on some general trend in the history of philosophy.

b) Four sections:
   1) elementary logic (157 level)
   2) advanced logic
   3) philosophy of science
   4) formal theories of language

Those examined must answer questions in section (1) and in at least one other section.

c) Four sections:
   1) epistemology
   2) metaphysics
   3) philosophy of language
   4) philosophy of mind

Those examined must answer questions in section (1) or section (2) and in at least one other section.

d) Five sections:
   1) ethics and value theory
   2) social and political philosophy
   3) aesthetics
   4) philosophy of law
   5) philosophy of education

Those examined must answer questions in section (1) and in at least one other section.

3. Every student must take at least one preliminary examination during the first year of graduate study.

4. Every student must have passed at least two preliminary examinations by the end of the second year of graduate study.

5. Students may satisfy the remainder of the proficiency requirements in any one of the following ways:

a) passing two additional preliminary examinations before the end of the second year;

b) passing one additional preliminary examination before the end of the second year and fulfilling the general course requirement in the area in which an examination has not been taken (see 7 below for a description of course requirements);

c) passing one additional preliminary examination before the end of the second year, passing a specialized examination (see 8 below) in some area in which he has previously passed a preliminary examination, and fulfilling the special course requirement in the area in which an examination has not been taken;

d) fulfilling the course requirement in one of the two areas in which an examination has not been taken, passing a specialized examination in some area in which he or she has previously passed a preliminary examination, and fulfilling a special course requirement in the remaining area.

6. In addition to these programs a student may substitute a research paper for no more than one preliminary examination (excluding specialized examinations) or course requirement in any of the above options subject to the following conditions:

a) the student submits a written request for this substitution, including a detailed sketch of the proposed paper, to the faculty committee responsible for the preliminary examination in the relevant area no later than the second week of the autumn quarter of the student's second year of graduate study;

b) the faculty committee unanimously approves the request;

c) the final draft of the paper is submitted to the faculty committee no later than Friday of the second week in March of the student's second year of graduate study;
d) the faculty committee passes the paper.

7. Course requirements, general and special, in the areas are as follows:
   a) History of Philosophy
      1) general: four courses to be approved by the Director of Graduate Studies.
      2) special: two courses to be approved by the Director of Graduate Study (neither survey courses nor seminar courses may be chosen to satisfy this requirement).
   b) Logic and Philosophy of Science
      1) general: at least one of the following courses: 157, 160A, 160B, and three additional courses chosen from the following: 157, 160A, 160B, 161, 162, 163, 164, 166, 193, 201, 205, 242A, 242B, 242C. An advanced course in theoretical science or mathematics may be substituted for at most one of these three additional courses, subject to approval by the Director of Graduate Study;
      2) special: 157 and 160A.
   c) Epistemology and Metaphysics
      1) general: 184 plus three additional courses from the following: 169, 178, 181, 182, 185, 189, 201, 202, 220, 244, 245, 246;
      2) special: 184 plus one additional course from the above list.
   d) Value Theory
      1) general: 170 and three additional courses from the following list: 170, 171, 174, 175, 179, 185, 193, 203, 215;
      2) special: 170, and one additional course from the above list.

A grade of B or better must be obtained in a course if it is to count toward fulfilling a course requirement. Course requirements need not be completed during the second year of graduate study. Under no circumstances will courses taken at another university count toward fulfilling a course requirement.

8. At the request of individual students pursuing a program under 5.c or 5.d above, the faculty committee preparing the preliminary examination in a given area will administer a specialized examination in this area during the third week in March. This specialized examination will focus intensively on one or more of the sections of the regular examination and may be tailored to the student's special interests. The examination may be written, oral, or both written and oral, at the discretion of the committee.

9. First-year students should sign lists in the department office during February, of the preliminary examinations they propose to take during that year. Second-year students should inform the secretary, in February, of the program (see 5 and 6 above) they have chosen to satisfy the proficiency requirements.

10. Normally (to continue as a student in the Department) one is expected to have passed all examinations (preliminary and special) and research paper requirements in his chosen program by the end of the second year. Exceptions to this rule are the following:

   a) Students in interdepartmental degree programs may be permitted to postpone attempting to satisfy these requirements until the third year. Students must submit to the Director of Graduate Study a written request for such permission. In no case will permission be granted to postpone the preliminary examination taken during the first year.

   b) In special circumstances, determined by the Department, students who attempt and fail to satisfy these requirements by the end of the second year may be allowed an additional year in which to satisfy them.

Language Requirements—There is no departmental language requirement, but a student's dissertation committee may require him or her to demonstrate competence in one or more languages if his or her dissertation research makes this requirement appropriate.

Dissertation—Upon passing the preliminary examinations the candidate will submit a brief written statement of the dissertation plans to the Department, and a committee will be appointed to direct the research for and writing of the dissertation. Departmental approval of the dissertation
The dissertation requirement may be fulfilled either by one work of monographic character or by two or more separate articles whose appropriate length, number, and topical and methodological unity or diversity are to be decided in consultation with the dissertation committee.

The dissertation must be submitted to the committee in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive his or her degree.

Dissertations must be completed and approved within five years from the date of that application. A candidate taking more than five years will be required to reinstate candidacy by repassing the preliminary examinations.

Oral Examination — The University oral examination is taken after completion of an acceptable first draft of the dissertation, and is primarily a dissertation defense.

Special Graduate Programs in Logic, Philosophy of Language, and Philosophy of Science

Recognizing the interests of students in more technical areas of Philosophy, the Department offers programs allowing the student to concentrate in one of three fields. The difference between these special programs and the general graduate program in Philosophy lies in the course requirements and the written preliminary examination. The student need not declare his or her intention to participate in a specialized program until February 1 of the second year.

Courses—All students in these programs are required to take 160A,B (Symbolic Logic), 161 (Introduction to Set Theory), 164 (Philosophy of Science), 181 (Philosophy of Language), 184 (Theory of Knowledge). In addition a student is required to take one course or seminar in the general area of history of philosophy and one course or seminar in the general area of ethics, value theory, and social philosophy (the courses are to be chosen in consultation with the student's adviser). These course requirements must be completed by the end of the third year of the student's residence in graduate school. In lieu of these courses equivalent or more advanced course work may be offered subject to Departmental approval. A program of advanced courses in the student's specialty will depend on the preparation of the individual student and is decided in consultation with his or her Departmental adviser.

Preliminary Examinations
1. All first-year students must pass the preliminary examination in logic and philosophy of science given to students in the general graduate program (see above).
2. All second-year students must pass a special written examination, four hours in duration, containing three sections, given during the second week in March:
   1) logic
   2) philosophy of science
   3) philosophy of language
   Questions from at least two sections must be answered.
3. All third-year students must pass an examination in the area in which they propose to write a dissertation. This examination will be tailored to the student's special interests. It may be written, oral, or a combination of both, at the discretion of the examining committee. This examination will be given no later than the third week in March.
   It is expected that the student will pass these examinations in order to continue as a graduate student. When circumstances warrant, however, a student may be permitted to take an examination a second time.

Graduate Program in Humanities

The Department of Philosophy also participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Philosophy and Humanities. For a description of that program, see the section "Humanities Special Programs."

Graduate Fellowships and Assistantships

The Department endeavors to provide financial support, when needed, to anyone admitted as a graduate student and maintaining a satisfactory level of graduate work, provided that need, or the possibility of it, is made known to the Department before admission. Fellowships provided by the Locke and Weiss funds are reserved for students in philosophy. Application forms for
fellowships may be secured by writing the office of Financial Aids.

The Department of Philosophy no longer offers separate teaching assistantships as part of its support program. Each graduate student, whether receiving financial support of some kind or not, is considered a member of the Philosophy Fellows program, in which he or she will have certain teaching duties. Details of this program may be obtained from the Department. In any term in which he or she is teaching a section, the student may register for 239, "Teaching Methods in Philosophy." Members of the Philosophy faculty will provide the student with individual guidance during this teaching experience. Whenever possible, the student's teaching experience will be in courses he or she chooses.

INTRODUCTORY COURSES

These courses will acquaint the student with some of the most important problems, positions and methods in Philosophy. Some are designed to give the student general preparation for further work in Philosophy. Some apply the philosopher's approach to particular problems and subjects the student may encounter in other areas of study. Each course covers a wide variety of subject matter. The student's choices among introductory courses should be determined by interest in the topics covered. All of these courses are recommended for freshmen and other students without prior work in Philosophy.

1. Introduction to Philosophical Concepts—This course introduces the student to the critical and rational examination of such questions as: (a) what should be the over-all program of one's life? (b) what is our relationship to Nature? (c) what are the limits of human knowledge? and (d) what are viable conceptions of the human self? The course will present samples of what historically important philosophers as well as contemporary philosophers have to contribute toward the answering of these questions. Recommended for freshmen.

5 units, Spr (Urmson) MTWTh 9; section by arrangement

2. Introduction to Ethics—An introduction to some of the major problems of ethical theory (e.g., utilitarianism and its alternatives) including an examination of the works of classical and contemporary moralists, and an examination of some specific moral problems (e.g., abortion, punishment).

5 units, Aut (Bratman) MTWTh 9

5. Introduction to Philosophy—This is a general introduction to the problems with which philosophers are and always have been concerned, the conflicts in point of view that have arisen in the attempts that have been made to solve these problems, and the practical consequences of adopting any of these points of view. The course also strives to enlarge the intellectual horizon of students by making them familiar with concepts which everyone needs if he is to deal adequately with fundamental beliefs, and to clarify the often highly ambiguous terminology that is associated with these concepts. The course meets five times a week.

(Graduate students enroll in 105.)

5 units, Aut (Mothershead) MTWTh 9

7. Introduction to Political Philosophy—Prior to any systematic critique of the conception of political society, it is essential that one try to gauge the force of its philosophic underpinnings. It will be the purpose of this course to develop the analytic tools necessary for this kind of evaluation. The first part of the course will consider the anarchist challenge to the legitimacy of any form of political authority, and this will be followed by a survey of the classic attempts to meet this challenge via the notions of the social contract and natural rights. We will then turn from the problem of justifying the state to the issue of how the justice of an existing state is to be evaluated. Rawls' novel approach to this question will be introduced, and we will contrast it with various utilitarian treatments. Finally, in order to provide a perspective from which to evaluate the viability of these traditional accounts, we will present the Marxist view of the philosophical issues studied and end with an examination of the notion of community.

(Graduate students enroll in 175.)

4 units, Spr (Strasnick) MTWTh 11

10. The Evolution of Scientific Concepts—This course studies the influence of conceptual changes on the development of modern science, both from an historical and from a philosophical point of view. This year's title is "Knowledge, Certainty, and the Mechan-
46. Philosophical Chinese—Introduction to Classical Chinese and to Chinese philosophical concepts, through study of short philosophical texts; for students who have had no previous work in a Far Eastern language. This course is intended for students who are not yet sure they wish to invest the time needed to learn to read and speak Chinese well, but who would like to learn something of the language of early Chinese philosophy, sufficient to enable them to read translations of Chinese philosophers, and books and articles in English about them, with some critical awareness of underlying language problems when a language radically unlike English is the medium of philosophical thinking. Significant Chinese texts will be examined and explicated as they are encountered, as quotations in articles or as problematic passages in translated works. Philosophers treated will include Confucius, Mencius, and Lao Tzu. This course is self-contained and does not assume that the student will do further work in the subject; a student taking the course may, however, continue study of classical Chinese by enrolling in 47 in the spring quarter and 101A the next year. (Students should enroll in Asian Languages 46.)

3 units, Win (Nivison) MWF 10

47. Philosophical Chinese—Continuation of 46. Reading in Mencius and Han Fei Tzu. (Students should enroll in Asian Languages 47.)

3 units, Spr (Nivison) MWF 10

57. Introduction to Logic—(Graduate students enroll in 157.) Discussions of axioms and rules of inference of first order predicate logic. Natural deduction rules. Interpretation and validity, theory of description, theory of definition; axiomatic theories. Basic definitions and operation with sets. The first class meeting is an organizational meeting only, held at 1:15 on the first Tuesday of the quarter.

5 units, Aut, Win, Spr (Suppes) T 1:15

79. Philosophy of Law—The course will deal with three general topics: (1) the nature and function of legal systems, (2) the relation of legal norms to other types of norms, including moral norms, (3) judicial decisions and legal reasoning. The general topics will be approached historically and will also be examined with special reference to modern problems and cases in the areas of punish-
ment and responsibility, legal regulation of private conduct and free expression, and civil disobedience. No prerequisites, but some background in philosophy, political science, social science or the history of ideas is recommended. (Graduate students enroll in 179.)

4 units, Win (Rhinelander) MWF 10

99A, B, C. Undergraduate Colloquium — Group tutorial for undergraduates on topics chosen by student groups. Prerequisite: 2 courses in Philosophy.

3 units, Aut, Win, Spr (Staff)

HISTORY OF PHILOSOPHY

100. Greek Philosophy — Characterization of historical situation in which Western science and philosophy began. Rise of critical thought. Early metaphysical speculation. Sophists and Socrates. Post-Socratic ethical schools. Philosophies of Plato, Aristotle, the Epicureans, the Stoics, the Skeptics, and Neo-Platonism. Prerequisite: some general course in philosophy, such as 2, 5, or 7.

4 or 5 units, Win (Urmson) MTWTh 9

101. Early Christian, Medieval, and Renaissance Philosophy — This course examines medieval developments in philosophy of language, philosophy of religion, philosophy of science, theory of knowledge, and ethics. The readings are arranged by topic; they focus on the work of Augustine, Anselm, Abelard, Aquinas, Scotus, and Occam. Prerequisite: one course in philosophy or permission of instructor.

4 or 5 units, Aut (Serene) MTWTh 10

102. Modern Philosophy (Seventeenth and Eighteenth Centuries) — Francis Bacon and the new scientific empiricism. Materialism of Thomas Hobbes. Philosophic systems of Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and the philosophy of the Enlightenment. Philosophy of Immanuel Kant. Prerequisite: 2 courses in Philosophy or permission of the instructor.

4 units, Win (Hacking) MWF 1:15

103. Philosophy in the Nineteenth and Early Twentieth Centuries — Trends in philosophy during the period considered as a background for understanding of ideas influential today. Philosophers to be studied include Fichte, Hegel, Schopenhauer, Marx and Engels, Comte, J. S. Mill, Spencer, Brad-ley, Nietzsche, Bergson, James, and Dewey. Prerequisites: two philosophy courses. Recommended: 102.

4 or 5 units, Spr (Mothershead) MTWTh 10

104. Contemporary Philosophy — Some principal developments in contemporary philosophical thinking. Prerequisites: a total of two philosophy courses.

4 units, Sum (Follesdal)

105. Introduction to Philosophy — For graduate students. Lectures same as 5.

5 units, Aut (Mothershead) MTWTh 11

122. Chinese Philosophy from Han through Sung—Buddhism in China will be reviewed in this course but not treated in depth. Special attention will be given to the "Neo-Confucians" Ch'eng I, Ch'eng Hao, and Chu Hsi.

Spr (Nivison) MWF 1:15

Units to be arranged


3 units, Win (Nivison) given 1976–77


3 units, Aut (Nivison) MWF 1:15

136. Philosophy of Plato.

4 units, Win (Moravcsik) given 1976–77

137. Philosophy of Aristotle — Prerequisite: 100 or equivalent.

4 units, Win, given 1976–77

145. Philosophy of David Hume — Prerequisite: 102 or equivalent.

3 units, Aut (Perry) given 1976–77

146. Philosophy of Descartes and Locke.

3 units, Spr (Urmson) MWF 3:15

147. The Philosophy of Kant — An introduction to the most important themes of the Critique of Pure Reason. Other works by Kant may also be discussed.

4 units, Spr (Staff) given 1976–77

148. The Philosophy of Nietzsche — A study of the major themes of Nietzsche's philosophy, focusing especially on his critique of knowledge and morality. Topics to be considered include Nietzsche's conception of truth and value, the doctrines of the over-
man and the eternal recurrence, and Nietzsche's account of self-realization.

4 units, Aut (Strasnick) MWF 3:15

152A. The Philosophy of Heidegger—Study and discussion of selected works by Heidegger in English translation including Being and Time. Students who want to take this course, should preferably have taken course 178 or have comparable background in phenomenology.

3 units (Føllesdal) alternate summers given 1976–77

152B. The Philosophy of Sartre—Study and discussion of selected works by Sartre in English translation, including Being and Nothingness, and several of Sartre's novels and plays.

3 units, Sum (Føllesdal) given 1976–77

SYSTEMATIC PHILOSOPHY

116. Philosophical Problems in Machine Intelligence—For graduate students. Lectures same as 16.

3 units, Win (Smith) MWF 9


3 units, Spr (Cartwright) MWF 11

156. Introduction to Ethics—For graduate students. Lectures same as Philosophy 2. Special section for graduate students.

5 units, Aut (Bratman) MTWTh 9

157. Introduction to Logic—For graduate students. Lectures same as Philosophy 57.

160A,B. Symbolic Logic—Thorough treatment of validity, provability, consistency, completeness, definability and decision problems for logical calculi, and axiomatic theories.

160A. 3 units, Aut (Monk) MWF 1:15
160B. 3 units, Win (Monk) MWF 1:15

161. Introduction to Set Theory—Intuitive justification of the axioms. Operations on sets, relations and functions. Equivalence and ordering relations. Equipollence of sets and cardinal arithmetic. Topics on ordinal numbers and axiom of choice as time permits. Prerequisite: 160A or equivalent. First meeting is organizational only.

3 units, Aut, Win, Spr (Suppes) T 2:15

162. Theory of Automata—An introduction to finite automata. Comparison of different notions of computability. Relationship to programming languages and theories of grammars.

3 units, Aut (Suppes) given 1976–77


3 units, Spr (Monk) MWF 2:15

164. Philosophy of Science—Detailed analysis of the structure and methods of empirical science. Application of set-theoretical models in particular sciences. Students are expected to write a paper on applying set-theoretical methods to a scientific or philosophical topic within their domain of interest. Examples in the course range from physics to psychology and linguistics.

3 units, Aut (Cartwright) given 1976–77

166A. Wittgenstein's Philosophy of Logic—An examination of Wittgenstein's views on the nature of mathematics and mathematical reasoning.

3 units, Aut (Kreisel) TTh 2:15

166B. Russell's Philosophy of Logic—An examination of Russell's views on the nature of mathematics and mathematical reasoning.

3 units, Aut (Kreisel) given 1976–77


4 units, Win (Kreisel) MWF 3:15

169. Authority and Reason in Medieval Religion—(Enroll in Humanities 184.) (Berman, Bernstein and Serene) given 1976–77

170. Ethical Theories—A systematic treatment of basic issues in both normative ethics and metaethics. Topics covered will include: utilitarianism and its alternatives; the relevance of generalization arguments to ethics; the possibility of deriving normative conclusions from merely factual premises; naturalism, intuitionism, and noncognitivism. Readings will include both historical and contemporary philosophical works. Prerequisite: One course in philosophy.

4 units, Win (Bratman) MTWTh 2:15
171. Political Theory—This course will examine accounts of political society that are critical of the basic tenets of traditional liberalism. This year we shall focus on some of the major figures in the late 18th and 19th century movement of philosophical anarchism. Topics to be considered include the anarchist account of notions like justice, equality, and property. The anarchist vision of the ideal society will be probed, along with the relation of this vision of psychological conceptions of the nature of man and his motivations. Those to be studied include William Godwin, Proudhon, Bakunin, and Kropotkin.

4 units, Spr (Strasnick) MTWTh 9

172. Psychology of Perceptual Experience—(Enroll in Psychology 172.)

174. Aesthetics—Some central problems in philosophy of art: the nature of a work of art, modern and traditional definitions and theories of art, aesthetic experience, objectivity and non-relativity in criticism, possibility of standards of taste or of evaluation, special topics concerning aesthetic perception and the notion of aesthetic sensibility.

4 units, Spr, given 1976–77

175. Introduction to Political Philosophy—Lectures same as Philosophy 7. For graduate students and advanced undergraduates. Special section. Units negotiable.

4 units, Spr (Strasnick) MTWTh 11


3 units, alternate Sum (Føllesdal)

179. Philosophy of Law—For graduate students. Lectures same as 79.

4 units, Win (Rhinelander) MWF 10

181. Philosophy of Language—A study of the concepts and techniques required for the syntactic and semantic analysis of natural languages, including elements of formal semantics and transformational grammar. Prerequisites: two courses in philosophy or linguistics.

4 units, Aut (Hintikka, Wasow) MTWTh 3:15

182. Metaphysics—An examination of some problems of ontology and essentialism. Prerequisite: 2 courses in Philosophy.

4 units, Win, given 1976–77

184. Theory of Knowledge—Topics in recent epistemology, including Russell’s theory of knowledge by acquaintance and description, and his subsequent logical atomism; problems of verification and induction; the difference between dreaming and reality; Popper’s epistemology without the knowing subjects; knowledge of the past.

4 units, Aut (Hacking) MWF 2:15

185. Theory of Action—A systematic treatment of some of the basic questions about the nature of human agency raised by the traditional problem of reconciling free-will and causal determinism. Topics covered will include: traditional views about free-will (“hard” and “soft” determinism, and libertarianism); analysis of the concepts of action, voluntary action, and intentional action; the nature of reasons; explanations of actions; are reasons causes of actions? what is it to be free to act in a certain way? deliberation and foreknowledge. Prerequisite: two courses in philosophy.

4 units, Aut (Bratman) MTWTh 11

186. Causal Models in the Behavioral and Natural Sciences—Philosophic problems of causation in contemporary science, focusing primarily on causal models in the behavioral sciences and their differences from deterministic and statistical explanations in physics.

4 units, Spr (Cartwright) MWF 1:15

189. The Concept of Mind—A discussion of the concepts of action and behavior, belief, desire, sensation, and perception, and of their logical interrelations.

4 units, Win (Perry) given 1976–77

193. Theory of Social Decision Making—A political society is, like the individuals that compose it, a decision maker. And, as in the case of individuals, there are standards of consistency and morality that its decisions should satisfy. Beginning with Arrow’s paradox, we will take a formalistic approach to normative issues of social choice. In particular, we will concentrate on the nature and justification of ordinal versus cardinal analysis, the status of interpersonal comparisons of welfare, the formal structure of the notions of impartiality
and benevolence, and the relation of models of individual decision making with their social counterparts. Though the argumentation will be formal in nature, the course will also stress the connection of social choice theory with political philosophy and distributive justice, and we will consider the question of how an axiomatic model of social choice can fit into a larger moral theory.

3 units, Win (Strasnick) MWF 11

196. Tutorial—Senior year.
5 units, any quarter (Staff)
by arrangement

197. Individual Work for Undergraduates.
Any quarter (Staff) by arrangement

199A,C. Seminar in Philosophical Topics—Open to junior and senior students with consent of instructor.

199A. Topic: Aesthetics.
3 units, Aut (Urmson) Th 4:15

199C. Seminar in Philosophical Topics: Leibniz—A survey of Leibniz’s chief philosophical themes with special emphasis on the principle of sufficient reason, the theory of creation, space and time, and identity.
3 units, Spr (Hacking) W 4:15–6:05

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS

201. Mathematical Linguistics—Investigation of mathematical results relevant to empirical issues in linguistics. Special attention given to the theorems of Peters and Ritchie concerning the generative capacity of transformational grammar and the work of Hamburger and Wexler on learnability of grammars. (Same as Linguistics 202.)
3 units, Spr (Wasow) TTh 2:15

3 units, Spr (Wasow, Moravcsik) given 1976–77

203. Seminar in Aristotle’s Ethics.
3 units, Aut (Urmson) T 4:15

204. Seminar in Political Theory—Detailed analysis of works that are currently being discussed in the philosophical literature. This year we shall study Rawls’ *Theory of Justice* and some of the critical literature that has appeared in response to it.
3 units, Win (Strasnick) W 4:15

205. Philosophical Foundations of Quantum Mechanics—The course will center around problems in the foundations of quantum mechanics which have been considered philosophically important, such as the uncertainty principle, the status of causality, complementarity principle, the role of probability concepts and the need for a multivalued logic. Various axiomatic formulations of classical quantum mechanics will also be discussed.
3 units, Win (Cartwright) given 1976–77

215. Philosophy and Theory—(Enroll in Education 405.) An advanced seminar which focuses on philosophy of social science, including an examination of the bases for social science in the philosophical tradition. Readings will include the works of Plato, J. S. Mill, Marx, Weber, and Durkheim, as well as recent critiques of the relationship of philosophy to contemporary sociological theory.
4 units, Spr (Pacheco) T 7–10 p.m.

216A. Philosophical and Educational Thought of the Pragmatists—(Enroll in Education 304A.) The course is an introduction to the influential philosophical and educational writings of C. S. Peirce, William James, and John Dewey. The following topics will be discussed: (1) The philosophy of pragmatism — Peirce on meaning and chance; James on truth and the “biological view of mind”; Dewey on truth, knowledge, body and mind; (2) criticisms of pragmatism, especially those of G. E. Moore and Bertrand Russell; (3) the educational writings of James and Dewey; (4) the contemporary scene: Peirce, Dewey, and Popper; Dewey and the open classroom.
4 units, Aut (Phillips) TTh 2:15

216C. Philosophical Problems of Education as a Social Science—(Enroll in Education 304C.) Important philosophical problems arise in the context of methodology and theory in the fields of psychology, sociology, anthropology, political science, and administrative studies. Several of these problems also arise in education, and they form the core of the present course: the possibility of a “science of man,” the problem of rationality, holistic versus individu-
alistic explanations (including systems theory, organicism, structuralism, and gestalt versus atomistic psychology).

4 units, Spr (Phillips) MW 1:15

220. Epistemology—A survey of the central problems of epistemology emphasizing the uses of modern techniques in clarifying classical epistemological issues.

4 units, Win (Hintikka) given 1976–77


3 units, Win (Hintikka) T 4:15

236. Seminar in the Philosophy of Plato—A study of metaphysical and epistemological themes in the later Platonic dialogues.

3 units, Win (Hintikka) Th 4:15


3 units, Win (Hintikka) given 1976–77

239. Teaching Methods in Philosophy.

1 to 3 units, any quarter (Staff) by arrangement

240. Individual Work for Graduates.

Any quarter (Staff) by arrangement

242A,B,C. Seminar in the Philosophy of Science.

242A. Topic: Quantum Mechanics.

3 units, Aut (Cartwright, Suppes) M 4:15–6:05


3 units, Win (Suppes) M 4:15–6:05


3 units, Spr (Suppes) M 4:15–6:05

245. Seminar in the Philosophy of Mind.

3 units, Spr (Perry) given 1976–77

246. Seminar in the Philosophy of Action.

3 units, Spr (Bratman) T 4:15


Any quarter (Staff) by arrangement

276. Seminar in Psychoanalytic Theory — (Enroll in Psychology 276.) This seminar will examine concepts from psychoanalytic theory. It will critically explore the theoretical ideas and examine attempts to objectify the concepts empirically from cognitive, behavioral and motivational standpoints.

3 units, Spr (Horowitz, Suppes) M 2:15–4:05

280. Chinese Religious Thought—(Enroll in Religious Studies 215.)

5 units, Spr (Nivison, Yearley) given 1976–77


3 units, Spr (Kreisel) TTh 2:15

289. Intuitionistic Mathematics — Formal theory of standard intuitionistic systems including Brouwer’s theory of free choice sequences. Generalized inductive definitions. Completeness questions for propositional and predicate logic (with respect to definability and derivability). Prerequisite: consent of instructor.

3 units, Aut (Kreisel) given 1976–77

290A,B,C. Mathematical Logic—(Enroll in Mathematics 290A,B,C.)

291A,B. Topics in Model Theory—(Enroll in Mathematics 291A, B.)

292A,B. Topics in Recursion Theory—(Enroll in Mathematics 292A,B.)

293A,B. Topics in Proof Theory—(Enroll in Mathematics 293A,B.)

294A,B. Topics in Set Theory — (Enroll in Mathematics 294A,B.)


391 A. Units by arrangement, Aut (Kreisel) W 4:15–6:05

391B. Units by arrangement, Win (Kreisel) T 4:15

391C. Units by arrangement, Spr given 1976–77

PHYSICS

Emeriti: Felix Bloch, Paul H. Kirpatrick, David L. Webster (Professors)

OFFERINGS AND FACILITIES

The Russell H. Varian Laboratory of Physics, the adjacent Physics Lecture Hall, and the nearby W. W. Hansen Laboratories of Physics (High Energy Physics Laboratory, Microwave Laboratory, and Stanford Synchrotron Radiation Project) form a closely related complex housing a range of physics activities from general courses through advanced research. The facilities include an 18 MeV Tandem Van de Graaff accelerator and a 1.2 BeV electron linear accelerator. A superconducting electron linear accelerator is under construction. Separated from this group is the Stanford Linear Accelerator Center (SLAC), a separate very high-energy physics laboratory which has as its principal tool a two-mile-long, 20-BeV electron accelerator and a 4-BeV electron-position storage ring.

Professor Mason Yearian is the Director of the High Energy Physics Laboratory; Professors Fairbank, Hofstadter, Schwartz, Schwettman, and Wojcicki are on the staff of the Laboratory. The staffs of the other branches of the W. W. Hansen Laboratories of Physics and the Stanford Linear Accelerator Center are mentioned elsewhere (see Applied Physics Department, Stanford Linear Accelerator Center).

One of the most important facilities is the Physics Library, which includes current subscriptions and back sets of important journals, together with textbooks, scholarly treatises in English, French, German, and Russian and the collected works of the most eminent physicists. It is a center for reading and study of physics at all levels.

In addition to course work providing a sound foundation in classical and modern physics, undergraduates are offered laboratory work at several levels. Both series of introductory courses include laboratories in which students carry out individual experiments. The Intermediate and Advanced Physics Laboratories offer facilities for increasingly complex individual work, including independent investigations.

The Department offers courses in gravitation. Students who wish to specialize in this field or in astronomy, astrophysics, or space science should also consult the Astronomy Course Program in this bulletin.

Graduate students find opportunities for research in the fields of astrophysics, theoretical physics, low temperature physics, molecular physics, nuclear physics including the Mossbauer effect and atomic collision physics, high energy physics, coherent optical radiation, and solid state physics. The fields of astrophysics, microwave physics, plasma physics, ferrites, biophysics, and others of a similar nature are offered in the Applied Physics Department and in the Biophysics Program.

The number of graduate students admitted to the Physics Department is strictly limited. Students should complete application by January 15, 1976, for the following autumn. Graduate students may normally enter the Department only at the beginning of autumn quarter.

PROGRAMS OF STUDY

The study of physics is undertaken by three principal classes of undergraduates: those including physics as part of a general education, those preparing for careers in professional fields that require a knowledge of physics, such as medicine or engineering, and those preparing for teaching or research careers in physics itself. In this Department the courses numbered below 200 are planned to serve all three of these groups. The courses numbered above 200 meet the needs mainly of the third group, but also of some students majoring in other branches of science and in engineering.

BACHELOR OF SCIENCE

Department requirements for the degree of Bachelor of Science are as follows: Physics 51, 53, 54, 100, 110, 111, 120, 121, 122, 130, 131, 132, 161, 170, 171, 200, 201. Physics 61, 62, 63, and 101 can replace all of the Physics 50 series requirements. The Department strongly advises the study of Chemistry 41 and 43 and also the study of a modern language.

Two course sequences can be followed. One (Sequence II), based on Physics 61, 62, 63, is deemed preferable for students who have had physics and a year of calculus in high school. The other one (Sequence I),
based on Physics 51, 53, 55, 57, is mainly for students who have had a lesser background in science and mathematics. Students contemplating a major in physics are urged to consult with the instructor of Physics 61 at the earliest possible date to see which sequence would be the most suitable for them. Students who decide to enter the physics program after the freshman year would normally be advised to take the Physics 61, 62, 63 sequence, provided they had previously taken Mathematics 41, 42, and 43.

Sample programs in physics and mathematics under the two sequences are shown below. Students should consult their advisers about the course distribution requirements in other areas. The sequence of courses during the first two years is relatively inflexible, but considerable freedom exists during the upper-class years. Students are urged to work out, in consultation with their advisers, a program which will best fulfill their individual aims. The Undergraduate Office of the Physics Department has more detailed information on how to obtain a Bachelor's degree in Physics. This should be carefully studied by prospective majors, especially if they intend to make use of Stanford's programs abroad. Under some circumstances the Department will permit, by petition, flexibility in the requirements so that the student may fit a period abroad into the program.

SEQUENCE I

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 51, 53</td>
<td>Mechanics, Electricity</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Physics 54</td>
<td>Electricity Laboratory</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 41, 42, 43</td>
<td>Analytic Geometry and Calculus</td>
<td>5</td>
<td>5</td>
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</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 55, 57</td>
<td>Light and Heat, Atomic Physics</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 56, 58</td>
<td>Light and Heat, Atomic Physics Laboratory</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 110, 111</td>
<td>Int. Mechanics</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Math. 44, 45, 46</td>
<td>Advanced Calculus</td>
<td>3</td>
<td>3</td>
<td>(3)</td>
</tr>
<tr>
<td>Math. 130, 131, 132</td>
<td>Ordinary Differential Equations, Partial Differential Equations</td>
<td>3</td>
<td>3</td>
<td>(3)</td>
</tr>
</tbody>
</table>

* Additional elective units must be added to bring the total number of units to 180 as required by the University. Students should consult their advisers about the course distribution requirements in areas outside of the sciences.

† Not required for degree in physics.

‡ Students who have not taken Physics 58 must also take Physics 101.

**Third Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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</thead>
<tbody>
<tr>
<td>Physics 100, Int. Physics Laboratory</td>
<td>2</td>
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</tr>
<tr>
<td>Physics 120, 121, 122</td>
<td>Int. Electricity and Magnetism</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 130, 131, 132</td>
<td>Atomic and Nuclear Structure</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Math. 106</td>
<td>Complex Variables</td>
<td>(3)</td>
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</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 170, 171, 172</td>
<td>Thermodynamics, Kinetic Theory and Introduction to Statistical Mechanics, Physics of Solids</td>
<td>3</td>
<td>3</td>
<td>(3)</td>
</tr>
<tr>
<td>Physics 161, Optics</td>
<td>3</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Physics 200, 201</td>
<td>Advanced Physics Laboratory</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 210, 211</td>
<td>Introductory Theoretical Physics</td>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 113, 114, or 120</td>
<td>Linear Algebra and Matrix Theory or Modern Algebra</td>
<td>(3)</td>
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</tbody>
</table>

**SEQUENCE II**

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 61, 62, 63</td>
<td>Advanced Fresh. Physics</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Math. 43, 44, 45</td>
<td>Analytic Geometry, Calculus, Advanced Calculus</td>
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**Second Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 110, 111</td>
<td>Int. Mechanics</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 100, 101</td>
<td>Int. Physics Laboratory</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Physics 120, 121, 123</td>
<td>Int. Electricity and Magnetism</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 161</td>
<td>Int. Optics</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>Math. 46</td>
<td>Advanced Calculus</td>
<td>3</td>
<td>3</td>
<td>(3)</td>
</tr>
<tr>
<td>Math. 106</td>
<td>Complex Variables</td>
<td>(3)</td>
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**Third Year**

<table>
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<th>Subject</th>
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<tbody>
<tr>
<td>Physics 130, 131, 132</td>
<td>Atomic and Nuclear Structure</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 161</td>
<td>Optics</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 170, 171, 172</td>
<td>Thermodynamics, Kinetic Theory and Introduction to Statistical Mechanics, Physics of Solids</td>
<td>3</td>
<td>3</td>
<td>(3)</td>
</tr>
<tr>
<td>Physics 210, 211</td>
<td>Introductory Theoretical Physics</td>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 113, 114, or 120</td>
<td>Linear Algebra and Matrix Theory or Modern Algebra</td>
<td>(3)</td>
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Fourth Year*

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject A W Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 200, 201. Advanced Physics Laboratory</td>
<td>3 3</td>
</tr>
<tr>
<td>Physics 220, 221. Classical Electrodynamics</td>
<td>(3 3)†</td>
</tr>
<tr>
<td>Physics 230, 231, 232. Quantum Mechanics</td>
<td>(3 3 3)†</td>
</tr>
</tbody>
</table>

MASTER OF SCIENCE

The Physics Department does not offer a separate program for the Master of Science degree, but this degree may be awarded for a portion of the Doctor's degree work.

University requirements for the Master's degree are discussed in the “Degrees” section of this bulletin. Among the Departmental requirements are a B average in courses 130, 131, 132, 170, 171, 172, 201, 210, 211, and, if no thesis is submitted, at least 9 additional units of course work above the 200 level (not including 260, 290, 389, or 390).

DOCTOR OF PHILOSOPHY

The University’s basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section “Degrees” in this bulletin. The following are Departmental requirements:

Minimum subject matter requirements for the Ph.D. degree in Physics consist of 130, 131, 132, 170, 171, 172, one quarter of Advanced Laboratory (200, 201), 210, 211, 220, 221, 230, 231, 232, 260, 270, 330, and at least two quarters of any of the following courses: 240, 241, 250, 251, 331, 332, 334, 370, 371. All Ph.D. candidates must also take the following mathematics courses or have taken their equivalent previously: 106, 113, 114, 130, 131, 132. A minimum grade average of B during the last five quarters is required in the courses taken toward the Ph.D. degree.

Prior to making an application for Ph.D. candidacy, each candidate for the Ph.D. is required to pass a written comprehensive examination on undergraduate, graduate, and first year physics, given annually on the Thursday and Friday preceding the start of the autumn quarter. The examination should be taken in the summer after the first year graduate courses have been taken. After completion of the thesis he or she must take the University oral examination (defense of thesis). The Physics faculty believes that it is valuable for a scientist to have facility with a foreign language for cultural reasons and in order to establish better contact at meetings in foreign countries.

The Physics Department does not require a minor, but students are advised that the following mathematics courses have been found useful for graduate study in physics, especially for theoretical work: 208, 210, 220, 254, 256.

All prospective Ph.D. candidates in physics, regardless of their source of financial support, are urged to gain teaching experience as an integral part of their graduate training.

The student interested in applied physics and biophysics research should also be aware of the Ph.D. granted independently by the Applied Physics Department and by the Biophysics Program. Students interested in astronomy, astrophysics, or space science should consult the Astronomy Course Program. See elsewhere in this bulletin.

Minors in physics must take either Physics 210, 211, and one other course above 100, or Physics 130, 131, and 132, or Physics 170, 171, and 172, with the appropriate prerequisites. All prospective physics minors must receive approval of their physics course program (at least one year before the award of the Ph.D.) from the Physics Graduate Study Committee.

The office of the Physics Department has more detailed information on how to obtain an advanced degree in Physics. This should be consulted by prospective candidates for advanced degrees.

TEACHING CREDENTIALS AND MASTER OF ARTS IN TEACHING

In its capacity as agent for the State Board of Education, the University grants credentials for teaching in California in junior and senior high schools and junior colleges. Applicants for these credentials should consult the Credential Secretary of the School of Education for details of the requirements in connection with the teaching of physics.

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. A suggested minimum program
in the teaching field of physics would be Physics 57, 100, 101, 110, 111, 120, 121, and Mathematics 130, 131. Up to 6 units of equivalent course work, taken elsewhere as a graduate student, can be transferred. Detailed requirements for the degree are outlined in the "School of Education" section.

**Fellowships and Assistantships**

The Physics Department makes an effort to support all its graduate students requiring financial aid. The support is through fellowships, teaching assistantships, research assistantships, or a combination of some of these. Applications for financial aid should be made to the Graduate Awards Office before January 15, 1976.

**Courses**

There are four series of beginning courses. The Ten Series (11, 15, 19) is recommended for the humanities or social science student who wishes to familiarize himself with the methodology and content of modern physics. The different quarters are independent. The Twenty Series (21, 23, 29) includes courses prescribed or recommended for general students and for students preparing for medicine or biology; the Fifty Series (51, 53, 54, 55, 56, 57, 58) includes courses for students of engineering, chemistry, geology, mathematics, and physics. The Advanced Freshman Series (61, 62, 63) is for the well-prepared student who wishes to advance rapidly in physics.

The Twenty and Fifty Series are similar in content and objectives. Both comprise demonstration lectures on fundamental principles of physics, problem work on application of these principles to actual cases, and laboratory experiments closely correlated with the lectures. Their objectives are not only to give information on particular subjects, but also to provide training in the use of the scientific method. The primary difference between the two series of courses lies in the fact that topics are discussed more thoroughly and are treated with greater mathematical rigor in the Fifty Series.

Courses beyond 60 are numbered in accordance with the following three-digit code. The first digit indicates the approximate level of the course: undergraduate courses (1), first- and second-year graduate courses (2), more advanced courses (3). The second digit indicates the general subject matter: laboratory (0) mathematical physics and mechanics (1), electricity (2), atomic and quantum physics (3), nuclear physics (4), high energy physics (5), structure of matter (7), independent study and research (9).

All undergraduates are offered help with physics problems in the departmental counseling and tutoring center called The Reference Frame. The center is staffed Mondays through Fridays, 9 a.m. to 9 p.m.

11. The World of Physics: Nuclei and Particles — This course proposes to familiarize the humanities or social science student with part of modern physics. Properties of elementary particles will be discussed. The course is open only to students not majoring in the physical sciences or engineering. No prerequisite.

3 units, Spr (Wojcicki) T 2:15-4:05; discussion Th 2:15

15. Special Topics in Physics — (Formerly Physics 10.) This course proposes to familiarize the humanities or social science student with part of modern physics. In 1975–76, the subject will be Cosmic Evolution. After discussing the physical laws that govern the universe, its evolution will be traced from the initial primeval fireball, through the formation of galaxies, stars, and planets to the development of life. A feeling for astronomical distances and times will be developed, and exotic astronomical objects, such as quasars, pulsars, and black holes, will be discussed. No prerequisites.

3 units, Win (Will) TTh 2:15; discussion T 3:15

19. An Introduction to Physics ("Physics for Poets") — A presentation from non-technical, non-mathematical viewpoints of the aims, methods (experimental and theoretical) and achievements in the attempts to understand the basic principles governing the physical world. Each topic is usually introduced through the historical background, but the emphasis is on present knowledge and current problems. Likely topics: classical mechanics, relativity, and quantum mechanics. No prerequisites.

3 units, Aut (Glavish) MW 2:15, one hour discussion by arrangement

21. Mechanics and Heat—Equilibrium, uni-
form and accelerated motion, force, work, momentum and energy; heat, temperature, properties of matter; pressure, behavior of fluids, elementary kinetic theory of gases. Prerequisite: working knowledge of elementary algebra, geometry.

4 units, Aut (Fairbank) lec. MWF 10 or 11 and lab.
Sum (Staff) lec. MTWTh 10; lab. T or Th 2:15-5:05

23. Electricity and Optics—Electric charges and currents, magnetism, induced currents; wave motion, interference, diffraction, geometrical optics. Prerequisite: 21.
4 units, Win (Wojcicki) lec. MWF 10 or 11 and lab.

29. Modern Physics — Basis of modern atomic theory, structure and properties of atoms, the nucleus, radioactivity. Prerequisite: 23.
4 units, Spr (Little) lec. MWF 10 or 11 and lab.

51. Mechanics — Vectors, particle kinematics and dynamics, work, energy, momentum, angular momentum; conservation laws; rigid bodies; oscillations. Discussions based on use of calculus. Prerequisites: Mathematics 41 or 11 and continuation in Mathematics 42, or consent of instructor.
4 units, Win (Schawlow) lec. MWF 9 or 10; and discussions

53. Electricity—Electric charges and currents, magnetism, induced currents, electric oscillations, electromagnetic waves. Prerequisites: 51 and Mathematics 42 or 21, or consent of instructor.
4 units, Spr (Wagoner) lec. MWF 9 or 10; and discussions (Schwettman)

54. Electricity Laboratory — Concurrent registration in 53 is required.
1 unit, Spr (Schwettman)

55. Light and Heat — Reflection and refraction of light, lens systems; light and electromagnetic waves; temperature, properties of matter, introduction to kinetic theory of matter. Prerequisites: 53 and Mathematics 43 or 23, or consent of instructor.
4 units, Aut (Meyerhof) lec. MWF 9 or 10; and discussions (Schwettman)

56. Light and Heat Laboratory—Concurrent registration in 55 is required.
1 unit, Aut (Schwettman)

57. Atomic Physics—Relativity, experimental basis of quantum theory, Schrödinger equation, atomic structure, nuclear structure, high energy physics, elementary particles. Prerequisite: 55.
3 units, Win (Ritson) TTh 11:00-12:15

58. Atomic Physics Laboratory — Concurrent or prior registration in 57 is required.
1 unit, Win (Ritson)

61, 62, 63. Advanced Freshman Physics—An introduction to Newtonian mechanics, special relativity, electricity and magnetism, atomic physics and quantum mechanics from an advanced viewpoint. The format will consist of lectures and small discussions sections. This sequence is designed primarily for students contemplating majoring in physics. Prerequisites: prior or concurrent registration in Math 43 and some high school calculus or consent of instructor.

61. 4 units, Aut (Schwartz) TTh 9:00-10:50
62. 4 units, Win (Schwartz) TTh 9:00-10:50
63. 4 units, Spr (Schwartz) TTh 9:00-10:50

100, 101. Intermediate Physics Laboratory — Fundamental experiments in mechanics, heat, electricity and magnetism, optics, and atomic physics. One set of apparatus for each experiment is available so that one or two students will perform a given experiment during a particular laboratory session. Students will work one or two weeks per experiment, completing ten to fifteen experiments during two quarters. Prerequisites: 111 and concurrent or prior registration in 121 and 122.

100. 2 units, Aut (Ritson) W or Th 1:15-5:05
101. 2 units, Spr (Triplett) W or Th 1:15-5:05

110, 111. Intermediate Mechanics — Mechanics of systems of particles and rigid bodies. Coordinate transformation and vectors; Newtonian mechanics; linear and nonlinear oscillations; Hamilton’s principle, Lagrangian and Hamiltonian dynamics; central forces, planetary motion; collisions; non-inertial reference systems; rigid body dynamics; coupled oscillations. Prerequisites: 51 and Mathematics 130.

110. 3 units, Win (Yearian) MWF 9
111. 3 units, Spr (Yearian) MWF 9
120, 121, 122. Intermediate Electricity and Magnetism — Vector analysis, electrostatic fields, including multipole expansion; dielectrics. Special relativity and transformation between electric and magnetic fields. Maxwell's equations. Static magnetic fields, magnetic materials. Electromagnetic radiation, plane wave problems (free space, conductors and dielectric materials, boundaries). Dipole and quadrupole radiation. Wave guides and cavities. Prerequisites: 53 and prior or concurrent registration in 110. Concurrent or prior registration in Mathematics 130 and 131 with Physics 120 and 121, respectively, is required.

120. 3 units, Aut (Giffard) MWF 10
121. 3 units, Win (Giffard) MWF 10
122. 3 units, Spr (Giffard) MWF 10

130, 131. Atomic Structure — Origin of quantum theory, Bohr theory of H atom, including elliptic orbits, Schrödinger equation, one electron atom. First order perturbation theory (time independent and time dependent), magnetic moment and spin. Helium atom, many-electron atom, molecular spectra, X-ray spectra. Prerequisites: 57 or admission to Accelerated Sequence and 111. Concurrent or prior registration in 120, 121, 122, or equivalent, and in Mathematics 130 and 131 is required.

130. 3 units, Aut (Hofstadter) TTh 1:15-2:30
131. 3 units, Win (Hofstadter) TTh 1:15-2:30


3 units, Spr (Hofstadter) TTh 1:15-2:30

161. Intermediate Optics — Interference, Fresnel and Fraunhofer diffraction, wave aspects of image formation, Fourier optics and holography, crystal optics, lasers and their modes, optical waveguides. Prerequisites: 122.

3 units, Aut (Litke) MWF 10


170. 3 units, Aut (Triplett) MWF 9
171. 3 units, Win (Triplett) MWF 9

172. Physics of Solids — Introduction to the principal types of solids, with emphasis on their thermal, electrical and magnetic properties. Elementary treatment of phonons in solids, electrons in metals, energy bands. Applications to semiconductors, rectification, superconductors, para- and ferromagnetism, magnetic resonance. Prerequisite: 171.

3 units, Spr (Schawlow) MWF 9

190. Independent Study and Senior Thesis — Experimental or theoretical physics under supervision of a faculty member. Prerequisites: superior work as an undergraduate physics major, approval of the instructor, and of the Undergraduate Study Committee of the Department of Physics.

Any quarter (Staff) by arrangement

191. Senior Seminar: Atoms, Molecules and Radiation — An introduction to the interaction of electromagnetic radiation with matter, with applications to laser physics and modern atomic and molecular spectroscopy. Emphasis will be put on the dynamics of the resonant interaction, on nonlinear processes and coherence phenomena (e.g. quantum beats, saturation phenomena, optical mutations, self-induced transparency, photon echoes, multiphoton processes). Prerequisites: Physics 120–122, and 130–131 or equivalent.

3 units, Win (Hansch) TTh 3:15; one hour discussion by arrangement

192. Senior Seminar: Basic Gravitation — An introduction to the structure of relativistic theories of gravitation, with applications to problems in astrophysics. Prerequisites: Physics 120, 121, 122 or equivalent.

3 units, alternate years, given 1976–77

193. Senior Seminar: Astronomy — (Enroll in Astronomy 193B or C.)

3 units, Spr (Walker) W 2:15–4:05, discussion F 2:15
200, 201. Advanced Physics Laboratory—Experiments in atomic physics, nuclear physics, solid state physics, low temperature physics, and particle physics. Zeeman effect, isotope shift, gyromagnetic ratio of the electron, $\beta$ spectra, Compton effect, $\pi-\mu$ decay, X-rays, nuclear magnetic resonance, lasers, Mössbauer effect, and superconductivity. Experiments with transistors, electronic circuits, including amplifiers, oscillators, transmission lines, etc. Physics 200 and 201 consist of a selection of the more fundamental experiments. Prerequisites: 100, 101, 121, and 131. (Note—These courses may be taken in any of the three quarters. Furthermore, a student may take 200 alone or simultaneously with 201.)

200. 3 units, Aut, Win, Spr (Hanna) M or T 1:15–5:05
201. 3 units, Aut, Win, Spr (Hanna) M or T 1:15–5:05

210. Advanced Mechanics — Elementary principles of mechanics (D'Alembert's principle, Lagrange's equations), variational principles, two-body central force problem, rigid body kinematics and dynamics, Hamilton's equations, canonical transformations, Hamilton-Jacobi theory. Prerequisites: 111 and Mathematics 131. 3 units, Aut (Fetter) MWF 10

211. Mathematical Physics—Complex variables, complex integration, special functions (Legendre, Bessel, Hypergeometric) and their occurrence in the partial differential equations of physics, Fourier and Laplace transforms, and other topics of interest. Prerequisites: 210 and preferably Mathematics 106 and 132. 3 units, Win (Fetter) MWF 10

212. Classical Theory of Fields— Electrostatics and magnetostatics (boundary value problems, Green's functions), thermodynamic relations, Maxwell's equations, electromagnetic properties of matter, waves, wave guides and cavities, dispersion relations, magnetohydrodynamics. Non-relativistic radiation, special relativity, covariant formulation of Maxwell's equations, Lienard-Wiechert potential, relativistic radiation, electromagnetic scattering. Prerequisites: 122 or equivalent, Mathematics 106 and 132, or concurrent registration in Physics 210 and 211.

220, 221. Quantum Mechanics — The first quarter develops the Schrödinger equation: the formalism of state vectors is employed. The eigenvalues and eigenfunctions are found for simple systems such as the harmonic oscillator and the hydrogen atom. The properties of angular momentum are presented from a group theoretical point of view. In the second quarter variational techniques and perturbation theory are introduced to treat the more complicated systems of many-electron atoms and molecules. The interaction of such systems with radiation is also analyzed using time-dependent perturbation theory. The third quarter deals with scattering theory. The concepts of the scattering matrix, phase shifts, complex potentials, and dispersion relations are developed. The technique of second quantization is also introduced. Prerequisites: 132 and 211 and Mathematics 106 and 132, and preferably Physics 222.

220. 3 units, Aut (Walecka) MWF 11:00
221. 3 units, Win (Walecka) MWF 11:00
222. 3 units, Spr (Walecka) MWF 11:00


230. 3 units, Spr (Hansch) MWF 2:15 alternate years, given 1975-76
231. 3 units, Win (Hansch) MWF 2:15
232. 3 units, Spr (Hansch) MWF 2:15

240, 241. Nuclear Physics — Nuclear force: properties of nuclei; nuclear models, nuclear structure; alpha, beta and gamma decays; nuclear reactions. Prerequisites: 132 and 231, or equivalent.

240. 3 units, Aut (Glavish) TTh 11–12:30
241. 3 units, Win (Glavish) TTh 11–12:30

250, 251. High Energy Physics—Transition probabilities; relativistic treatment of kinematics, spin, phase space; particles and conservation laws (parity, isospin, hypercharge, etc.); quantum numbers of the baryons and mesons; scattering of strongly interacting particles. Unitary symmetry, weak interac-
tions (muon decay and properties), Regge poles, dispersion relations, nuclear-nucleon interactions. Prerequisites: 240 and 330; concurrent registration in 331, 332 recommended.

250. 3 units, Win (Litke) MWF 10
251. 3 units, Spr (Litke) MWF 10

260. Research Activities at Stanford — Review of research activities in the Department of Physics at a level suitable for entering graduate students. Registration required by all entering students.

0 to 3 units, Spr (Peccei) TTh 1:15
Win (Hanna)


3 units, Spr (Peccei) MWF 9

290. Literature of Physics—Intensive study of literature of any special topic. Chiefly preparation, presentation of reports upon topics studied. Prerequisites: 25 units of college physics and consent of instructor. If taken under the supervision of a faculty member outside the Department, approval of the Physics Department Chairman is required.

Any quarter (Staff) by arrangement

299. Teaching of Physics — Techniques of teaching Physics by means of lectures and laboratories. All teaching assistants in Physics are required to register for this course.

0 to 3 units, Aut, Win, Spr (Schwettman) by arrangement

330, 331, 332. Advanced Quantum Mechanics—Review of quantum mechanics and relativity, relativistic single particle equations (Klein-Gordon and Dirac), second quantization, canonical field theory, relativistic scattering theory. Quantum electrodynamics: applications, radiative corrections, renormalization theory, the Lamb shift. Symmetry principles, phenomenological field theories, special topics in field theory. Prerequisites: 221 and 232.

330. 3 units, Aut (Staff) TTh 9:00-10:50
331. 3 units, Win (Staff) TTh 9:00-10:50
332. 3 units, Spr (Staff) TTh 9:00-10:50


3 units, Aut (Donnelly) TTh 1:15-3:05

341, 342. Nuclear Theory—Nuclear matter, theory of angular momentum, group theory and nuclear spectroscopy. Nuclear models. Weak interactions, nuclear reactions, and special topics in intermediate energy physics. Prerequisites: 221, 241, 251, 340, concurrent or prior registration in 331, 332 is recommended.

341. 3 units, Win (Donnelly) TTh 1:15-3:05; alternate years, given 1975-76
342. 3 units, Spr (Donnelly) TTh 1:15-3:05; alternate years, given 1975-76

350, 351. Elementary Particle Theory — S-matrix analysis, helicity and partial wave analysis, dispersion relations, symmetries and applications. Theories of strong interactions, hadron models, reaction mechanisms (Regge Theory, duality, absorption), many-particle processes (statistical models, inclusive reactions, scaling). Theories of weak interactions, current algebras. Prerequisite: 332.

350. 3 units, Aut, alternate years, 1976-77
351. 3 units, Win, alternate years, 1976-77

352. Symmetries and Lagrangians — Internal symmetries in Lagrangian models with an emphasis on gauge symmetries and spontaneous breakdown. Some of the models to be discussed are: the Higgs model, the Sigma model, the Yang-Mills model, and the renormalizable gauge models of weak, electromagnetic and strong interactions, with applications.

3 units, Spr, alternate years, 1976-77

368. 3 units, Aut (Will) MWF 11
    alternate years, given 1975–76

369. 3 units, Spr (Will) MWF 11
    alternate years, given 1975–76

370, 371. Structure of Condensed Matter—
    Topics from solid state and low temperature
    physics. Properties of superconductors, Lon-
    don theory, Ginzburg-Landau theory, BCS
    theory, Josephson effect. Properties of liquid
    Helium, Helium II (Landau and Feynman
    theories), Bogolubov theory, rotating Hel-
    ium, vortices, Helium 3, Fermi liquid. Pre-

370. 3 units, Win, alternate years, 1976–77

371. 3 units, Spr, alternate years,
    1976–77

389. Research Orientation—The purpose of
    this course is to allow students to become
    familiar with the activities of one or more
    research groups, within the Department or
    outside. Registration is limited to one quar-
    ter per research group with an overall limita-
    tion of two quarters. Consent of the student's
    adviser is required for registration.

Any quarter (Staff) by arrangement

390. Research — All work in experimental
    or theoretical problems in research, as dis-
    tinguished from independent study of non-
    research character listed as Physics 190 and
    290. Open only to graduate physics major
    students, with consent of instructor. If taken
    under supervision of a faculty member out-
    side the Department, Physics Graduate Stu-
    dy Committee approval is required.

Any quarter (Staff) by arrangement

PROGRAMS OF STUDY

BACHELOR OF ARTS

Major in Political Science

The minimum requirements for recommenda-
 tion for the degree of Bachelor of Arts with political science as the major are:
1. Registration as a major student in the De-
    partment for at least one quarter, and a
    minimum of 25 units of work offered by
    this Department or members of this De-
    partment teaching at overseas campuses.
2. The completion of 45 units of political sci-
    ence, including:
   a) An advanced course or seminar (num-
       bered 100 or above) in at least three of
       the following fields: public administra-
       tion, comparative politics, international
       relations, political theory, American
       politics, public law.
   b) At least one seminar, which may be
       counted toward fulfillment of a), above.
       No more than 10 units of directed reading
       may be counted as credit toward the major.
       Courses used to fulfill the major require-
       ment must be taken for standard letter
       grades, although courses in excess of the
       required 45 units may be taken on a pass/no
       credit basis.

Major in Social Sciences (Political Science)

The student who wishes to pursue a pro-
 gram of interdisciplinary study in the social
 sciences with an emphasis on political sci-
 ence may enroll as a major in Social Sci-
 ences (Political Science). The major must be
 declared no later than the winter quarter of
the junior year. For the Bachelor's degree, a total of 50 units is required, as follows:

1. 30 units in political science, all of which must be taken for standard letter grades. The 30 units in political science should include:
   a) Three advanced courses or seminars (numbered 100 or above). These must include courses in at least two of the six fields in political science.
   b) At least one seminar which may be counted toward fulfillment of a) above. Of these 30 units, at least 15 must be completed in courses offered by this Department or by members of this Department teaching at overseas campuses.

2. 20 units from the course offerings of the departments of Anthropology, Communication, Economics, History, Psychology, and Sociology, selected in consultation with the student's adviser.

HONORS THESIS PROGRAM IN POLITICAL SCIENCE

The honors thesis program offers qualified students an opportunity to conduct independent research, and to write a thesis of superior quality summarizing the results of their research. The program provides for close contact between students and their advisers, so that students can receive intensive guidance and assistance throughout their research and writing. The aim is to help students go through the process of research, analysis, drafting, rethinking, and redrafting which is essential to excellence in writing.

Because the honors thesis program involves close student-faculty contact, the basic requirement for admission to the program is that students secure the agreement of a regular faculty member to be their thesis adviser. Students should be aware that no faculty member can effectively supervise more than a few honors theses each year. Application to the program should therefore be made as early as possible, and certainly well before the beginning of the quarter in which the student wishes to enter the program. Application forms can be obtained from the Department Office, should be countersigned by both the student and his or her thesis adviser, and then approved by the Director of Undergraduate Studies, who supervises the program. Normally, the thesis adviser will be a faculty member with whom the student has already worked. Normally, too, students enroll in the program in their senior year, and have at least a 3.3 average in political science courses when they apply.

The honors thesis program is based on the assumption that good writing takes time. Students are therefore strongly discouraged from attempting to complete an honors thesis in less than two quarters. While details will always be worked out on an individual basis between students and their thesis advisers, the following patterns are typical: (a) If a student already has substantial background on the thesis topic, then the honors thesis program can be completed in two or three quarters (for a total of 10–15 units). (b) If a student has done little or no previous work on the topic, but the thesis adviser believes that the proposed project is viable, then the honors thesis program should be spread over three quarters (for a total of 15 units).

Successful completion of the honors thesis program, and graduation with honors in political science, requires (a) completion of all requirements for the major and (b) successful completion of a thesis of honors quality. Honors work done for credit (as Political Science 199) does not count toward the completion of the requirements for the major, since the honors thesis program is regarded as additional work, beyond the normal requirements for graduation in the department.

GRADUATE STUDY

ADMISSION TO GRADUATE STANDING

All applicants for admission to graduate work are required to take the Aptitude Test of the Graduate Record Examination. This examination may be taken at most American colleges and by arrangement may be taken in nearly all foreign countries. For details concerning this test see the Information Bulletin. Overseas applicants, who may not receive the Information Bulletin promptly, should write directly to the Educational Testing Service, Box 955, Princeton, New Jersey 08540. The normal quota of students to be admitted is filled from those who have completed their applications by Jan-
uary 1. Only in the most exceptional circumstances will students applying after that date be admitted. Applications completed after June 1 will not be considered. Graduate students enter the Department at the beginning of the academic year.

Except in unusual circumstances, the Department will not admit graduate students who will not be able to take a full-time program. That is, students will be expected to carry a full course load except for time devoted to teaching or research assistantships.

**Master of Arts**

The Department offers a terminal Master of Arts program for a limited number of students. Applicants for the A.M. program are selected on the basis of the same criteria as Ph.D. candidates. Should a student upon successful completion of the Master of Arts program wish to enter the Ph.D. program, he or she will be subject to the same selection process as all other applicants who have received an A.M. degree from other universities. Applicants for the A.M. program are not eligible for University scholarships, fellowships, or teaching assistantships, and they should not apply unless they can pay their own tuition, fees, and maintenance.

The Department also offers the A.M. degree in joint degree programs with professional schools within the University. The normal procedure in these instances is for the student to apply sometime during the first year in the professional school within the University.

The A.M. degree will be awarded to terminal A.M. students as well as to doctoral candidates if they have completed the following requirements:

The faculty of the Department recommends a candidate for the Master's degree if he or she has satisfactorily completed, in the judgment of the Department, at least one full academic year as a graduate student, with 45 units of work in political science of which at least 25 units must be taken in graduate seminars. Not more than 25 units of the 45-unit requirement may be taken in a single field. The student shall take at least one course or seminar in three fields and at least two seminars in each of two fields. By special permission, a maximum of ten units of work done in related departments may be accepted in lieu of a portion of the work in political science. Courses numbered below 100 and grades below the level of B will not be considered acceptable for the A.M.

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this bulletin.

The Department does not offer a coterminous Bachelor's and Master's Degree program.

**Master of Arts in the Teaching of Political Science**

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in political science courses and 12 units in the School of Education. Detailed requirements for the course are outlined in the section "School of Education" in this bulletin.

**Doctor of Philosophy**

a. The candidate for the Ph.D. degree will offer three of the following fields of political science: American politics, comparative politics, international relations, political theory, public administration, and public law. The student will prepare and submit himself or herself to written examinations in two of these six fields of political science. The requirement for the third field may be satisfied either by taking a written examination in that field or by offering a minimum of ten units with a grade of B or better in the third field from among the formal graduate level courses in the Department.

b. The Ph.D. candidate is required to demonstrate the following:

1. competence in a foreign language; and/or
2. competence in statistics and/or related skills such as scale analysis, content analysis, mathematics for social science, or computer science.

The language and/or skill alternatives shall be those most likely to be useful in connection with the student's dissertation research. Level of competence needed for successful completion of the research shall be determined by the student's adviser and program committee. In consultation with his or her adviser and program committee, the stu-
dent shall propose a relevant program of preparation in a language and/or statistics. This program shall be mandatory unless the student can demonstrate, through an examination in a language or statistics, that he or she has mastered the necessary skills. In many cases, it may be necessary for the student to show competence in both a language and statistics.

c. If the candidate has not completed at least one year of previous undergraduate instruction, or 5 quarter units of previous graduate instruction, in political theory, he or she will take 5 quarter units of graduate instruction in political theory.

d. Early in the third quarter in residence, each first-year graduate student will submit to the student's adviser a statement of purpose. This statement will indicate the student's proposed major fields of study, the courses already taken and those planned to be taken in order to cover the fields, the student's plans for meeting language and/or skill field requirements, and, where possible, dissertation ideas or plans. This statement will be discussed with, and must be approved by, the student's adviser not later than May 15. It will then be reviewed by the Director of Graduate Studies and, if approved, kept in the student's file. The main purposes of this procedure are, in order of importance: to advise and assist the student to realize his or her educational goals; to provide an incentive for clarifying goals and for identifying ways to achieve them; to facilitate assessment of progress toward the degree.

e. When both a student and the adviser feel that he or she is ready, the student may take one or more written comprehensive examinations. Students may elect to take these examinations either simultaneously or singly in any two successive examination periods. It is normally desirable to take them at the same time. These examinations are normally given in the third and fourth weeks of the autumn and spring quarters.

f. Doctoral candidates who apply for the A.M. degree will be awarded that degree upon completion of the requirements outlined in the description of the Master of Arts program.

g. As part of the Ph.D. program, the candidate will normally serve as a teaching assistant for several quarters.

Minor and Teacher's Credential

Minor in Political Science—Candidates in other departments, offering a minor in political science, select two fields in political science in consultation with the Director of Graduate Studies, and submit to her or him, or to a member of the faculty designated as a minor adviser, a program of study for approval. No individual shall take less than 20 units in political science, including at least one graduate seminar in each field. Candidates will be examined in their fields in the general oral examination.

Teacher's Recommendation—For the recommendation for the Stanford Junior College Teacher's Credential with political science as a major, the applicant should have completed, in a manner satisfactory to the Department, at least 40 units in political science. For a minor, the applicant should have completed 24 units, including Political Science 10.

Prizes

The attention of undergraduate students is called to the annual Edwin A. Cottrell Memorial Prize for the best student in Political Science 1, the Arnaud B. Leavelle Memorial Prize for the best student in Political Science 150, the Lindsay Peters, Jr., Memorial Prize for the year's outstanding student each quarter in Political Science 10.

Summer Session

During the summer quarter the Political Science Department offers a variety of courses and seminars. The specific offerings depend on the summer quarter faculty.

Course Offerings

The Department uses the following course numbering system:

1-99 Introductory Courses
100-199 Advanced Courses and Undergraduate Seminars (may be open to graduates)
200-299 Undergraduate-Graduate Seminars
300-400 Graduate Seminars

Introductory Courses

1. Major Issues of American Public Policy—Alternative public policies in selected areas, including control of monopoly, social
welfare, poverty, government corruption, foreign policy. Political process; influence of cultural, economic, political factors on determination of public policy.

5 units, Aut (Marshall) MWF 10  
Win (Marshall) MWF 11  
plus section

8. Introduction to the Study of Political Behavior—This seminar-workshop, limited to fifteen students, will review some interdisciplinary approaches to the study of individual and group political behavior. There will be a series of exercises in the quantitative analysis of political data, but no special computational skill is required.

5 units, Win (Eulau) TTh 2:15–4:05

9. Introduction to Political Opinion and Political Behavior—An introductory survey of public opinion, political participation, ideology and voting in American politics.

5 units, Aut (Sniderman) given 1976–77

10. American Government — Congress, the President, political parties, and pressure groups; the process of policy formation in the federal government. Mr. Horn emphasizes the Constitution, the Supreme Court, and judicial review. Mr. Manley emphasizes Congress and the Presidency.

5 units, Win (Manley) MWF 10  
Spr (Horn) MWF 11

15. Introduction to Political Development — Analysis of the formation and development of political systems, from the primitive state to the post-industrial society. The course focuses on several central problems of politics (participation, economic distribution, authority, the structure of political organizations) and discusses the emergence and resolution of these problems at different levels of development.

5 units, Spr (Harding) given 1976–77

20. Introduction to Comparative Government and Politics — Political development, governmental institutions and political processes in selected political systems, such as England, the Soviet Union, and Japan.

4 to 5 units, Aut (Steiner) MTWThF 9

35. How Nations Deal with Each Other—(Same as History 35.) A general course in international relations, emphasizing the interaction of political, economic, social and cultural factors. Special attention will be given to problems of international conflict and distribution of wealth. A variety of analytical approaches, drawn from economics, history, political science and moral philosophy, will be used to develop explanations of events and prescriptions for policy.

4 to 5 units, Aut (R. Keohane) MWTThF 11

50. Freedom and Order in Western Political Theory—An introductory survey of political thought since the Reformation, with particular attention to varying conceptions of the nature and conditions of political and social freedom.

5 units, Win (Drekmeier) given 1976–77

88. Seminar: Introduction to Political Science—This seminar, limited to fifteen students, is designed for undergraduates who are interested in majoring in political science or one of the other social sciences. After reviewing some contemporary controversies over the “proper study” of politics, the seminar will explore the roots of these controversies in a historical perspective. There will be lectures by the instructor, group discussion of common readings, and presentations of students’ research papers.

5 units, Aut (Eulau) TTh 2:15–4:05

**ADVANCED COURSES AND UNDERGRADUATE SEMINARS**

Advanced undergraduate courses are open to undergraduates who have the necessary prerequisites and to graduates where advisable. Undergraduate seminars have limited enrollments, and admission generally requires the consent of the instructor. They are intended for juniors and seniors, but may admit graduates where advisable. Sign-up sheets for undergraduate seminars are posted in the Department office at registration time. Undergraduates interested in taking seminars should also consider the undergraduate-graduate seminars, numbered 200–299, listed in the next section.

**PUBLIC ADMINISTRATION**

The courses and seminars listed below are open to all undergraduates in the University, regardless of major. There are no prerequisites. There are no formal course sequences in public administration, but if their schedules permit, students may find it useful to take Political Science 100 as their first course. It is the introductory
course in the area and, as such, helps place the other courses in some perspective.

It should also be noted that public administration courses numbered 200-210 are undergraduate-graduate seminars and are open equally to undergraduates and to graduates. There are, however, prerequisites for some of these courses. Students interested in enrolling in them should check the course descriptions.

100. Public Administration — Relation of public policy-making to administration, planning, principles of organization, problems of supervision and personal motivation, framework of decision-making, the budget, administrative responsibility.

5 units, Aut (Walker) MTWTh 11
Spr (Walker) MTWTh 11

102. Leadership in Organizations — The problems of leadership in complex organizations, such as universities, schools, hospitals, business firms, armies, and public bureaucracies. Special attention to the role of major executives. (Same as Education 333 and Sociology 262.)

4 units, Spr (March) MW 1:15-3:05

103. Organizational Decision Making — An examination of the process of decision making in modern complex organizations, such as universities, schools, hospitals, business firms, armies, and public bureaucracies. The impact of information, power, resources, organizational structure, and the environment. Alternative models of choice and their implications. (Same as Education 120 and Sociology 263.)

4 units, Win (March) MW 1:15-3:05

106. Seminar on the Evaluation of Government Performance—How can one evaluate the effectiveness of government programs in general and social service programs in particular? What factors account for failure to reach stated goals? To what extent might administrative changes increase program effectiveness? The seminar will consider these questions while examining the record of federally-funded manpower training and public service employment programs. Graduate enrollment permitted.

5 units, Win (Abernethy) W 2:15-4:50

109. Directed Reading in Public Administration—Advanced individual study in public administration.

Any quarter (Staff) by arrangement

COMPARATIVE POLITICS

Students interested in comparative politics are encouraged to consider taking Political Science 15, “Introduction to Political Development,” or Political Science 20, “Introduction to Comparative Government and Politics,” before beginning more advanced work.

Undergraduate courses and seminars in comparative politics generally fall into two groups: those dealing with a particular country or region, and those dealing with major political problems or processes. Students concentrating in comparative politics are encouraged to take courses from both groups, and are also urged to do course work in more than one country or region.

111. European Politics: The British Political System—The development of the British political system; political socialization and culture; the structure and functions of parties, interest groups, media of communication, parliament, cabinet and civil service; evaluation of performance and prospects.

4 to 5 units, Win (Almond) MTWTh 9

112. Contemporary Asian Politics — Major problems of the area; evolutionary and revolutionary processes of change; and attempts to build viable political structures.

4 to 5 units, Aut (Ike) MTWTh 10

113. Latin American Politics — Survey of major themes in contemporary Latin American politics. Topics include colonial legacies, the international environment and dependency, cultural contexts and value-systems, social stratification and politics, interest groups, the military, political parties, political institutions and leaders, political ideologies, developmental consequences of government action, alternative political and economic models.

4 to 5 units, Spr (Packenham) MTWTh 1:15

114. Government and Politics in Japan—Focus will be on contemporary politics. Lectures will deal with the historical background, the social context of politics, political institutions, political forces, parties and elections, and the political process.

4 to 5 units, Win (Ike) MTWTh 10

The course has four themes: the origins of revolution in modern China, the politics of social and economic modernization in China since 1949, the problems of bureaucratization and political participation, and the succession to Mao Tse-tung.

4 to 5 semester units, Spr (Harding) MTWTh 11

115L. Law and Society in the People's Republic of China—(Same as Law 243.) This course examines the questions: What norms of behavior do the Chinese leaders want the people to adopt? How are these norms articulated and communicated to the people? What means are used to get the people to follow these norms? What happens to those who refuse to follow? For all these questions, an effort is made to identify the ideological, cultural, and other factors which affect the choices made by the Chinese leaders.

4 to 5 semester units, Spr (Li)

117C. Slavic Civilization—(Same as Slavic 117C.) An interdisciplinary introduction to the political, social, economic, and cultural history of the Slavic peoples of Bulgaria, Czechoslovakia, Poland, Russia, and Yugoslavia from the time of the Slavic migrations to the present. Readings and lectures will stress the similarities and differences among the Slavs themselves as well as the continuing tension of their relationship to the more familiar western experience. Three lectures a week will be offered by faculty from various departments, and a two-hour discussion section will be included as an integral part of the course.

5 units, Spr (Dallin, Triska, Staff)

118A. Political Change in Tropical Africa—Examines the colonial situation, the growth of nationalism, the achievement of political independence, ethnic patterns in new states, civilian and military leadership, the role of party and bureaucracy, problems in development planning, and efforts at pan-African cooperation.

5 units, Win (Abernethy) MWF 9

118B. Southern Africa: The Domestic and International Politics of Race—Examines the political histories of ten countries with special attention to South Africa, Angola, and Mozambique. Stresses the interaction of domestic and international politics, through an analysis of apartheid's international implications, regional transport networks, African liberation movements, the pattern of foreign investment, and military trends in the region.

5 units, Spr (Abernethy) MWF 9

118L.M. Political Leadership—An examination of political leadership from conceptual, historical, and comparative perspective. Lectures in 118L will analyze leadership in peasant societies, empires, revolutionary movements, modernizing politics and modern industrial states. 118L is a prerequisite to 118M; the second quarter will be run as a seminar and encourage individual research.

118L. 5 units, Win (Lewis) MWF 9
118M. 5 units, Spr (Lewis) T 2:15-4:05

119. Socialism in Cuba and Chile—An examination of the two socialist experiences in Latin America. The interrelationships between political, economic, and cultural change will be stressed.

5 units, Aut (Fagen) TWTh 2:15-4:05

119A. The Soviet Union: Politics and Society Since 1917—(Same as History 123A.) Survey of major trends and developments since the Revolution, and discussion of selected topics, including alternative interpretations, elite conflicts, role of ideology, social stratification, and changing values.

5 units, Spr (Dallin) MTWTh 10

121. Seminar: Political Institutions and Development—Analysis of political institutions, such as political parties, the military, bureaucracies, legislatures, and judiciaries, and their consequences for such developmental values as political participation, human rights, economic growth, socioeconomic equality, governmental capacity, and national integration. Focuses mainly on the contemporary Third World but other times and places are also considered. Mainly for juniors and seniors.

5 units, given 1976-77

122. Seminar: Modernization and Democracy in Asia—Political Change in Japan, the Philippines, and India.

5 units, Spr (Ike) Th 2:15-4:05

123. Seminar: Authoritarian Brazil—Major themes in Brazilian society and politics. Special attention to the issues of dependency and autonomy and to various developmental
problems and outcomes. Principally for undergraduates.

5 units, Aut (Packenham) M 2:15–4:05

124. Seminar: Latin American Dependency Theories—Main themes and issues in contemporary Latin American dependency theories.

5 units, Aut (Packenham) T 4:15–6:05

125. Seminar: Politics of China—This seminar will deal with major issues in Chinese politics with special emphasis on recent political developments.

5 units, Aut (Lewis, Li) M 2:15–4:05

126. Seminar: Eastern Europe—(World War II to the Present.) Systematic examination of the eight East European political systems in terms of their historical development, their policy-making processes, and their system maintenance and adaptation.

5 units, Aut (Triska, Cocks) W 2:15–4:05

126B. Seminar: Soviet Politics and Society Since 1917—(Same as History 219S.)

4 to 5 units, Aut (Dallin) given 1976–77

126C. Colloquium: Problems in Soviet History and Politics—(Same as History 326.) Prerequisites: History 123A, Political Science 119A or equivalent.

5 units, Win (Dallin) T 2:15–4:05

127. Seminar: Politics of Development: Eastern Europe—A comparative study of the social pressures and consequences which economic development and modernization produce on the nature and structure of political authority in the East European political systems. Three pilot survey research studies on social participation (Poland, Hungary, and Yugoslavia) will be available for the seminar participants.

5 units, Win (Triska) given 1976–77


5 units, Spr (Almond) Th 10–12

129. Directed Reading in Comparative Politics—Advanced individual study in comparative politics.

Any quarter (Staff) by arrangement

INTERNATIONAL RELATIONS

Students interested in international relations are encouraged to take Political Science 35, “How Nations Deal With Each Other.” While not a formal prerequisite for many of the courses listed below, Political Science 35 is an introduction to international relations and thus provides a desirable background for more advanced work.

The courses in international relations offered by the Political Science Department can generally be divided into two groups: those dealing with global political, military, and economic problems; and those dealing with the foreign relations of specific nations or geographic regions. Students concentrating in international relations are encouraged to select their courses from both these groups.

Students with interests in international relations are encouraged to refer to the “International Relations” section of this catalog, which lists international relations courses given in other departments.

130. Introduction to International Law—A broad overview of theories, development, present state and propensities of international law as a process in various critical arenas of international interaction.

4 to 5 units, Win (Triska) TWTh 2:15–3:30

131. International Dependency—What is meant when we say that one state is dependent upon another, more powerful state? What are the implications of a dependency relationship for the domestic political economy of both parties? What occurs when a weak state tries to reduce its dependence on a strong state? These questions will be examined through an historical analysis of European colonialism and through contemporary case studies, including U.S.-Peru, U.S.-Canada, France-Senegal, and the Soviet Union-Czechoslovakia. Desirable prerequisite: 35.

5 units, Spr (Abernethy) MWF 1:15

132. International Communism—Survey of communism as an international movement, both under the Comintern and since its dissolution, with emphasis on organization, ideology, and appeals; discussion of tensions and cleavages among and within communist parties social bases of support; and patterns of successes, failures, and adaptation. (Same as History 123B.)

5 units, Aut (Dallin) given 1976–77

133. The International System and Comparable Systems—A comparison, in terms of conflict and integration, of historical and contemporary international systems with se-
lected inter-city systems (in ancient Greece, for example), certain inter-band and inter-tribal systems, and the like, with consideration for some possible future trends.

5 units, Win (North) given 1976-77

134. International Organizations in World Politics — Analysis of the role of international organizations in contemporary world politics. Attention will be concentrated on new issues facing international organizations arising from increased interdependence in a variety of issue-areas. The experience of European integration will be discussed, as well as that of the United Nations and its affiliated agencies.

5 units, Win (R. Keohane) MTWTh 9

135. Diplomatic Revolution of Our Time—(Same as History 135.) An investigation of the problems raised by the collapse of the traditional system of Western diplomacy as a result of two world wars, the expansion of the diplomatic community, the breakdown of its internal homogeneity, the emergence of new nations, tensions between great and small powers, negotiations between states with conflicting national and cultural traditions, the functions and limitations of international organizations, and the new dimensions of diplomacy that have emerged since 1945.

5 units, Win (George, Staff) MTWTh 11

135R. Seminar on Force and Diplomacy—Student research. Prerequisite: 135.

5 units, Spr (George) W 2:15-4:05

135C—See 35 in list of introductory courses.

136. Soviet Foreign Policy—(Same as History 122B.)

5 units, Aut (Dallin) MTWF 11

137. The World of Superpowers in the Seventies—A comparative and interactional study of the superpowers—U.S., China, U.S.S.R., Europe and Japan—in terms of recent major events and development. Emphasis is on political change and formulation of theory of political dynamics.

4 to 5 units, Spr (Ike, North, Triska) MTWThF 1:15

137W. Underdevelopment and Foreign Policy—An examination of the problems which the condition of underdevelopment poses for foreign policy and alternative ways of dealing with those problems. Particular attention will be given to the meaning of underdevel-

opment; the nature of foreign policy elites and the domestic political determinants of foreign policy; the nonaligned movement and its significance; independence and development as goals of foreign policy; foreign aid, neo-colonialism, and dependency relationships; foreign investment and problems of dealing with multi-national corporations; and "resource diplomacy," with emphasis on the experience of OPEC and its implications for development in the Third World. Illustrations will be drawn mainly from Southeast Asia.

5 units, Aut (Weinstein) MTWTh 1:15

138A.B. Arms Control and Disarmament—General international security relations, stressing political, conceptual, and technological problems of national security policies and arms control. 138A is a prerequisite to 138B; the second quarter in 1975-76 will be a simulation of an arms control negotiation.

138A. 5 units, Win (Lewis, L. Weiler, Barton, Staff) MTWTh 1:15

138B. 5 units, Spr (Lewis, L. Weiler, Barton, Staff) MWF 1:15 and tutorials, by special arrangement

138W. Strategic Doctrines and Security in East Asia—Problems of security in East Asia viewed primarily within the context of strategic doctrines of the United States, with attention also to strategic thinking in Japan, China, the USSR and those Asian nations which have been the scene of armed conflict since World War II. The course will examine the nature of conflict in the region and analyze critically the Asian application of a wide range of strategic concepts, including the open door, containment, the domino theory, nonalignment, massive retaliation, flexible response, limited war, counterinsurgency, people's war, the Nixon Doctrine, regionalism, and neutralization. Many cases will be surveyed, but special attention will be given to the Indochina conflict, the Korean war, the U.S.-Japan alliance, and the problem of nuclear proliferation in Asia.

5 units, Spr (Weinstein) MTWF 11

139. Chinese Foreign Policy — Analysis of China's goals and conduct in world affairs. The principal themes of the course are the historical roots of Chinese foreign policy; China's dilemmas as a revolutionary power;
and the domestic context of China's foreign relations.

5 units, Win (Harding) given 1976–77

140A, B, C. Cross-Discipline Seminar: Decision-making in International Development—(Same as Education 274A, B, C, Engineering 297A, B, C, and Social Thought 197A, B, C.) Students in Political Science and several other disciplines will learn how their fields of specialization interact with problems of population, food, natural resources, energy technology, and human values. Wise decision-making in the world of tomorrow must depend upon an understanding of the meaning of interdependence—between man and man, between man and his environment, between nation and nation and between present and future generations. Autumn quarter will seek to define the global and national problems related to human survival utilizing specialists from several academic disciplines. Winter quarter will focus upon the ethics of development and strategies for change. Spring quarter will concentrate on the role and responsibility of the individual in his own society. (The course may be taken for 1 unit pass/fail or for more graded units with an individual project.)

140A. 1 to 3 units, Aut (North, Cooper, McWhorter and others)
M 7:30-9:30 p.m. and by arrangement

140B. 1 to 3 units, Win (North, Cooper, McWhorter and others)
M 7:30-9:30 p.m. and by arrangement

140C. 1 to 3 units, Spr (North, Cooper, McWhorter and others)
M 7:30-9:30 p.m. and by arrangement


5 units, Spr (Packenham) T 2:15-4:05

141L. Seminar-Workshop: United States-China Relations—This workshop will concentrate on major currents in U.S.-China relations. Students will complete research on selected problems and work together to develop a coherent assessment of all major issues affecting U.S.-China relations.

5 units, Spr (Lewis, Li) Th 2:15-4:05

142. Seminar: The Dynamics of National Expansion—Readings and research in the processes of colonialism and other forms of national expansion.

5 units, Win (North) T 4:15-6:05

143. Seminar: Political Economy of U.S.-Latin American Relations—Limited to advanced undergraduates, knowledge of Spanish or Portuguese recommended. Consent of instructor required.

5 units, Win (Fagen) T 2:15-4:05

144. Seminar: U.S. Foreign Policy-Making Process—Focus on presidential-level decision-making, the organization and operation of the National Security Council and the informational and advisory role of other departments and agencies in the Executive Branch. Theoretical approaches and case studies. Enrollment limited to 15 juniors and seniors with previous courses in international relations and public administration.

5 units, Spr (George) TTh 2:15-4:05

145. Seminar: Dynamics of International Conflict — Expansion, competition, arms races, conflicts and crises.

5 units, Win (North) Th 4:15-6:05

146. Seminar in Soviet Foreign Policy—Contemporary Soviet foreign policy decision-making, instruments of Soviet foreign policy, Soviet interaction with the communist party-states, the developing nations, the West, and the U.S. testing of hypotheses concerning Soviet and communist international organizations; diplomacy, negotiation, and risk-taking; agreements; and conference behavior.

5 units, Win (Triska) Th 4:15-6:05

147. Seminar: China in the International System—Readings and research on China's relations with the U.S., the U.S.S.R., Japan, the Third World and various other countries.

5 units, Aut (North) Th 4:15-6:05

147C. Seminar: International Aspects of Environmental Disruption—Many environmental problems transcend national borders. Others are at least partially the result of international politics and economic activities. In this seminar, students will explore the environmental crisis as a sub-set of international relations, with particular emphasis on
148. Seminar: International Communism—
(Same as History 420B.)
5 units, Win (Dallin) given 1976–77

149. Directed Reading in International Relations—Advanced individual study in international relations.
Any quarter (Staff) by arrangement

POLITICAL THEORY

Undergraduate courses in political theory are arranged in several groups and sequences. While the courses can often be taken separately, an understanding of how they are related to one another may help students interested in political theory to construct their course of study.

Lecture sequence in the history of political ideas: 150, 151, 152, 153. Seminar groups and sequences:


b) The development of a science of society and politics: 158A, 158B, 266.

c) Political theory in the context of contemporary ideas: 160A, 160B.

150. Political Thought: Myth and Speculation in the Ancient World—The beginnings of political speculation in preliterate societies, the ancient world, and pre-Socratic Hellas; the philosophical systems of Plato, Aristotle, and the Hellenistic schools; Roman institutions and theories of law and politics.
5 units, Aut (Drekmeier) MTWThF 11

151. Political Thought: Augustine to Hobbes — The search for a principle of authority consistent with spiritual ideals, with new forms of social integration, and with the private goals of the individual.
5 units, Aut (Drekmeier) given 1976–77

152. Political Thought: Machiavelli to Rousseau—The development of political thought in the early modern era. Concepts of liberty, authority, and obligation in five major theorists of the period. Attempts to define the means and goals appropriate to political action, and the different methods employed in the study of politics, will receive special attention.
5 units, Win (N. Keohane) MTWTh 10
Sections by arrangement

153. Political Thought: The Modern Period—Democratic theory, liberalism, socialism, communism and anarchism from 1785 to the present. The course will undertake critical analysis of attempts to adapt the ideals of democracy and social justice to the large modern state. The Federalist papers, Tocqueville, Mill, Marx, Bakunin and Lenin will be read, along with briefer selections from other works.
5 units, Spr (N. Keohane) MTWTh 10
Sections by arrangement

158A,B. Theory, Power, and Social Science.

158A. The development of modern social science and social philosophy: discussions of value, the nature of man, human interaction, the organization of power, belief systems, social change, and related themes in the different idealist, formalist, and positivist schools of thought. No prerequisite, but 153 or a course in modern philosophy or intellectual history will be helpful. This course provides the historical and philosophical background for 158B.
5 units, Win (Drekmeier) MTWThF 11

158B. The theory of political structure and process: typology of social relationships, organization and leadership, social class and ideology, alienation and participation, etc. Political sociologies of elites, bureaucracy, and class in the writings of Marx, Toennies, Simmel, Weber, Mannheim, Durkheim, Michels, and contemporary theorists. Psychoanalytic, phenomenological, and other conceptions of the nature of consciousness and experience will be considered in the analysis of behavioral aspects of the subject. 158A strongly recommended.
5 units, Spr (Drekmeier) MTWThF 11

160A,B. Seminar: "Modernisms" — "Modern" thought characteristically seeks insight into its own roots. The course will consider how such increased awareness of subjectivity affects subsequent action or expression. The lectures will also consider salient "family resemblances" (Wittgenstein) discernable in the period of 1900–1940 in fields as divergent as social and political theory, legal theory, philosophy, historiography, literature, art, and even music.

160A. 5 units, Win (Rotag) M 2:15–4:05
160B. 5 units, Spr (Rotag) M 2:15–4:05
161. Seminar in Power, Authority, and Disobedience.

5 units, Win (Drekmeier) M 4:15-6:05

163. Seminar on Freedom and Equality—An analysis of varied treatments of these two concepts, and supposed tensions between them, in modern social thought. Attention will be given to the differences between “negative” and “positive” liberty, and to different ways of thinking about equality, including equality of opportunity and equality between the sexes. Readings will be drawn from contemporary political theorists as well as earlier philosophers.

5 units, Aut (N. Keohane) W 2:15-4:05

165. Seminar: European Roots of American Democratic Thought—This course, which will be offered this year as a seminar and later as a lecture course, will explore the connections between European and American democratic theory. We will first read those European political philosophers who have made the most important contributions to American political thought, including Machiavelli, Locke and Montesquieu. Then we will concentrate upon colonial and constitutional American political thought, with special attention to the political theories of the revolutionary period. We will then turn back to look for references to America in French Revolutionary materials, and deal fairly extensively with Tocqueville. There will be a final section on contemporary American democratic theory.

5 units, Spr (N. Keohane) W 2:15-4:05

168. Alienation and Detachment—The history and theory of concepts of estrangement, objectivation, and alienation and their place in the development of the philosophy of politics, society, and art.

5 units, Spr (Drekmeier) given 1976-77

169. Directed Reading in Political Theory—Advanced individual study in political theory.

Any quarter (Staff) by arrangement

PUBLIC LAW

170. The Supreme Court and the Constitution—Theory and practice of constitutional government in the United States. Formation of the Constitution; federal court system; separation of powers; judicial review; Congressional and Presidential authority; citizenship, suffrage and representation; emphasis on nature of legal reasoning and judicial process. Prerequisite: third-year standing.

5 units, Aut (Horn) MTWThF 1:15

171. Seminar: Conservatism and Constitutionalism—The seminar will consider three topics: (1) Purposes of the Polity and Forms of Government (including Corrupt Forms); (2) Primacy of the State or of the Individual—Power (Force) or Rights—Government of Laws or Men; (3) Equality or Hierarchy (Rank, Privilege), and especially relations of the Polity and the Economy. Topics will be examined through study of works of political and legal theorists. Prerequisite: consent of instructor.

5 units, Win (Horn) M 4:15-5:05 and Th 4:15-6:05


5 units, Spr (Horn) MTWThF 1:15

173. Civil Liberties in the United States—Civil liberties in contemporary American culture; theory, history underlying them. Free speech, press in era of mass communications; freedom of association; religious liberties; rights of ethnic minorities. Prerequisite: third-year standing.

5 units, Win (Horn) MTWThF 1:15

174. The Criminal Law and the Criminal System—(Same as Law 107 and Sociology 132.) Exploration of the purposes and processes of the criminal law with emphasis on the actual operation of the system, and application of theory to contemporary problems. Topics will include the police, the trial, sentencing, corrections and “non-victim” crimes.

5 units, Aut (Kaplan) given 1976-77

174K. The Bill of Rights—(Same as Law 102.) An inquiry into the problems of interpreting the Bill of Rights of the U.S. Constitution. Attention will be directed to the First Amendment guarantees, including the issues of advocacy of unlawful conduct, obscenity, libel and slander, access to private and to
public forums, and free exercise of religion; Fourth, Fifth and Ninth Amendment aspects of the right to privacy; and Fifth and Fourteenth Amendment prohibitions on racial and sexual discrimination. Enrollment limited to 30.

5 units, Aut (Kaplan) MWF 11

179. Directed Reading in Public Law — Advanced individual study in public law. Any quarter by arrangement with Public Law faculty

AMERICAN POLITICS

180. State and Local Politics in the Federal System — The course presents a contrast among the types of problems, the capacity to respond to them, and the variations in policy results which occur on the state and local levels of government. Emphasis will be given to the expansion of conflict and appeal to a higher level which is possible within the federal system and to both the expanded resources and increased program intervention which may result from federal participation in state and local policies.

5 units, Win (Larson) MTWThF 1:15

180L. Politics and Society — (Same as Sociology 183.) An analysis of the relationship of sociological structures to political behavior. This course will deal with topics such as social stratification, mass movements and the political roles of academic intellectuals.

5 units, Win (Lipset) MWF 10

181. Personality and Politics — A study of the relationship between psychological makeup of citizens and political leaders and political belief, deviance and leadership.

5 units, Win (Sniderman) given 1976–77

182. Political Disaffection and Political Protest — A study of the meaning of political alienation in America today, its sources and its consequences.

5 units, Spr (Sniderman) given 1976–77

183. Criminal Justice in America — The course will explore the administration of justice in America. Topics include police behavior, the process of arrest, the quality of defense counsel, prosecutorial discretion, plea-bargaining, sentencing, and correction.

5 units, Aut (Casper) MW 10; section by arrangement

184. Legislative Behavior — Congressional elections, constituent relations, policy making and leadership, relations between Congress and administrative and executive agencies; the committee system, seniority and procedure; Congress as an element in the party system. Prerequisites: third-year standing and 10 or equivalent.

5 units (Manley) given 1976–77

185. Introduction to Models in Social Science — (Same as Education 110 and Sociology 271.) An introduction to models in social science. Models of choice, exchange, adaptation, diffusion, and structure are used to make predictions in a variety of situations involving human behavior. Emphasis is placed on the invention and application of models more than on the testing of them.

4 units, Aut (March) MW 1:15 sections M 10, 11, or 12

186. Politics and the American Legal System — The relationship of legal institutions to the broader political system. Topics will include judicial recruitment and decision-making, litigation and social change, and the impact of court decisions.

5 units, Win (Casper) given 1976–77

187. Voter Realignment and Political Parties — Examining the United States, the course traces the relationship of change in voting patterns to changes in political parties from 1776 to the present. This overview is then used to examine the literature predicting future realignment or collapse of political parties in the U.S.

5 units, Aut (Larson) MTWThF 9

188. Organization of Political Parties in the U.S. — The variety of levels, forms and degrees of organization of political parties in the U.S. will be covered. Differences as to types of incentives, effectiveness of authority, and methods of recruitment will be emphasized. Additionally, questions of the relationship between party functions and party form will be examined. Both current and historical materials will be used.

5 units, Win (Larson) MTWThF 9

189. Presidential Voting in the American Political System.

5 units, Spr (Brody) MW 9

190. Seminar: Political Parties and Pressure Groups — The focus is on the intersection of pressure groups and parties as they affect government policy. Some of the topics to be covered include: differentiation of individ-
ual and group political behavior in theory and practice; channels of access to party and government; factors affecting choice of channels; degrees of, or organization for, pressure and pressure points.

5 units, Spr (Larson) Th 4:15–6:05

190M. Seminar: Computer Models of Social Behavior—(Same as Computer Science 127, Education 218, Psychology 154, Sociology 273.) Models of human behavior in social situations. Particular attention is given to specifying simulation models, determining their properties, and testing them. Enrollment is limited to 20. Prerequisites: knowledge of at least one programming language, advanced courses in social science, consent of instructors.

4 units, Win (March, Feigenbaum) T 3:15–5:05

191. Seminar: The Warren Court and Civil Liberties—A discussion of the impact of the Warren court upon civil liberties and civil rights. Reading will include court decisions and materials dealing with the relationship of the court to other branches of government.

5 units, Aut (Casper) given 1976–77

192A,B. Seminar: Urban Structure and Policy—This urban studies core seminar analyzes the interaction of metropolitan economic trends, social structure, culture, and political activity, particularly as it affects the quality of urban life. The spring quarter focuses on the development of city planning and competing visions toward which the city should be planned. Limited to undergraduates with a strong interest in urban studies, the course emphasizes class discussion of readings, short papers, and student presentations. (Same as Urban Studies 100A,B.)

192A. 5 units, Win (Mollenkopf) Th 2:15–4:05

192B. 5 units, Spr (Mollenkopf) Th 2:15–4:05

192G. Seminar/Workshop: The Politics of Health—National health policy will be analyzed in terms of political determinants, focusing on the processes of health policy formulation, implementation, evaluation and modification. Participants will analyze Medicare, national health insurance, and health delivery systems, as well as radical structural reform proposals. Limited enrollment. Prerequisite: Political Science 10 or equivalent.

5 units, Spr (Manley, Staff) W 4:15–6:05

193A,B. Seminar: Congress and the Presidency—This seminar is designed for junior and senior majors in political science and graduate students where advisable. The purposes of the seminar are to acquaint the student with a variety of research strategies and methods used in the study of American politics and to provide a context for the development of individual research projects. Prerequisites: consent of instructor. Students should plan to take both A and B.

193A. 5 units, Win (Manley) W 2:15–4:05

193B. 5 units, Spr (Manley) W 2:15–4:05

194. Seminar: Public Policy Outputs and American State Politics—The seminar addresses the question, “Do differences in state political institutions make a difference in policy?” Some of the institutional differences to be investigated include: political culture, reform government, party factions, interest group strength. The course will draw upon studies from welfare economics, traditional political science case studies, and current literature in political science testing the connection between politics and public policy.

5 units, Aut (Larson) M 4:15–6:05

194C. Seminar: Public Policy Toward the Mass Media—(Same as Communication 232.) An examination of the policy process relating to the mass media: how technological and regulatory developments will affect the future of mass media; an effort to define a more coherent public policy toward communication and society.

5 units, Spr (Cater) M 4:15–5:30

195. Introductory Seminar in Politics—Historical, social, and ideological factors affecting American politics, emergent patterns in the party system; analysis of the nature of public opinion and voting behavior.

5 units, Aut (Rosenzweig) given 1976–77

195M. Seminar: Political and Economic Power in the United States—The purpose of this seminar is to explore various theories about the distribution of political and economic power in contemporary America. Among the topics covered are pluralism, elitism, modern capitalism, the welfare and warfare state, and the role of national political institutions in affecting the distribution of economic values. Special attention will be
placed on the works of Dahl, Mills, Miliband, Shonfield and Galbraith. Prerequisites: Political Science 10 or equivalent, and junior standing.

5 units, Spr (Manley) Th 2:15-4:05

196A, B. Seminar: Presidential Decision-Making

196A. Role of personality factors in incumbent's conception of the Presidency, his organization and management of the policy-making system, use of advisers, performance as a decision-maker. Enrollment limited to 20 juniors and seniors. Desirable prerequisite: previous courses in American government, policy-making, organization theory, psychology.

5 units, Aut (George) given 1976-77

196B. Student Research — Prerequisite: 196A or equivalent.

5 units, Win (George) given 1976-77

198. Directed Reading in American Politics—Advanced individual study in politics. Prerequisite: 10 or equivalent.

Any quarter (Staff) by arrangement

UNDERGRADUATE HONORS

199. Senior Honors Thesis.

Any quarter (Staff) by arrangement

GRADUATE—UNDERGRADUATE SEMINARS

Conducted as seminars or colloquia, and open to both advanced undergraduates and graduates. In most cases non-majors as well as majors are welcome, but enrollments are limited. Sign-up sheets for all 200-level courses are posted in the Departmental Office at registration times. These sheets should be checked for indications of class size and other specific enrollment information.

204. Seminar: Planning and Administration for Metropolitan Areas—Urban planning in the context of political and administrative decision-making; governmental structure and divisions as factors in land use development and control.

5 units, Win (Walker) T 2:15-4:05

207. Seminar: Government and Natural Resources—Political, economic, administrative factors affecting public policy for river basin development, soil conservation, management of public domain, related problems. Pressure groups, legislative bodies, administrative agencies in the decision-making process. Recommended: Economics 1.

5 units, Win (Marshall) T 2:15-4:05

208. Seminar: Administrative Responsibility—Conflicting loyalties, accountabilities of administrative officials in decision-making processes; responsibility to public at large, pressure groups, chief executive, legislature, profession. Case study method used.

5 units, Spr (Marshall) T 2:15-4:05

209. Directed Reading in Public Administration.

Any quarter (Staff) by arrangement

210. Administrative Behavior — Environment of administrative action; political, social, psychological factors in management; problem of incentives.

5 units, Win (Walker) MTWTh 11

210A. Non-Rational Factors in Administrative Behavior—Special psychological problems in supervisory and subordinate roles; impact of cultural expectations and personality structure on organizational behavior.

5 units, Spr (Walker) W 2:15-4:05

211. Theories in Comparative Politics—Concepts, models, theoretical frameworks, and typologies in comparative politics; theoretical approaches to political development.

5 units, Win (Almond) T 10-12

212. Comparative Political Institutions and Processes—Cross-national analysis of specific institutions, processes, and problems such as political parties, interest groups, bureaucracies, legislatures, political socialization, political leadership, political system performance, and the like.

5 units, Spr (Almond, Staff) T 10-12

213. Seminar: Political Leadership—Readings and discussion of current approaches to study of political leadership: social background elite analysis; ideology and "operational code" belief systems; political style and political skill; charismatic leadership; political personality; role and personality; psychobiography.

5 units, Aut (George) TTh 2:15-4:05

220. Seminar: Comparative Political Socialization—Theories of political socialization; political socialization and political culture; analysis of the functioning of agents
of political socialization in various political systems; political socialization and political change.

5 units, Spr (Steiner) given 1976-77


5 units, Spr (Ward) W 2:15-4:05

221. Seminar: Comparative Politics, Parties and Party Systems—Development and functions of parties; typologies of parties and of party systems; parties and political participation.

5 units, Win (Steiner) T 4:15-6:05

223. Colloquium in Chinese Politics: Maoism—A consideration of the political history of modern China as reflected in the writings and speeches of Mao Tse-tung. Special attention will be given to the origins and evolution of Maoism, its effects on China's economic and political development, and its prospects after Mao's death. The colloquium will also be concerned with the general problem of the roles of charismatic leadership and ideology in a developing society. Prerequisite: 115 or the equivalent and consent of the instructor.

5 units, Spr (Harding) T 4:15-6:05

224. Seminar: Comparative Local Politics—Subnational institutional structures in various political systems; local-national linkages with emphasis on the relationship of decentralization to development and democracy; comparative urbanism; community power in comparative perspective.

5 units (Steiner) given 1976-77

227. Seminar in Comparative Politics: Africa—Examines the record of selected African states in formulating and implementing public policy, with special reference to rural development. Open to selected undergraduates who have taken an Africa-related course.

5 units, Spr (Abernethy) given 1976-77

228. Seminar in Decision-making and Bureaucratic Politics in the Soviet Union—A study of the problems and processes of Soviet decision-making. Particular attention given to the changing nature and role of institutional structure, administrative theory, organizational behavior, and bureaucratic politics in policy making and implementation. For both undergraduate and graduate students.

5 units, Win (Cocks) M 2:15-4:05

229. Directed Reading in Comparative Politics.

Any quarter (Staff) by arrangement

230. Seminar: International Law—Survey of recent international law developments. Particular attention will be given to the oceans and the law of sea conferences, as well as to issues such as hijacking, terrorism, international pollution, and new states.

5 units, Spr (Triska) M 4:15-6:05

235. Seminar: United States and the Pacific—An analysis in political, strategic, economic, and cultural terms of recent and contemporary United States' relationships with major states and regions bordering the Pacific Ocean. Attention will be focused on the process by which a society and polity that has always been Atlantic and European in its principal orientations has gradually acquired an increasingly important Pacific orientation as well.

5 units, Win (Ward) T 2:15-4:05

241. Seminar: Transnational Relations—From the perspective of theory in international relations, this seminar will attempt a critique of traditional state-centric models of world politics. From a substantive point of view, the focus will be on the politics of international economic issues and ways in which international arrangements might be constructed to deal with them. Students will have the opportunity to investigate at least two issue-areas in depth.

5 units, Spr (R. Keohane) T 4:15-6:05

243. Seminar: International Relations Theory—Examines and compares both traditional and some of the more contemporary approaches to international relations theory from an interdisciplinary viewpoint. Realists, idealists, behavioralists, environmentalists, socio-cultural evolutionists, futurists, and others.

5 units, Aut (North) T 4:15-6:05

249. Directed Reading in International Relations.

Any quarter (Staff) by arrangement

5 units, Aut (Drekmeier) M 4:15-6:05

264. Seminar on the Public Interest—An analysis of the meanings of private and public interest in selected political philosophers, with special attention to contemporary attempts to define the “public interest” and provide empirical referents for it, or to deny its validity. Open to advanced undergraduates and graduate students.

5 units, Spr (N. Keohane) given 1976-77

266. Political Science in Political Philosophy—An analysis of the work of four major political theorists—Aristotle, Machiavelli, Hobbes, and Montesquieu—each of whom has been regarded, by himself or by others as “the first political scientist.” Their methods, beliefs about their purposes and achievements, and statements or crucial questions in political theory will be compared and criticized. The seminar is designed especially for graduate students who want to develop some acquaintance with the teachings of important political thinkers of the past; it will also serve the needs of those who plan to take the examination in political theory. Exceptionally well-qualified undergraduates may be admitted with the consent of the instructor.

5 units, Win (N. Keohane) given 1976-77

267. Rousseau, Hegel, Marx—A comparative study of three great social theorists, their interconnections and points of difference. Ideas about the development of the human species, the connections between the individual and community, the pattern of history, economic and social roots of alienation, freedom and authority, theory and practice will be analyzed, with special attention to the refining of the dialectical approach to the understanding of politics.

5 units, Win (N. Keohane) T 4:15-6:05

269. Directed Reading in Political Theory.

Any quarter (Staff) by arrangement


5 units, Win (Horn) given 1976-77

276. Seminar: the Constitutional Scope and Limits of "Free Speech"—The seminar will consider the historical origins and the major analytic problems of the laws regarding "free speech."

5 units, Aut (Rogat) M 2:15-4:05

279. Directed Reading in Public Law.

Any quarter (Staff) by arrangement

280. Contemporary Problems in Social Institutions—(Same as Education 202 and Sociology 180.) An examination of the social structure, process, problems, and ideology of a specific social institution. The institution to be considered varies each year.

4 units, Aut (March) T 7-10 p.m.

281. Seminar: Empirical Political Theory—An inquiry into the epistemological assumptions of major contemporary approaches in political science: rational choice models, exchange and coalition theory, decision-making approaches, conflict theory, and others. Limited enrollment; open to graduate students and advanced undergraduates.

5 units, Aut (Eulau) W 2:15-4:05

282. Seminar: Topics in Political Sociology—(Same as Sociology 245.) An analysis of differing approaches based on reading the works of major figures such as Lasswell, Mannheim, Marx, Michels and Weber.

5 units, Win (Lipset) T 4:15

283. Seminar: Politics of American Federalism—An inquiry into the political origins, transformations and dynamics of the American federal system, with special emphasis on the problem of representation (rather than adjudication and administration). Limited enrollment; open to graduate students and advanced undergraduates.

5 units, Win (Eulau) given 1976-77

288. Seminar: Legal Institutions and Processes—A discussion of legal institutions and the political process. Topics will include judicial recruitment, the analysis of judicial decision-making, techniques for lobbying courts, and the impact of court decisions.

5 units, Aut (Casper) M 2:15-4:05

289. Modes of Political Analysis.

5 units, Win (Eulau) given 1976-77
290. Introduction to Political Data Analysis—Prerequisite: Statistics 60.
5 units, Win (Brody) M 2:15–4:05
Lab Th 1:15

294A,B. Research Seminar in Political Behavior — Intensive review of and independent research on, public opinion, attitude change, political alienation, participation, and voting. Students must take both quarters.
294A. 5 units, Win (Sniderman) given 1976–77
294B. 5 units, Spr (Sniderman) given 1976–77

299. Directed Reading in American Politics.
Any quarter (Staff) by arrangement

GRADUATE SEMINARS

Seminars numbered 300 and above are limited to graduate students. Instructors should be consulted before enrolling.

300. Thesis.
Any quarter (Staff) by arrangement

304A,B,C. Advanced Research in Organizations I, II, III—(Same as Education 418A, B, and Sociology 365A,B,C.) A research seminar for advanced graduate students. Emphasis is placed on developing original theoretical formulations of major concepts in organization theory. Prerequisites: advanced courses in organizations, research methods, consent of instructor.
304A. Advanced Research in Organizations I.
4 units, Aut (March, Staff) to be arranged
304B. Advanced Research in Organizations II.
4 units, Win (March, Staff) to be arranged
304C. Advanced Research in Organizations III.
4 units, Spr (March, Staff) to be arranged

313A,B. Graduate Seminar-Workshop on Dependence and Development in Latin America — Emphasis on the interplay between political and economic, and domestic and international factors in Latin American development and underdevelopment. An advanced research seminar, knowledge of Spanish or Portuguese highly recommended. Consent of the instructor required. Normally a two-quarter sequence for 5 units each quarter.
313A. 5 units, Win (Fagen) W 2:15–4:05
313B. 5 units, Spr (Fagen) W 2:15–4:05
Continuation of 313A. Cannot be taken without 313A.

322. Research on the Politics of Britain, France, Germany—The interaction of politics and public policy in Britain, France and Germany.
5 units, Aut (Almond) W 2:15–4:05

323. Research Seminar on the Comparative Study of Political Socialization—(Same as Education 408.) The seminar emphasizes the conceptual and methodological problems involved in studying the role of education as a source of political learning in different cultural and sub-cultural settings. It is based on empirical data from field studies in different cultures and includes some secondary analysis of such data. Requires previous course work in the general area of political socialization, and facility in the handling of empirical data.
4 units, Spr (Weiler) given 1976–77

5 units, Aut (Ike) W 2:15–4:05

336. Research Seminar: Comparative Foreign Policy, Eastern Europe—Workshop in the problems posed by comparative study of foreign policies. (Offered jointly with the Department of History.)
5 units, Spr (Triska, Lederer) given 1976–77

366A,B,C. Philosophical Foundations of Political Inquiry—Research workshop open to advanced graduate students interested in the application of philosophy of science to the study of politics.
5 units, Aut, Win, Spr (North, Staff) to be arranged

384A,B. Seminar: American Politics and Public Policy-Making — The first quarter consists of a broad and critical exploration of the literature on American national government and national policy-making, with an emphasis on Congress and the Presidency. The second quarter is a research seminar.
Joint sessions may be held with graduate students at Berkeley. Students should plan to take both A and B.

384A. 5 units, Win (Manley) given 1976-77
384B. 5 units, Spr (Manley) given 1976-77

PSYCHOLOGY

Emeriti: Edith M. Dowley, Paul R. Farnsworth, Ernest R. Hilgard, Maud Merrill James, Quinn McNemar, Louis Meek Stolz, Robert R. Sears (Professors)
Chairman: Eleanor E. Maccoby
Vice Chairman: Leo Ganz
Professors: Richard C. Atkinson (on leave 1975-77), Albert Bandura, Daryl J. Bem, Gordon H. Bower (on leave spring quarter 1975-76), Robert C. Calfee (by courtesy), Alfredo Castañeda (by courtesy), Herbert H. Clark (on leave 1975-76), Arthur P. Coadarci (by courtesy), William C. Dement (by courtesy), Edward A. Feigenbaum (by courtesy), Nathaniel L. Gage (by courtesy), Leo Ganz, Thomas W. Harrell (by courtesy), Albert H. Hastorf, Robert D. Hess (by courtesy), John D. Krumboitz (by courtesy), Douglas H. Lawrence, Harold J. Leavitt (by courtesy), Seymour Levine (by courtesy), Eleanor E. Maccoby, Walter Mischel, Merrill M. Mittler (by courtesy), Karl H. Pribram, David Rosenhan (on leave spring quarter 1975-76), Roger N. Shepard, Albert E. Siegel (by courtesy), Richard E. Snow (by courtesy), Patrick Suppes (by courtesy), Ewart A. C. Thomas, Carl Thoresen (by courtesy), Eugene J. Webb (by courtesy), Philip G. Zimbardo
Associate Professors: J. Merrill Carlsmith (on leave autumn and winter quarters 1975-76), Leonard M. Horowitz, Lee Ross, Edward E. Smith
Assistant Professors: Irvin Brown, Sandra L. Bem (on leave autumn and winter quarters 1975-76), S. Shirley Feldman, D. Michelle Irwin (Director, The Bing Nursery School), Mark R. Lepper, Ellen Markman, Barbara Sakitt, Jeffrey J. Wine (on leave autumn quarter 1975-76)
Senior Research Associate: Norman H. Mackworth
Lecturer: Harriet N. Mischel

OFFERINGS AND FACILITIES

The Department of Psychology comprises facilities and personnel housed in Jordan Hall, where it maintains extensive laboratory and shop facilities. Several of the laboratories are equipped with computers and others are linked directly to the University's Computer Center. The Department maintains a nursery school close to the Escondido married students' housing area. This provides a laboratory for child observation, for training in nursery school practice, and for research.

The Department provides: (1) courses designed for the general student; (2) a major program leading to the degree of Bachelor of Arts; and (3) programs of graduate study and research leading to the degree of Doctor of Philosophy. Applications are not accepted for the Master's degree.

PROGRAMS OF STUDY

BACHELOR OF ARTS

For the Bachelor's degree, a total of 40 units of psychology are required, including 1, 60, and at least two courses from Group A and at least two courses from Group B. Group A consists of broad content courses in the areas of cognition, perception, physiological psychology and psycholinguistics. Group B consists of courses in the areas of social, developmental, abnormal and personality.


The listing of courses under Groups A and B are not rigid and may change from year to year; students are encouraged to check with the Department Secretary for additional information.

A transfer student must take at least 15 units of course work in the Department in order to receive the Department's recommendation for graduation. Transfer students may receive transfer units for courses completed in psychology at any accredited university or college provided they were taught by a regular faculty member. There is no
limit to the number of units that may be transferred, but all students must still meet the "core course" requirement through courses completed at Stanford.

**Senior Honors Program in Psychology**

A Senior Honors Program is designed for those exceptionally able students who wish, in their major, to pursue an intensive and somewhat independent study of psychology, and to engage in psychological research. Admission to the Program will be made at the end of the student's junior year on the basis of academic performance and demonstrated desire to do research. The Program is directed toward the integrating of a substantial body of theoretical and factual information, and the development of creative scholarly skills, by independent study, small seminars, and extended research experience. Particular emphasis is laid on the planning of an individual program for the student that will combine his specialized interests with the body of basic general psychology essential for all students who are undertaking concentrated study in the field. The Program includes arrangements for continuous supervised research activity during the student's senior year. At the end of the year, the student will submit a written report of his or her research as a thesis.

**Advanced Degrees**

There are no specific course requirements for admission to the doctoral program. However, an applicant should have research experience as an undergraduate, as well as the equivalent of an undergraduate major in psychology. The major focus of the doctoral program is on research training, and admission is highly selective. The department would like to increase the proportion of women in the graduate doctoral program, particularly in the areas of cognitive, mathematical and physiological psychology and urges qualified women to apply.

Applicants for admission must file a report of their scores (aptitude and advanced psychology) on the Graduate Record Examination as part of the application. This examination may be taken at most universities and colleges (see your registrar for further information.)

Except for students also enrolled in the School of Medicine or the Graduate School of Business, no student will be accepted who does not plan to continue through to the doctorate. The taking of a degree of Master of Arts is optional. A Stanford graduate is ordinarily not accepted for an advanced degree in the Department unless he or she is also registered in the School of Medicine or the Graduate School of Business.

**Master of Arts**

For the degree of Master of Arts, at least 27 units in psychology beyond the equivalent of an undergraduate major are required as well as sufficient additional units outside of psychology to make up a program totaling 45 or more units. In partial fulfillment of this unit requirement Psychology 151 must be elected as well as two other courses from the content areas, one to be selected from 208, 209, 210, 214, and 215, and one to be selected from 211, 212, 213, and 254. The student is normally expected to spend one-half of his or her time in research and must present a thesis based on a portion of that research. The student will normally take no more than 9 units of course work each quarter.

**Doctor of Philosophy**

In addition to fulfilling the residence requirement for the degree, the following requirements are stipulated:

1. The course requirements mentioned above in connection with the Master's degree and also 152 and 207 must be completed by all candidates for the doctorate. These requirements should normally be met by all graduate students during their first year of graduate work. If a student already has a Master's degree in psychology from another institution, he or she must present evidence of competence in these course-areas during his first year at Stanford. This may be done either by examination or by taking the courses.

2. It is expected that the student will spend at least one-half of the time in research from the beginning of the first year of graduate study to the completion of the Ph.D. At the end of the first year of graduate study, the student must file with the Department a written report of his or her first-year research activities.

3. In addition to the course requirements above, the student must show competence in three additional content areas. This re-
requirement normally should be completed during the second year of graduate study and may be met either by taking the appropriate courses (at least one to be selected from 208, 209, 210, 214, and 215, and at least one to be selected from 211, 212, 213, and 254) or by special examination in these areas. Further course work prior to the admission to doctoral candidacy is to be arranged under the guidance of the student's adviser.

4. The candidate shall either complete a University minor, satisfactory to the minor department, or may elect to have the minor waived by selecting 12 approved units outside the Department.

5. The candidate shall select a dissertation reading committee satisfactory to the Department. The minimum membership of this committee is to be: (1) the principal dissertation adviser; (2) a second member from within the Department; and (3) a third member chosen from either Psychology or another department.

6. The candidate shall pass the University Oral Examination which will cover the relevant literature to his or her doctoral research and a defense of the dissertation proposal.

7. The candidate shall complete a dissertation satisfactory to the Dissertation Reading Committee.

Ph.D. candidacy expires five years after admission to candidacy by the University Committee on Graduate Studies. Reapplication will require Departmental reexamination.

Fellowships, Scholarships, and Assistantships

In past years, the Department has provided four years of support to all students who make reasonable progress toward the Ph.D., and we have every hope of continuing this policy. Research and teaching assistantships, United States Public Health Service traineeships, and some University Fellowships are available. The type of support offered may vary from year to year. The Department, of course, depends on the fact that a number of its students receive outside awards. Qualified applicants are asked to take the initiative in applying for predoctoral fellowships from the National Science Foun-
The Psychology Colloquium meets on most Wednesday afternoons at 3:45. Topics of current interest are presented by speakers from Stanford and from other institutions. Graduate students are expected to attend.

### SUMMER SESSION

The courses announced for the Summer Session are those regularly scheduled in the Department curriculum. Additional courses may be announced in the Summer Session Bulletin, to be issued in February, 1976.

### COURSES OPEN TO ALL STUDENTS

Additional courses not listed here are frequently offered in the areas of their special research competence by selected postdoctoral or terminal Ph.D. personnel. These are listed in the quarterly time schedules, and the course descriptions are circulated in advance.

1. **General Psychology**—A survey of the major topics, theories, and research results of contemporary psychology. Personality development, motivation and emotional adjustment, social behavior, learning, perception, and the physiological basis of behavior are among the topics presented.

   - **4 units, Aut (D. Bem) MWF 10**
   - **Win (Zimbardo) TThF 2:15-3:30**
   - **Spr (Fraser) MWF 11**

1A. General Psychology Discussion Section

   - Optional supplement to Psychology 1. Small discussion groups led by graduate teaching assistants. Prerequisite: concurrent enrollment in 1.

   - **1 unit, Aut/Win/Spr (Staff) by arrangement**

60. **Statistical Methods**—To acquaint the student with the elements of statistical description (measures of average, variation, correlation, etc.) and, more importantly, to develop an understanding of statistical inference. Emphasis is placed on those statistical methods of principal relevance to psychology and related social sciences.

   - **5 units, Aut (Horowitz) MTWThF 9**
   - **Win (Thomas) MTWThF 9**
   - **Spr (Wescourt) MTWThF 9**

102. **Perception**—A survey of the traditional topics in visual and auditory perception. The course deals with the psychological aspects of brightness and color vision, the perception of objects, space, and movement, and briefly with the effects of attention and set. Similar topics are discussed in the area of audition. Prerequisites: 1 and 60.

   - **3 units, Win (Lawrence) MWF 2:15**

102A. Perception Laboratory — Optional supplement to 102. Laboratory demonstrations and experiments on varied topics of visual and auditory perception. Prerequisite: concurrent enrollment in 102.

   - **2 units, Win (Lawrence) by arrangement**

103. **Learning and Performance**—The course deals primarily with instrumental and classical conditioning and the attempts to build comprehensive theories of learning on the data from these experimental paradigms. Prerequisites: 1 and 60.

   - **3 units, Spr (Lawrence) MWF 2:15**

103A. Learning and Performance Laboratory—Optional supplement to 103. Laboratory demonstrations and experiments. Prerequisite: concurrent enrollment in 103.

   - **2 units, Spr (Lawrence) by arrangement**

104. **Special Laboratory Projects**—Independent study. Offered for pass / no credit,
110. Perception and Cognition—An introduction to the scientific study of the cognitive processes that underlie our perception of physically present objects and events and, also, our representation, in imagery and thought, of objects and events that are not physically present. Currently central experimental methods and findings providing information about such cognitive processes will be concretely illustrated by means of classroom experiments and demonstrations. Prerequisites: Psychology 1 or equivalent.

3 units, Aut (Shepard) TTh 1:00-2:05

111. Developmental Psychology—Child development from birth through middle childhood. A broad introduction to the nature of change during childhood to the theories of development. No prerequisites, but Psychology 1 recommended.

3 to 5 units, Aut (Maccoby, Markman) MWF 11; sections by arrangement

113. Adolescent Development—This course focuses on the cognitive and personality development that takes place during adolescence. Prerequisite: 111 or equivalent.

4 units, Aut (Feldman) TTh 11:00-1:00

114. Exceptional Children—The study of children who deviate markedly in respect to mental, emotional, or social development.

4 units, Spr (Owen) TTh 4:15-5:05

115. Social Development—The study of socialization and the development of interpersonal relationships. Topics to include cooperation and competition, conscience and conduct, social expectations and behavior. Prerequisite: 111 or equivalent.

4 units, Aut (Lepper) MWF

116. Middle Childhood—This course focuses on the cognitive, personality, and social development of children between the ages of five and eleven. Prerequisite: 111 or equivalent.

3 units, Aut (Feldman) MWF

117. Observation of Children—Enrollment limited to 16. Prerequisites: 111 or equivalent, and consent of instructor.

3 to 5 units, Aut, Spr (Staff) Th 2:15-4:05 and by arrangement

118. Nursery School Practice—Supervised experience with the nursery school child. Prerequisites: 111, 117, and consent of instructor.

4 units, Aut, Spr (Staff) T 2:15-4:05 and by arrangement

121. Social Psychology—The study of interpersonal behavior. A survey of relevant research concerning attitudes, groups, person perception, and selected topics in social psychology. Prerequisite: 1 or equivalent.

4 units, Win (D. Bern) MWF 11

122. Selected Topics in Social Psychology—Designed to deal with a selection of topics
not typically covered in Psychology 121, including social psychological research on personality differences, societal ideologies, and the social psychology of psychology. Prerequisites: Psychology 1 or equivalent.

3–4 units, Spr (D. Bem) TTh 3:15–4:45
given 1976–77

127. Selected Problems in Personality and Social Psychology—Lectures will deal with current problems and research in contemporary personality and social psychology which can fruitfully be approached through attribution, self perception, and other “cognitive” approaches. Discussion sections will concern themselves with the role of self perception in existential and humanistic psychology. Prerequisites: 1, and one course in either social psychology or personality.

4 units, Aut (Ross) TTh 2:15–4:05 and by arrangement

132. Theories of Personality—An introduction to psychodynamic, humanistic, and social learning approaches to understanding the maintenance and modification of personality. The course will examine naturalistic and artificially induced changes in personality and behavior throughout the life cycle. Topics will include normal and abnormal development, education, and psychotherapy. Recommended: 1 or equivalent.

3 to 4 units, Spr (H. Mischel) TTh 10:30–12:00

134. Personality and Assessment—Theories and findings regarding the psychological causes, assessment, and modification of personality. Focuses on major approaches and findings in the analysis and modification of complex normal and deviant human behavior. Prerequisite: 1 and 60, or equivalents, and at least junior standing.

3 units, Spr (W. Mischel) W 2:15–5:00

136. Abnormal Psychology—Genetic, psychodynamic, behavioral and social psychological aspects of positive and negative abnormalities. Approaches to behavior change, including drugs, institutionalization, psychotherapy and behavior modification. Prerequisites: 1 or equivalent, and at least junior standing.

4 units, Win (Yalom) MWF 10


3 units, Spr (Staff) Th 3:15–5:05
and by arrangement

141. History of Psychology—This course will explore the development of psychological theory from an historical perspective. Major systematic positions such as structuralism, Gestalt theory, behaviorism and psychoanalysis will be discussed in some detail. The historical roots of major contemporary positions will be explored. Prerequisites: students should usually have taken 3 courses in Psychology.

4 units, Spr (Hastorf) TTh 11–12:15

143. Experimental Psychology of Reading—(Same as Education 389.) Review of research literature on the reading process, and acquisition of reading. Emphasis on critical evaluation of process research, and on interaction of psychological, linguistic, and educational aspects of reading. Prerequisite: consent of the instructor.

3–4 units, Spr (Calfee, Smith) MWF 9
and by arrangement

145. Psychological Foundations of Education—(Same as Education 215.) Introductory course in application of psychological principles to educational practices. The spring quarter offering is planned especially for teachers in training. Prerequisite: 1 or equivalent.

4 units, Aut (Cronbach) TTh 3:15–4:30, W 3:15–4:05
Spr (Gage) TTh 4:15–6:05
Sum (Staff) MTWTh 10 and by arrangement

146. Language and Thought—Surveys current topics of interest in language and thought, including language acquisition by children, language comprehension and production, phonological perception, biological bases of language, meaning, linguistic relativity, bilingualism, and aphasia. These topics will be treated from a cognitive point of view and will be related to other cognitive processes such as perception and reasoning. Prerequisite: 1 or equivalent.

4 units, Aut (Stillings) MWF 1:15

147. Animal Behavior: Neurobiological Aspects—(Same as Biology 164.) Ethological viewpoints of behavior will be presented, with an emphasis on understanding their physiological substrates. Prerequisites: Psy-
148. Chemical Mechanisms of Behavior — 
This course describes the mechanisms of chemical transmission in the brain and the role of neurotransmitters in regulating behavior. The mode of action of psychoactive drugs is studied in relation to these transmitters. Both neurochemistry and neuropharmacology are employed as tools to reach a better understanding of such phenomena as arousal, mood swings, addiction, aggression and affective disorders. Prerequisites: Psychology 1 and 107 or consent of the instructor.

4 units, Win (Wine) TTh 9:00-10:30

151. Statistical Methodology — Prerequisite: 60 or equivalent.

3 to 4 units, Win (Horowitz) MTWThF 9

152. Analysis of Data — Prerequisite: 151 or consent of instructor.

3 to 4 units, Spr (Kraemer) MWThF 9

154. Seminar: Computer Models of Social Behavior — (Same as Computer Science 127, Education 218, Political Science 190M, Sociology 273.) Models of human behavior in social situations. Particular attention is given to specifying simulation models, determining their properties, and testing them. Enrollment is limited to 20. Prerequisites: knowledge of at least one programming language, advanced courses in social science, consent of instructors.

4 units, Win (Feigenbaum, March) M 3:15-5:05, alternate years, given 1975-76

155. Human Abilities — (Same as Education 255.) The nature, development, and measurement of intellectual abilities. Prerequisites: Psychology 1 and Education 250 or Psychology 60.

3 units, Spr (Snow) MWF 10

157. Sleep and Dreams — A survey of current knowledge in the area of sleep, dreams and sleep pathologies. Physiology of REM sleep versus NREM sleep, circadian rhythms, developmental and phylogenetic aspects, the insomnias, the hypersomnias, sleep walking, sleep talking, night terrors, sleeping pills, dream content and psychophysiological correlation. Course will only touch on dream interpretation. No prerequisite.

3 units, Win (Dement) TTh 11

157A. Sleep and Dreams Discussion Sections — Optional supplement to Sleep and Dreams. Prerequisite: concurrent enrollment in 157.

1 unit, Win (Staff) by arrangement

163. Mathematical Psychology— (See 215.)

164. Mathematical Representation of Structures in Psychological Data— (See 218.)

166. Mathematical Theories of Perception and Psychophysics— (See 222.)

4 units, Win (Sakitt) WF 1:15-2:45

170. Hypnotic Phenomena — Demonstrations, lectures, readings, and discussions on hypnosis, with emphasis on experimental studies. Limited to graduate students in psychology and graduate students in other fields by special consent, and to senior majors in psychology.

3 units, Aut (Morgan) TTh 2:15-3:45

175. Word Brain: Picture Brain — In cognitive processing the brain makes use of at least two different systems; verbal activity mainly occurs in the left brain, while pictorial processing occurs normally in the right brain. The course will concentrate mainly on the evidence of lateralization in visual fields, and on the relationship between memory, coding and retrieval, with an attempt to bring together brain research and cognitive behavioral studies. The development of handedness, and cerebral dominance in relation to sex differences during the first decade of life will be considered. The course will cover the effects of brain damage on thinking about written or spoken words, pictures and maps, as well as music and touch patterns. Prerequisite: Consent of the instructor.

3 units, Aut (Mackworth) M 2:15-4:05

176. The Cognitive Processes in Reading — This seminar will review experimental and theoretical research dealing with the reading process. Primary emphasis will be on providing a general theory within which to view the reading process and within this theoretical framework to consider reading difficulties and optimal methods of instruction. Prerequisite: consent of instructor.

3 units, Win (Mackworth) M 2:15-4:05
177. Pictorial Thinking—The difference between visual images of the external world and creative visual imagination, which can picture future events, will be discussed in relation to perceptual development in children, and the creation of inventions by adults. Pictorial processing will also be considered in relation to the unusual processing exhibited by adults and children with impaired language ability. Faulty categorization and poor formation of internal models may well be found. Demonstration of the general points will be by a series of colored slides which will also provide some group experiments in which the class will participate.

3 units, Spr (Mackworth) M 2:15-4:05

180. Undergraduate Seminar: Selected Topics in Psychology—(Refer to quarterly time schedules for seminar listings.)

182. Senior Honors Seminar — Limited to students in the Senior Honors Program. Can be repeated for credit.

4 units, Aut, Win, Spr (Staff) by arrangement

184A. Individual Participation and Study in Paraprofessional Programs — Four programs within the broadly defined area of Community Mental Health will utilize a limited number of Stanford volunteers. Each program provides training sessions and academic credit for participants.

Two programs involve work with young children. At the Zonta Children’s Center in San Jose, students will begin behavior modification techniques while working with schizophrenic and autistic children at the center. At the Children’s Health Council volunteers will be assigned responsibility for one child with emotional behavior problems and will work within a family setting, serving as a combined “big brother or sister,” counselor, tutor, therapist and friend. Volunteers at the Veterans Administration Hospital work with middle-aged male outpatients. The program uses classroom instruction and a “community outreach” project to assist the mental patients in acquiring the skills and confidence required for social interaction. Awaht High School also uses a number of Stanford undergraduates to serve as “Environmental Counselors” to help adolescents with emotional and academic problems. (Note: “Share” volunteers may also receive credit for Psychology 184.)

These programs demand a heavy commitment in terms of time and energy (8 to 12 hours per week) but offer an unusual opportunity for mature, responsible and dedicated individuals. They are particularly recommended for students who anticipate careers in counseling, clinical, community, or educational psychology. Prerequisite: students must be prepared to take this course for two consecutive quarters.

3 to 5 units, Aut (Ross) by arrangement

184B. Individual Participation and Study in Paraprofessional Programs — (Same as 184A.)

3 to 5 units, Win (Ross) by arrangement

184C. Individual Participation and Study in Paraprofessional Programs — (Same as 184A and 184B.)

3 to 5 units, Spr (Ross) by arrangement

188. Reading and Special Work — Independent study. Offered for pass/no credit, except on special arrangement with instructor. Can be repeated for credit. Prerequisite: consent of instructor.

1 to 3 units, any quarter (Staff) by arrangement

189. Endocrines and Behavior—This course focuses on the influences of hormones on behavior. In particular, reproduction and reproductive behavior, nocturnal behavior, courtship and aggression will be discussed in terms of gonadal hormonal influences. Further, the influences of the pituitary-adrenal system on sensory processes, learning and memory will also be discussed. The neuroendocrine control of hormonal systems will be covered.

5 units, Spr (Levine) MWF 8 alternate years, given 1975-76

190A. Early Experience—This course focuses on the experimental literature related to the effects of pre- and postnatal environmental factors on development and adult function. The material covers both animal and human research and deals with behavioral and physiological function.

5 units, Spr (Levine) MWF 8 alternate years, given 1976-77

190C. Special Topics in Sleep Research—This intensive undergraduate seminar is designed to allow students to cover, in great detail, selected areas of sleep research. Students will read journal articles dealing with
a topic of their own choice and report in weekly class discussions. A fundamental background in chemistry, physiology, physiological psychology or biology is recommended. Prerequisites: Psychology 157 and permission of instructor.

3 units, Spr (Miller) by arrangement

191. Undergraduate Seminar: Behavior Change — Application of social learning principles to the modification of prosocial and deviant behavior. Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Win (Bandura) MW 10

192. Undergraduate Seminar: Aggression — Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Spr (Bandura) M 2:15–4:05

194B. Undergraduate Seminar: Moral Development — Prerequisite: consent of instructor.

3 units, Spr (Lepper) by arrangement

195. Undergraduate Seminar: Personality — Open to both non-majors and majors in psychology. Prerequisite: consent of instructor.

3 units, Win (H. Mischel) by arrangement

196. Human Relations in the Nursery School — The course will explore the many ways in which children, teachers, parents and other adults affect the behavior and learning of the preschool child. Observations of adult-child and child-child interactions in a variety of naturalistic settings and role-playing sessions in class will provide the focus. Prerequisites: 117 and 118 and consent of instructor.

3 to 4 units, Spr (B. Shepard) Th 1:15–4:00

198. Undergraduate Seminar: Experimental Studies of Selective Perception — Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Aut (Lawrence) T 2:15–4:05

Courses Primarily for Graduate Students

Undergraduate students may be admitted only by consent of instructor.

207. Contemporary Viewpoints in Psychology — A survey of major issues in contemporary psychology with their historical back-grounds. Required of and limited to first-year graduate students in psychology.

3 units, Aut (Hilgard) MWF 11–12

208. Physiological Psychology — Advanced physiological psychology focusing on the neural mechanisms operative in the control and modification of behavior. Prerequisite: 108 or equivalent, or consent of instructor.

3 units, Win (Ganz, Pibram, Wine) MW 10–12

209. Perception — Advanced treatment of visual perception. Prerequisite: graduate standing in Psychology or consent of instructor.

3 units, Aut (Ganz) TTh 9:00–10:30

210. Memory and Learning — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (Smith) TTh 11:00–12:30

211. Developmental Psychology — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Win (Maccoby, Markman) MW 10–12

212. Social Psychology — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Win (Lepper) TTh 1:15–3:05

213. Personality — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (W. Mischel) W 2:15–5:00

214. Psycholinguistics — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Spr (Clifton) TTh 2:30–3:45

215. Mathematical Psychology — A survey of mathematical theories of choice behavior, decision-making, psychophysical judgments, utility and motivation, learning, memory, and concept formation. Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Spr (Thomas) MW 11

216. Graduate Seminar: Issues in Psychopathology — This seminar will examine selected literature on psychopathology. It will critically explore the theoretical ideas and examine attempts to objectify the concepts empirically from cognitive, behavioral, and
motivational standpoints. Prerequisites: Psychology 151 and 152.

3 units, Aut (Horowitz and Rosenhan) by arrangement

218. Mathematical Representation of Structures in Psychological Data—Theory and methods of multidimensional scaling, hierarchical clustering, and related methods for discovering and representing structures underlying matrices of psychological data (with particular attention to data from experiments on perception and cognition). Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (Shepard) MW 2:15-4:00

222. Mathematical Theories of Perception and Psychophysics—Mathematical theories of perception and psychophysics including signal detection theory, Fourier analysis and its applications in perception, information theory and other topics. Prerequisite: Psychology 1 and some calculus.

4 units, Win (Sakitt) WF 1:15-2:45

224. Models of Thought Processes—(Same as Computer Science 224.) Introductory survey of concepts and problems in artificial intelligence research; heuristic processes in problem solving, and heuristic programming; information processing models as explanations of human cognitive and affective behavior. Prerequisite: Computer Science 105 or 106, or equivalent.

2 units, Spr (Green) TTh 1:15-2:30

228. Seminar in Animal Communication—(Same as Hearing and Speech Sciences 281 and Biological Sciences 200.) A general survey of the communicative aspects of social behavior of animals, including man. Emphasis will be placed on diversity of signal systems and the contrasts between these systems and human linguistic behavior. Prerequisite: consent of instructor.

3-4 units, Win (Dewson) by arrangement


4 units, Aut (Dewson) by arrangement

230. Seminar in Neural Substrates of Human Communication—(Same as Hearing and Speech Sciences 390.) Prerequisite: consent of instructor.

3-4 units, Spr (Dewson) by arrangement

231. The Auditory Process—(Same as Hearing and Speech Sciences 292.) A systematic survey of our current knowledge of the operation of the auditory system. Emphasis is placed on acquiring a knowledge of the acoustic signal, and on an understanding of the methods of measuring a sensory process. Prerequisite: consent of instructor.

3 units, Aut (Schubert) by arrangement

232. Selected Topics in Psychoacoustics—(Same as Hearing and Speech Sciences 392.) A detailed study of the normal auditory mechanisms with particular emphasis on the use of psychoacoustic methods of analysis. Evaluation of current theories regarding auditory processing of information. Prerequisite: consent of instructor.

3 units, Win (Schubert) by arrangement

233. Peripheral Auditory Mechanisms—(Same as Hearing and Speech Sciences 393.) Study of the mechanisms and electrophysiology of the middle and inner ear. Analysis of the ear as a transducer and of the neural encoding process. Prerequisite: consent of instructor.

3 units, Spr (Schubert) by arrangement

238. Graduate Seminar: The Development of Social Cognition—Discussion of the research literature on the development of role taking, non-verbal communication, and moral behavior.

3 units, Win (Irwin) by arrangement

240. Child Language I—(Same as Linguistics 260.) Review of present knowledge of processes of language acquisition from a linguistic point of view. Survey of recent and past literature. Prerequisites: Linguistics 100 or 230, or consent of instructor.

4 units, Aut (E. Clark) TTh 10:00-11:30 given 1976-77

241. Child Language II—(Same as Linguistics 261.) Variable topics selected from semantics, syntax, or phonology. Topic for 1974-75: Language input to children and the acquisition of speech registers.

4 units, Win (E. Clark) by arrangement given 1976-77

243. Issues in Early Childhood Education—(Same as Education 244.) The course is
designed for graduate students interested in the education and development of the child during the first eight years of life. Philosophies and practices of various current early childhood programs will be reviewed in social, psychological and historical perspective. Such topics as: environments for early learning; teacher-child relationships; the role of curriculum in early childhood development; the effects of federal, state and local legislation on early school programs; the involvement of parents in the education of their children; will be explored as well as behavior change; school grouping; early reading; staffing, budgets, in-service teacher education.

3 units, Win (Staff) by arrangement

245. Socialization of the Young in Contemporary Society—(Same as Education 311A, B.) Students in this course will examine the role of the family, public school, preschool, and day care in socializing young children. Particular attention will be given to the processes through which institutions and social structures of the society affect individual behavior. Topics will include: discontinuities and continuities in socialization, diffuse socialization through mass media, variations by social class and ethnic groups in the U.S., national differences (Britain, China, Russia, Israel, Cuba, etc.) which illustrate relationships between socialization and political ideology.

3 units, Win, Spr (Hess) TTh 9 and by arrangement

248. Introduction to Test Theory—(Same as Education 252.) Concepts of reliability and validity; mathematical models underlying commonly used procedures for test analysis. Test scales and norms. Prerequisites: Education 250 or Psych. 60 or equivalent.

3 to 4 units, Aut (Snow) MW 2:15-4:05

249. Problems in Measurement — (Same as Education 353.) Survey of alternative mathematical models used in test construction and analysis covering such topics as generalizability theory, measurement of gains, theory of personnel decisions. Prerequisites: 152 and 248, or Education 250B and 252, or equivalent.

3 to 4 units, Sum (Cronbach) MW 2:15-4:05; alternate years, given 1975-76

251. Methodology in Social Science — Issues, approaches, and technical problems in field research, survey analyses, and experimental analyses in social science. Selected statistical techniques for assessment of behavioral and social data. Prerequisite: consent of instructor.

3 units, Aut (Thomas) MW 1:15-3:05

254. Principles of Personality Change—Prerequisite: graduate standing in psychology or consent of the instructor.

3 units, Aut (Bandura) M 2:15-4:05

255. Graduate Seminar: Social Learning—Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (Bandura) M 2:15-4:05

256. Graduate Seminar: Research in Special Topics of Social Psychology—This advanced graduate seminar will focus on theory and methodology involved in increasing our understanding of several topics of particular interest to the instructor, specifically: The social and cognitive processes involved in generating states labeled “mad”; the temporal control of affect, thought and action, the disinhibition of anti-social responding, and the utilization of social psychological knowledge to improve the quality of life. Prerequisites: Consent of the instructor.

3 units, Spr (Zimbardo) T 2-5

257. Individually Supervised Practicum — Can be repeated for credit. Prerequisites: graduate standing in psychology and consent of instructor.

3 to 5 units, Aut, Win, Spr (Staff) by arrangement

257A. Practicum in Teaching—Enrollment limited to students serving as teaching assistants in selected psychology courses. Can be repeated for credit.

3 to 5 units, Aut, Win, Spr (Staff) by arrangement

258. Graduate Seminar: Seminar in Visual Perception—Prerequisite: Consent of the instructor.

3–5 units, Aut (Sakitt) by arrangement

262. Graduate Seminar: Seminar in Visual Perception—Prerequisite: Consent of the instructor.

3 units, Aut, Win, Spr (Staff) by arrangement

264. Graduate Seminar: Topics in Human Learning—Prerequisite: consent of instructor.

3 units, Win (Bower) T 1:15-3:05

269. Graduate Seminar: Personality—Prerequisite: consent of instructor.

3 units, Win (W. Mischel) by arrangement
RELIGIOUS STUDIES

Chairman: William A. Clebsch

Professors: Robert M. Brown, William A. Clebsch (Religious Studies and Humanities), Edwin M. Good, David S. Nivison (Chinese and Philosophy and, by courtesy, Religious Studies), Lewis W. Spitz (History and, by courtesy, Religious Studies)

Associate Professors: Lawrence V. Berman, Lee H. Yearley

Assistant Professors: Winston B. Davis, Henry S. Levinson, Diana M. Paul

Lecturers: Robert G. Hamerton-Kelly, Wilhelm Pauck

OFFERINGS AND FACILITIES

As one of the humanities, the study of religion aims to understand works of religious literature, historical developments of religious tradition and practice, modes of religious thought, and varieties of world views in and among religions.

BACHELOR OF ARTS

The following Departmental requirements are in addition to the University's basic requirements for the Bachelor's degree:

1. At least two courses on particular religious traditions (111–129).
2. At least two courses on interactions of religions with particular cultures (131–149).
3. At least two courses on religious thinkers or schools of thought (151–189).
4. At least three advanced courses with prerequisites (211–299) one of which must be 217A, 217B, or 217C.
5. At least 12 units in cognate courses in other departments from an approved list; for example:
   Anthropology 243. Primitive Religion.
   Asian Languages 143. The Philosophy of Wang Yang-ming.
   Classics 163. Comparative Mythology: Topics from Greek and Roman, Near Eastern and African Culture.
   History 110. Age of the Reformation.
   Humanities 196. Religious Studies and the Humanities.

The Bachelor's degree with honors in Religious Studies may be earned by students...
who are recommended by their advisers and who meet additional requirements.

**Doctor of Philosophy in Religious Studies**

University regulations regarding this degree are found in the section "Degrees" in this Bulletin. The following requirements, dealing with residence, fields, courses, examinations, languages, and the dissertation are in addition to the University basic requirements for the Ph.D.

**Residence:** For the Ph.D. degree each student must complete three years (nine quarters) of full-time work, or their equivalent, in graduate study beyond the Bachelor of Arts degree. He or she will be expected to offer at least 90 units of graduate work in addition to the dissertation, of which at least the last 60 units must be taken at Stanford.

**Fields of Study:** The fields of East Asian Religions, Near Eastern Religions, Modern Religious Thought, and American Religions are approved and guidelines are established for each of them. Students may propose for approval any other substantial field of study in which there is a coherence of strengths in the faculty in Religious Studies and other faculty in the University.

**Courses:** Each student takes courses subject to approval of a faculty member designated as the adviser. During the first two years, graduate students often register for undergraduate courses and do advanced work in the topic under the instructor's guidance. The four required seminars must be completed satisfactorily before the candidacy essay is written.

**Candidacy Essays:** Candidacy essays are written in the sixth quarter of graduate study. These essays demonstrate students' ability to apply to their fields of concentration the interpretations of religious texts, the histories of religious movements, the systems of religious thought, and the comparisons of religious traditions. After the candidacy essay has been judged satisfactory, the student applies to qualify for the Ph.D. degree.

The University oral examination is normally taken in the spring quarter of the third year.

**Teaching internships:** At least two teaching internships under close supervision by faculty members are required during the third year, after the student has qualified for candidacy for the Ph.D. Students receive academic credit for the required internships, which are projects of academic training and not of employment.

**Language requirements:** Each student seeking the Ph.D. degree must demonstrate by examination a reading knowledge of two modern foreign languages, including French or German, before beginning the second full year of graduate work at Stanford. Before writing candidacy essays, students must demonstrate reading knowledge of other ancient or modern languages if relevant to the field of concentration. Knowledge of additional languages may be required for certain areas of dissertation research.

**Supporting programs:** A coherent and substantial supporting program shall be taken in advanced and graduate courses in other departments of the University.

**Dissertation:** During the University oral examination, the student engages in a colloquium on the proposed dissertation topic, demonstrating readiness to proceed with the dissertation. The dissertation must contribute to the humanistic study of religion and be written in acceptable English style. The dissertation is written under the direction of the candidate's adviser and at least two other members of the faculty, at least one of whom shall be a member of another department.

**Joint Ph.D. in Religious Studies and Humanities**

Religious Studies participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Religious Studies and Humanities. For a description of that program see the section on "Humanities Special Programs" in this bulletin.

**Courses General**

17. Comparative Religion — Comparative approaches to various religions in their social, personal, and intellectual dimensions. Designed as series but may be taken individually.

A. Varieties of Religious Community.
   3 units, Win (Davis) MWF 10

B. Varieties of Religious Personality.
   3 units, Aut (Clebsch) MWF 9

C. Varieties of Religious Thought.
   3 units, Spr (Yearley) MWF 11
21A. Jesus in the Gospels—Varying interpretations of Jesus and his teaching.
3 to 5 units, Aut (Hamerton-Kelly)
TWTh 11

21B. Theology of Paul — The religious thought of Paul within its cultural and historical context.
3 to 5 units (Hamerton-Kelly) given 1976–77

34. The Role of Women in Buddhism.
3 units, Aut (Paul) MWF 1:15

42. Philosophy of Religion — Traditional and contemporary issues in the philosophy of religion including religious epistemology, religious experience and the problem of evil.
3 units, Spr (Levinson) MWF 1:15

47. Christian Ethics.
3 to 5 units (Staff) given 1976–77

61. Old Testament—Styles of varying parts, ideas, cultural and religious settings.
3 units, Spr (Good) MWF 9

69A,B. Hebrew—Introduction to classical Hebrew language.
5 units (Good) given 1976–77

71. The Christian Story: Theology as Narrative—Christian faith as expressed through story: myth, biography, autobiography, historical narrative, folk tale, novel, etc., as ways to approach more formal and systematic statements.
3 to 5 units, Win (Brown) MTWTh 9

73. Liberation Theology—Third World theologians, black theology, women’s liberation, etc., stressing the relation of liberation to social and political revolutionary movements, consideration of the problem of violence.
3 to 5 units, Spr (Brown) MTWTh 10

74. Patterns of Secularization—(Same as VTS 174.) Cross-cultural study of the transition from traditional, religiously-oriented civilization to modern, secular society. (See detailed description under VTS 174.)
3 units, Win (Davis) MWF 1:15

RELIGIOUS TRADITIONS

113. Hinduism.
3 to 5 units, Aut (Paul) MWF 10

114. Buddhism—Thought and practice; selected scriptures.
3 to 5 units, Spr (Paul) MW 2:15–4:05

115. Confucianism and Taoism — Writings from the classic period: Confucius, Mencius, the Tao Te Ching, and others.
3 to 5 units, Win (Yearley) MWF 11

117. Shinto—Study of the indigenous religious traditions of Japan.
3 to 5 units (Davis) given 1976–77

123. Judaism—Talmudic and post-Talmudic Jewish thought: Midrash, Mishnah, and Talmud; codification of the law; Karaism; theology and philosophy; Kabbalah and Hasidism.
3 to 5 units, Win (Berman) TTh 2:15–4:05

3 to 5 units, Spr (Clebsch) MWF 9

127. Islam—Analysis of the Koran; traditional literature; basic concepts of law; sects; theology and philosophy; mysticism.
3 to 5 units, Aut (Berman) TTh 2:15–4:05

RELIGIONS AND CULTURES

5 units (Good) given 1976–77

3 to 5 units, Spr (Paul) MWF 10

137. Religion in Japan—Religious life in Japan: Shinto, Buddhist sects, Confucian schools; religious outlook of the folk, court, and the learned.
3 to 5 units, Aut (Davis) MWF 11

140. Age of the Reformation—(Same as History 110.)
5 units, Win (Pauck) MTWTh 10

141. Religious Thought Since the Enlightenment—Such thinkers as Descartes, Spinoza, Locke, Hume, Kant, Schleiermacher, Hegel, Kierkegaard, James, and Marx.
3–5 units, Win (Levinson) MWF 9

142. Foundations of Modern Jewish Thought — Talmudism, Hasidism, and Enlightenment; Zionism and other secular trends.
3 to 5 units, Spr (Berman) TTh 2:15–4:05
143. Modern European Theologians—Barth, Buber, Tillich, Teilhard de Chardin, Bonhoeffer, Rahner, and Moltmann.  
5 units (Brown) given 1976–77

148. American Religious Thought — Such thinkers as Edwards, Emerson, Bushnell, James, Royce, Santayana, Rauschenbusch, and the Niebuhrs.  
3 to 5 units, Win (Levinson)  
MW 4:15–6:05

**RELIIGIOUS THINKERS**

5 units (Good) given 1976–77

163. Prophets of Israel — Hebrew prophets as poets and religious functionaries.  
5 units, Win (Good) TTh 4:15–6:05

164. Muhammad and the Koran—The life of the founder of Islam as portrayed in the Koran and the traditional literature; the Near Eastern religious background.  
3 to 5 units (Berman) given 1976–77

3 to 5 units, Win (Berman) MW 4:15–6:05

171. Augustine—The thought in its historical setting.  
5 units (Yearley) given 1977–78

172. Maimonides — Scripture and its interpretation; concept of God and universe; prophecy; the political role of the law.  
3 to 5 units, Spr (Berman) MW 4:15–6:05

173. Aquinas—The thought in its historical setting.  
5 units (Yearley) given 1976–77

177. Religious Existentialists—Kierkegaard, Bultmann, Marcel, Buber, Tillich.  
5 units, Aut (Levinson) MWF 11

179. Religious Issues in the Writings of Elie Wiesel—The problem of evil, meaningfulness, the asking of questions to which there appear to be no answers, the beginnings of affirmation.  
5 units, Spr (Brown) MW 4:15–6:05

187. Modern Protestant Theologians.  
5 units (Brown) given 1976–77

**ADVANCED COURSES**

211. Buddhist Sutras — Perfection of Wisdom and Universal Salvation Sutras. Prerequisite: consent of instructor.  
5 units, Win (Paul) TTh 2:15–4:05

215. Chinese Religious Thought—(Same as Philosophy 280.) Prerequisite: consent of instructor.  
5 units (Nivison, Yearley) given 1976–77

217. Comparative Religion—(See 17.) Prerequisite: consent of instructor.  
A. Varieties of Religious Community.  
5 units, Win (Davis) MWF 10 and Section

B. Varieties of Religious Personality.  
5 units, Aut (Clebsch) MWF 9 and Section

C. Varieties of Religious Thought.  
5 units, Spr (Yearley) MWF 11 and Section

242. Philosophy of Religion—(See 42.) Prerequisite: consent of instructor.  
5 units, Spr (Levinson) MWF 1:15 and Section

261. Old Testament Poetry — The use of poetry as a vehicle for religious thought and expression; styles and techniques in representative poems. Prerequisite: consent of instructor.  
5 units (Good) given 1976–77

272. The Christian Story: Theology as System—Transformation of narrative into doctrinal form. Prerequisite: consent of instructor.  
5 units (Brown) given 1976–77

5 units (Staff) given 1976–77

276. Topics in Religious Thought—Prerequisite: consent of instructor.  
5 units (Staff) given 1976–77

277. The Sacred and the Social. Methodology of the relation between religious life and socio-cultural differentiation. Topic for
1975–76: Spencer, Durkheim, Marx, Tonnies, Weber, Bellah, Parsons, Redfield, Berger, and Luckmann. Prerequisite: one course in Religious Studies or Social Science, or consent of instructor.

5 units, Aut (Davis) TTh 4:15–6:05

278. Problems in Religious Thought.
5 units (Yearley) given 1976–77

299. Individual Work.
(Staff) by arrangement

GRADUATE COURSES

All courses numbered in the 100's and 200's may be taken at the graduate level. Graduate seminars are offered regularly, graduate research and teaching by arrangement.

301. Interpretations of Religious Texts — Required of all graduate students in Religious Studies; may be repeated for credit. Prerequisite: consent of instructor.

4 units (Staff) given 1976–77

303. Histories of Religious Movements — Required of all graduate students in Religious Studies; may be repeated for credit. Topic for 1975–76: the figure of Moses in Western religion; images, conceptions, continuities and discontinuities. Prerequisite: consent of instructor.

4 units, Aut (Good) MW 2:15–4:05

305. Systems of Religious Thought — Required of all graduate students in Religious Studies; may be repeated for credit. Prerequisite: consent of instructor.

4 units (Staff) given 1976–77

307. Comparisons of Religious Traditions — Required of all graduate students in Religious Studies; may be repeated for credit. Topic for 1975–76: various methods for, and problems in, comparing religious phenomena. Prerequisite: consent of instructor.

4 units, Win (Yearley) MW 2:15–4:05

347. Humanism and the Reformation — (Same as History 319.)
5 units, Spr (Spitz) Th 2:15–4:05

GRADUATE RESEARCH AND TEACHING

319. East Asian Religions.
(Davis, Nivison, Paul, Yearley) by arrangement

(Berman, Good, Hamerton-Kelly) by arrangement

339. Medieval Western Religions.
(Berman, Pauck, Spitz, Yearley) by arrangement

349. Modern European Religions.
(Staff) by arrangement

359. American Religions.
(Brown, Clebsch, Levinson) by arrangement

(Staff) by arrangement

379. Philosophy of Religion and Theology.
(Staff) by arrangement

(Staff) by arrangement

390. Teaching in Religious Studies—Supervised internship. Limited to graduate students in Religious Studies who are certified doctoral candidates. Prerequisite: consent of instructor.

2 to 5 units, Aut, Win, Spr (Staff) by arrangement

Spr (Staff) by arrangement

(Staff) by arrangement

CENTER FOR RUSSIAN AND EAST EUROPEAN STUDIES

Committee in Charge: The Committee on Russian and East European Studies, a subcommittee of the Committee on International Studies

Chairman: Wayne S. Vucinich, Department of History

The Center for Russian and East European Studies administers a Co-Terminal A.B./A.M. Program in Russian and East European Studies. The program is established for two types of students:
1. Advanced undergraduate students who need a coherent interdisciplinary program of study to assemble the skills and credentials necessary for admission to a Ph.D. program in the Russian and East European field.

2. Those students who wish to specialize in Russian and East European Studies as preparation for careers in government, law, journalism, business, or teaching at other than the college or university level.

The degree program is administered by a Masters Committee of faculty members constituted as a subcommittee of the Committee on Russian and East European Studies. The Masters Committee reviews each student's program and advises him or her as to the distribution of courses most appropriate to his or her interests and preparation.

The basic prerequisite for admission to the Co-Terminal Program is completion of a minimum of one year's study of Russian language (First-Year Russian). Two years of the language (Second-Year Russian) or the equivalent are to be completed before the awarding of the A.M. degree.

To qualify for simultaneous awarding of the A.M. degree, the student must, in addition to completing department requirements for the A.B. degree:

1. Petition the Masters Committee for admission to the Program no earlier than the beginning of the eighth quarter of undergraduate work. The petition, to be accepted, must be approved by both the Masters Committee and the Chairman of the department in which the student is a candidate for the A.B. degree.

2. Include in the petition a schedule of the proposed program, by quarter, to its completion. The student should seek the advice of members of the Masters Committee in drafting this schedule.

3. Complete fifteen full-time quarters or the equivalent, or three quarters after completing 180 units.

4. Complete, in addition to the 180 units required for the Bachelor's degree, a minimum of 40 units for the Master's degree. These units must be distributed as follows:

   a) A minimum of five graduate courses in the program field, three of which are to be taken in at least two departments other than that of the undergraduate major.

   b) The remaining courses required to make up the 40 units may include advanced undergraduate courses and may be taken in various departments, but all are to be in the Russian or East European field.

   N.B. At some time prior to completing the A.M. unit requirements, the student should take the basic undergraduate courses in Modern Russian History, Modern Russian Literature, and Soviet and East European Politics. This course work may be applied to the units required for the A.M. only when doing so does not interfere with completion of language—or graduate course requirements. Ordinarily, a student admitted to the Program will do course work on both Soviet and East European topics. Students wishing to specialize in one or the other alone may do so, subject to the prior approval of their programs by the Masters Committee.

5. Apply for each degree at the appropriate time.

Inquiries concerning this program should be addressed to the Chairman, Center for Russian and East European Studies, 237C History Building, Stanford, California, 94305.

The Center also administers an introductory undergraduate course in Slavic Civilization. The approach is an interdisciplinary one, utilizing lecturers from the various disciplines with competence in the field and integrating readings and lectures so as to give the student an understanding of the distinct contributions made by the various Slavic peoples. The course treats the histories and cultures of Bulgaria, Czechoslovakia, Poland, Russia and Yugoslavia:

**Introduction to Slavic Bibliography.**

2 units, Aut (Zalewski)

**History/Slavic 117A: Slavic Civilization to 1700.**

5 units, Aut (Vucinich, Staff)

**History/Slavic 117B: Slavic Civilization from 1700 to 1914.**

5 units, Win (Atkinson, Staff)
SLAVIC LANGUAGES AND LITERATURES

Emeriti: Edward J. Brown, Jack A. Posin (Professors); Sarra Kliachko, Elisabeth Stenbock-Fermor (Assistant Professors); Nicholas S. Pashin (Senior Lecturer)
Chairman: Joseph A. Van Campen
Professor: Joseph A. Van Campen
Associate Professor: Lawrence L. Stahlberger
Assistant Professors: Dina B. Crockett, Richard Schupbach, William Mills Todd III
Lecturer: Wojciech Zalewski (Curator, Russian and East European Collection, Stanford Libraries)
Acting Instructor: Hasya Pekurovskaya

OFFERINGS AND FACILITIES

The Department accepts candidates for the degree of Bachelor of Arts, Master of Arts, and Doctor of Philosophy. Particular requirements for each degree are described below.

MASTER OF ARTS IN TEACHING

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. Detailed requirements for the degree are outlined in the School of Education section of this bulletin. The program includes 45 units of which 25 must be in the teaching field and 12 in education. Specific language requirements are established in consultation with the Department.

JOINT PH.D. IN SLAVIC LANGUAGES AND LITERATURES AND HUMANITIES

The Department of Slavic Languages and Literatures participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Slavic Languages and Literatures and Humanities. For a description of that program, see the section "Humanities Special Programs" in this bulletin.

PROGRAMS OF STUDY

BACHELOR OF ARTS: RUSSIAN

Candidates must have completed the first-and second-year courses in reading, composition, and conversation (or their equivalent).

1. Concentration in Literature. Candidates are expected to complete a minimum of 35 units, selected with the approval of their adviser, to include in any case courses numbered 111, 112, 113, 145, 146, 147, 148, 187, 188.

2. Concentration in Russian Language with Translators Certificate awarded by the department. Besides the basic first- and second-year sequence or its equivalent, candidates should complete a minimum of 35 units, including in any case courses numbered 111, 112, 113, 161, 162, 163, 192, 193. Students should take at least 10 additional units within one of the following groups: (a) 147, 148, 187, 188; or (b) 170ABC, or equivalent courses. The remainder of the required units are to be selected from among the following: 114, 115, 116, 145, 146, 165, 191, 195, 198. (Students who entered the Translators Program in the spring of 1974 will be permitted to fulfill the requirements listed in the 1973-74 catalogue.) In addition, candidates are required to produce a publishable translation of a Russian text of substantial length not previously translated into English. (A translation of a text previously rendered into English will be accepted only if the student can demonstrate that his translation constitutes a substantial improvement over earlier versions.)

Students not majoring in Slavic Languages and Literatures can qualify for the departmental Translators Certificate by meeting the following requirements: (1) Completing with a grade of B— or better the following courses: 111, 112, 113, 161, 162, 163, 192, 193, and (2) producing a publishable translation in accordance with the requirements outlined in the preceding paragraph.

In addition to the 35 units mentioned above, students not enrolled in the Honors program in Humanities (for a description see "Humanities Special Programs" in this bulletin) are to select with the help of their adviser a minimum of three general courses (9 units) in support of their major program.
HONORS PROGRAM IN SLAVIC

Majors with a minimum grade average of "B+" in Russian courses are eligible to participate in the department's Honors Program. Students wishing to do serious research in Russian literature are referred to section A below. Those wishing to do honors work in the Russian language should be guided by section B.

A

1. Language prerequisites: Three years of Russian, and two years of college-level study in another European language, preferably French, German, or a second Slavic language.

2. Requirements in Russian literature: Slavic 145, 146, 147, 148, 187, 188, 200 (the last to be taken during the Autumn quarter of the candidate's senior year).

3. Requirements in other literatures (minimum): Humanities 61, 62, 63, or three courses in one West European literature to be selected in consultation with the student's faculty adviser.

4. Slavic 199, Individual Work. 5 units per quarter during the Winter and Spring quarters of the candidate's senior year. To receive honors, the candidate must receive a grade of "B" or better on a thesis written during this period.

5. Strongly recommended courses in other disciplines: A course sequence in Russian History and/or Russian Intellectual History.

B

Required

1. Four years of Russian, including Slavic 111-116, 161-163, 167-169, 170A,B,C.

2. At least two additional courses within the department to be chosen from among the following: 165, 191, 194, 195, 196, 197, 198, 211, 212.

3. Slavic 199, Individual Work. 6 to 9 units during the candidate's senior year. To receive honors, the candidate must receive a grade of "B" or better on a thesis or project conducted under the close supervision of a member of the professorial staff.

Recommended

4. Strongly recommended courses in Russian literature: 145, 146, 147, 148, 187, 188.

5. Recommended courses in other departments: Communications 100, 102, 107; Computer Science 105, 106, 109 or 111; History 120A, 120B, 123A; Linguistics 010, 200, 206, 208, 215, 230, 240, 252, 253; Mathematics 1; Philosophy 57A, 181.

MASTER OF ARTS: RUSSIAN

Admission to Candidacy—The requirements for admission to candidacy are:

1. A Bachelor of Arts degree (or its equivalent) from an accredited college or university.

2. A command of the Russian language sufficient to permit the student to do satisfactory graduate work in his or her area of specialization.

3. A familiarity with Russian literature sufficient to permit the student to perform adequately in courses at the graduate level.

The applicant's previous academic training in Russian language and literature must normally serve as a tentative indication of competence. Accordingly, the Department will not ordinarily consider applications from students who have not had at least three years of college Russian and some undergraduate training in Russian literature of the 19th and 20th centuries.

However, before registering for the first quarter's work in the Department, all entering graduate students are required to take placement examinations in language and literature. Students who fail to perform satisfactorily on such examinations will be required to register for remedial courses in the area or areas in which they are deficient. Such remedial courses, which must normally be completed within the first three quarters of residence, will carry no credit toward either the A.M. or the Ph.D. degree.

Course Requirements—Candidates for the A.M. who are not also candidates for the Ph.D. should plan their course load to insure that they will be adequately prepared for the A.M. Final Examination by the end of their third quarter of work. Those who are also candidates for the Ph.D. degree with a concentration in language and linguistics should include in their first year's work any courses needed for the A.M. examination in that area. Candidates for the Ph.D. with a concentration in literature should attempt to include as many of the Department's
basic course offerings as possible in their first-year program in order to insure that they have sufficient time to complete the A.M. thesis during their fourth quarter of registration.

Candidates for the A.M. degree must complete a program of 36 units, of which 27 units must be selected from the courses given by the department. The other 9 units may, with the approval of the candidate's adviser, be selected from courses in related fields. Of the 27 units based on the department's courses, a minimum of 9 must be in language courses, a minimum of 9 must be in literature courses, and the remaining 9 may be distributed in accordance with the needs and interests of the individual student, with the advice and approval of the student's departmental adviser.

It should be noted that no credit toward the A.M. degree will be allowed for first- or second-year courses in non-Slavic languages required for the Ph.D. degree.

Final Examination — Students not enrolled in the Ph.D. program are required to take a final examination. Regardless of the area of specialization, the student will be required to demonstrate on a written examination (1) a command of the phonology, morphology, syntax, and lexicology of contemporary Standard Russian sufficient to allow him to teach beginning and intermediate courses at the college level; (2) an ability to read contemporary Standard Russian sufficient to permit him to be a reliable guide to students studying contemporary Russian poetry or literary prose; and (3) sufficient familiarity with Russian literature of either the 19th or the 20th century to handle successfully survey courses dealing with his or her chosen period.

The examination should be passed at the end of the final quarter of required course work.

Doctor of Philosophy: Slavic

Candidates are not obliged to present a minor, but they are urged to offer one. Candidates for the doctorate in literature, whether or not they elect to present a full minor will be required in any case to complete a sequence of basic courses (normally 12 units) taken outside the Department of Slavic Languages and Literatures. The choice of patterns given in the next column may be offered: either

(1) A sequence of three courses in one West European literature, to be selected in consultation with the adviser, or

(2) Three basic courses in Comparative Literature to be selected in consultation with the graduate adviser and the Comparative Literature Department, or

(3) A course sequence in Russian History and/or Russian Intellectual History

If the student elects to present a minor in French, German, or Spanish he should take six graduate courses in that department. Students considering minors in other areas, such as Asian Languages, English, Comparative Literature, or History, should consult with their adviser, the chairman of the Slavic department, and the chairman of their minor department.

Candidacy—Candidates should read carefully the general regulations governing the conferring of this degree, as described in the section "Degrees" in this bulletin. For specific Departmental requirements and recommendations, the student should consult with the Department chairman. No student is accepted as a candidate until he has completed the equivalent of the training represented by the requirements for the Master of Arts degree as described above.

Admission to candidacy for the Ph.D. degree will be determined at the end of the fourth quarter of graduate studies. The candidate must by that time (1) have demonstrated his commitment to graduate studies by having successfully completed a minimum of 48 quarter units of credit with an average grade of B+ or better; (2) written an acceptable A.M. thesis, to be completed before the end of the 4th quarter. Failure to comply with the above two requirements will result in termination of candidacy for the Ph.D. degree. The terminated student may, at the discretion of the faculty, be given the opportunity to take the A.M. written examinations. If successful, he will then be awarded the A.M. degree, but will not be accepted as a candidate for the Ph.D. degree.

General Requirements—All candidates, regardless of their field of specialization, are expected to fulfill these requirements.

1. Have a reading knowledge of French and German, to be demonstrated by passing an examination.
2. Pass written and oral Departmental general qualifying examinations covering the following areas:

a) the history and structure of the Russian language and its relationship to the other Slavic languages;

b) the history of Russian literature including its relationship to the development of other Slavic literatures, or of European literature; or to Russian intellectual history.

(One or more sections of the written and/or oral examinations will be conducted in Russian, and the evaluation of the student's performance on these sections will include an evaluation of the command of the Russian language.)

3. Pass a University Oral Examination in the defense of a dissertation proposal covering: content relevant to the area of study, rationale for the proposed investigation, and strategy to be employed in the research.

4. Write a dissertation that embodies such results of research as would merit publication.

Specialization

Candidates in Slavic Languages and Literatures specialize either in language and linguistics or literature. Candidates may draw up individual programs of study and research in consultation with the graduate adviser. Requirements will thus vary according to the nature of the specialized program requested.

Continuation

Continuation in the Ph.D. program will be contingent upon the following: for first-year students, a high quality of performance in course work (decided by departmental evaluation); for second-year students in literature, an A.M. thesis, and for linguistics students, a written examination based on course materials and a reading list. Both the thesis and the written examination should be completed no later than the end of the first quarter of the second year.

Course Work and Overall Scheduling

1. Candidates for the Ph.D. degree are allowed as much freedom as possible in the selection of their course work. However, candidates will be held responsible for all the areas covered by the general examinations, regardless of whether they have registered for the Department's offerings in a given field. It should be noted that students may not normally register for individual work in a given area until they have covered the basic course offerings in that area. First-year students will be permitted to register for individual work only under special circumstances and must obtain the written approval of the graduate adviser. Those candidates who are also candidates for the A.M. degree should consult the section dealing with course requirements for that degree in planning their first year's work. For University residency requirements, see page 7. The A.M. thesis or written examination should be completed by the end of the fourth quarter of graduate study at the latest. The remainder of the second year of graduate study should be devoted to course work designed to prepare the student for the general qualifying examination and to fulfill the requirements for his or her minor, if any. The Departmental general qualifying examinations must be taken by the end of the first quarter of the third year of study; they may be taken during the second year if the student and the adviser feel this is appropriate. During the two quarters following the general qualifying examination the student should be primarily concerned with preparation for the University Oral Examination. (The latter should take place no later than the end of the third quarter of the third year.) However, students may, if necessary, do limited amounts of course work not directly related to the dissertation proposal. The fourth year should be devoted to the completion of the dissertation.

2. Students possessing the equivalent of the Stanford A.M. will normally be expected to adhere to the schedule for the second, third, and fourth years of work outlined under 1, above.

3. Students in the Ph.D. program will normally be expected to do four quarters of teaching after they have passed the qualifying examinations.

Note on Non-Slavic Language Requirements

It should be noted that no credit toward either the A.M. or the Ph.D. degrees will be granted for first- or second-year courses
in non-Slavic languages. It is assumed that on entering the program the student will have a reading knowledge of both German and French or, at the very least, of one of these languages. The reading examination in one of these languages must be passed by the end of the second year of study. The second examination must be passed before the candidate takes the University Oral Examination, i.e., before the end of the third year.

**General Courses**

Courses in this category may be of interest to students in other literatures, in comparative literature and in Russian area studies. These courses are primarily for undergraduates; however, by special arrangement with the department they can be taken for graduate credit.

145. **Russian Nineteenth-Century Prose**—Close reading of selected novels and short fiction by Pushkin, Lermontov, Gogol, Turgenev, Chekhov, Dostoevsky, Tolstoy. Discussions will focus on problems of literary structure with reference to Russian society and related developments in European literatures. Open to all students, including freshmen.

4 units, Aut (Todd) MWF 10

146. **Readings in Russian Modernism**—Selected works by Bely, Nabokov, Olesha, Pasternak, Solzhenitsyn and others. Discussions will focus on problems of literary structure with reference to the special status of culture in Soviet society and to related developments in European literatures. Open to all students, including freshmen.

4 units, Win (Todd) MWF 10

149. **Introduction to the Culture and Literature of the Slavic Peoples**—No foreign language required.

4 units (Stahlberger) given 1976-77

150. **Romanticism Among the Slavs**—Concentrates on three representative Romantic writers of the first half of the 19th century: Adam Mickiewicz, the Pole; Karel H. Mácha, the Czech; and Aleksandr Pushkin, the Russian.

4 units (Stahlberger) given 1976-77

151. **Dostoevsky**—Reading of major works in English translation with reference to related developments in European literature and intellectual history. Open to all students, including freshmen. Lectures and discussion sections.

4 units (Todd) given 1976-77

152. **Gogol**—Reading of major works in English translation with reference to related developments in European literatures. Open to all students.

4 units (Todd) given 1976-77

153. **Leo Tolstoy**—(Same as Comparative Literature 153.) Reading of major works in English translation including War and Peace, Anna Karenina, and Resurrection. Some comparative reference to the European novel in general, English and French. Open to all students.

4 units (Stahlberger) given 1976-77

154. **The Russian Drama**—A survey of the major Russian plays from Fonvizin to Mayakovskv, including Gogol and Chekhov. Particular attention will be paid to tradition and innovation in the development of Russian dramatic comedy. Open to all students. Readings and lectures in English.

4 units (Stahlberger) given 1976-77

**Slavic Courses**

**Undergraduate Courses**

By special arrangement with the department, courses numbered 100–159 can be taken for graduate credit. The Department urges students to take all three quarters of first-year, second-year, and third-year language series in the same academic year.

1. **First-Year Russian**.

5 units, Aut (Crockett, Staff) MTWThF 9, 12, and 1:15

2. **First-Year Russian**—Continuation of 1.

5 units, Win (Crockett, Staff) MTWThF 9, 12, and 1:15

3. **First-Year Russian**—Continuation of 2.

5 units, Spr (Crockett, Staff) MTWThF 9, 12, and 1:15

5. **Intensive First-Year Russian** — Equivalent to 1, 2, and 3 combined. Enrollment limited. Consent of instructor necessary. One hour of work daily required in Language Laboratory, by arrangement, in addition to class times.

12 units, Sum (Staff) MTWThF 8:00–9:30 and 10:30–12:00
51. Second-Year Russian.
5 units, Aut (Van Campen, Pekurovskaya, Staff) MTWThF 12 and 1:15

52. Second-Year Russian — Continuation of 51.
5 units, Win (Van Campen, Pekurovskaya, Staff) MTWThF 12 and 1:15

53. Second-Year Russian — Continuation of 52.
5 units, Spr (Van Campen, Pekurovskaya, Staff) MTWThF 12 and 1:15

111-113. Third-Year Russian — Emphasis on reading, vocabulary building and textual analysis. It is strongly recommended that students take 114-116 in conjunction with this series. Prerequisite: 53 or equivalent.
3 units, Aut (Schupbach) MWF 9
Win, Spr (Pashin) MWF 12:15-1:05

114-116. Third-Year Russian Conversation and Composition — Coordinated with and to be taken in conjunction with 111-113.
2 units, Aut, Win, Spr (Pekurovskaya) TTh 9

117A,B,C. Slavic Civilization — (Same as History 117A,B,C, and Political Science 117C in Spring quarter.) An interdisciplinary introduction to the political, social, economic, and cultural history of the Slavic peoples of Bulgaria, Czechoslovakia, Poland, Russia, and Yugoslavia from the time of the Slavic migrations to the present. Readings and lectures will stress the similarities and differences among the Slavs themselves as well as the continuing tension of their relationship to the more familiar western experience.
5 units, Aut, Win, Spr; for hours, see History 117A,B

147. Russian Nineteenth-Century Prose — Discussion of selected problems, based on readings in Russian. This course must be taken concurrently with General Course 145.
2 units, Aut (Staff) by arrangement

148. Russian Twentieth-Century Prose — Discussion of selected problems, based on readings in Russian. This course must be taken concurrently with General Course 146.
2 units, Win (Staff) by arrangement

TRANSLATORS PROGRAM

Students wishing to take any of the courses in the translators series who have not had the preceding courses in the series will be required to pass a qualifying examination given at the beginning of the quarter. Students planning to enter the Translators Program should give serious consideration to taking one or more of the following courses in their freshman and sophomore years at Stanford: Communications 100, 102, 107; English 1, 2.

THIRD-YEAR LEVEL

161. Third-Year Russian (for Translators) — Reading and translation of glossed texts from contemporary Soviet journals plus written and oral drills on constructions presenting particular difficulty to the translator.
3 units, Aut (Van Campen) TTh 1:15

162. Third-Year Russian (for Translators) — (Continuation of 161.) Reading and translation of more specialized texts. Written and oral drills. Emphasis on style and fluency of English translation.
3 units, Win (Van Campen) TTh 1:15

163. Third-Year Russian (for Translators) — Continuation of 162. Reading and translation (written and sight) of technical materials in the physical sciences and mathematics, as well as other areas.
3 units, Spr (Van Campen) TTh 1:15

FOURTH-YEAR LEVEL

192. Introduction to Independent Translation — Translation of texts in the student’s area of interest. Prerequisites: 161, 162, 163, or equivalent.
1 to 5 units, Aut, Win, Spr (Schupbach) by arrangement

193. Independent Translation — Translation of texts in fulfillment of requirements for the Translators Certificate. May be taken more than once for credit. Prerequisite: 192, or equivalent.
3 to 5 units, Aut, Win, Spr (Van Campen, Schupbach, Todd) by arrangement

ADVANCED AND GRADUATE COURSES

165. Introduction to the Structure of Russian — Analysis of the phonology and morphology of contemporary Russian. Prerequisite: Slavic 3, or consent of instructor.
3 units, Spr (Crockett) TTh 2:15
167–169. **Fourth-Year Russian** — Reading and discussion in Russian of literary texts, with compositions on material discussed.
2 units, Aut, Win, Spr (Pekurovkaya) TTh 10

170A,B,C. **Advanced Russian**—Fourth-year level course conducted in Russian. Program will include translation from English into Russian, phonetics, lexicoLOGY, and stylistics, plus supplementary practice for students interested in interpreting. Emphasis on preparation for work in news media and in cultural exchange programs. For each hour of class, students will have to spend no less than two hours working at home or in the Language Laboratory. A three quarter course.
10 units, Aut (Pashin) TTh 12:15–2:05
Win, Spr, W 1:15–3:05 F 1:15–2:05

172. **Pushkin.**
4 units, Spr (Stahlberger) MWF 11

184. **Introduction to Slavic Bibliography**—Analysis of basic Slavic research tools and bibliographic research media with emphasis on Russian and Soviet materials. The approach will be historical and evaluative. The aim of the course is to acquaint students with reference sources, bibliographic search techniques, library use, and materials available in Stanford University Libraries. Students will examine, evaluate and employ reference material. Knowledge of Russian and/or another Slavic language helpful. Open to graduate and undergraduate students. No final examination.
2 units, Aut (Zalewski) W 2:15–4:05

187. **Russian Poetry of the Nineteenth Century**—A study of the major representatives of Sentimentalism, Romanticism, Realism. Pushkin, Lermontov, Tjutchev and others. Lectures and discussions in English. Readings in Russian. Graduate students may earn 4 units.
3 units, Aut (Stahlberger) MWF 11

188. **Russian Poetry of the Twentieth Century**—A study of the major representatives of Symbolism, Acmeism and Futurism. Blok, Mandelshtam, Mayakovsky, Esenin and others. Lectures and discussions in English. Readings in Russian. Graduate students may earn 4 units.
3 units, Win (Stahlberger) MWF 11

189. **Russian Literature of the Middle Ages**—Introduction to Medieval Russian literature, art, and thought. Open to all students. An extra credit and weekly meeting will be arranged for students who wish to read the texts in the original.
4 units, Spr (Todd) MWF 10

190. **Russian Literature of the Eighteenth Century**—Emphasis on poetry: theory of genres, the satire, the ode, the mock-epic.
4 units, Aut (Stahlberger) MWF 1:15

191. **Derivational Morphology.**
3 units (Schupbach) given 1976–77

194. **Stylistics**—Seminar for graduate and advanced undergraduate students. Reading and discussion of attempts to define the concept of style and the role of language in literature, consideration of possible empirical approaches to the study of style, and exploratory analyses of individual works.
4 units (Crockett) given 1976–77

195. **The Russian Verb**—Study of problems of use of aspect; analysis of verb semantics dealing with the category as a whole and in particular with verb government and prefixation. Prerequisite: Slavic 53 or equivalent.
3 units, Aut (Schupbach) MWF 10

197. **Russian Lexicology and Phraseology.**
3 units (Staff) given 1976–77

198. **Russian Syntax**—Study of sentence structure and word order in contemporary Russian with emphasis on differences from English. Prerequisite: Slavic III or consent of instructor.
3 units (Crockett) given 1976–77

199. **Individual Work**—Open to Russian majors or students working on special projects. May be repeated for credit. Consent of instructor required.
1 to 5 units, any quarter (Staff) by arrangement

200. **Proseminar in Russian Literature**—The terms and concepts of literary study; the various approaches of literary criticism; versification and poetic language; bibliography and research methods. Students in this course should also register for Slavic 194, Slavic Bibliography. Required of all entering graduate students; recommended for others.
3 units, Aut (Brown) by arrangement

210A. **Contemporary Eastern European Film**—(Enroll in Communication 210A.)
The evolution of Eastern European cinema from the dogma of socialist realism. Readings will focus on the role of the arts in Communist society as articulated by Hegel, Marx, Engels, Lenin, Stalin, Mao, Trotsky, Lukács and others. An attempt will be made to establish the tenets of socialist realism and examine its dialectical relationship to recent developments in Soviet, Polish, Hungarian, Czech, and Yugoslav cinema. Weekly screenings will feature highlights from the works of contemporary Eastern European directors.

4 units, Aut (Kovács) MW 1:15

211. Introduction to Old Church Slavonic and Early Russian Texts.
3 units, Aut (Van Campen) TTh 2:15 and by arrangement

212. History of the Russian Literary Language—A survey of the major structural and semantic changes from the tenth to the nineteenth century. Readings in Russian from various periods and genres are assigned. Prerequisite: 211.
3 units, Win (Van Campen) TTh 2:15 and by arrangement

221. Studies in Russian Fiction: The Age of Realism—The development of realism over the first two-thirds of the nineteenth century, with special attention to problems of content and style as well as to social and philosophical background, both Russian and European.
4 units (Todd) given 1976–77

222. Studies in Russian Fiction: From Realism to Modernism—The evolution of naturalist, symbolist, neo-realist, and ornamentalist forms and movements in Russian prose in the late nineteenth and early twentieth centuries with special emphasis on stylistic and structural developments. To be taken in conjunction with 146.
4 units, Aut (Brown) M 2:15-4:05

223. Russian Formalist and American “New” Criticism—(Same as Comparative Literature 230.) Readings in the works of Russian Formalists and certain American “New Critics.” A knowledge of French, German or Russian is highly desirable.
4 units, Aut (Brown) W 4:15-6:05

277. Gogol—Also open to qualified undergraduate students.
4 units (Todd) given 1976–77

279. Dostoevsky—A study of Dostoevsky’s shorter works in the context of European thought and literature.
4 units (Todd) given in 1976–77

299. Individual Work — Exclusively for graduate students in Slavic working on theses or engaged in special work. Prerequisite: written consent of instructor.
1 to 12 units, any quarter (Brown, Crockett, Pashin, Schupbach, Stahlberger, Todd, Van Campen) by arrangement

300. Graduate Seminar: Acmeism—Emphasis on the works of Mandel’shtam.
4 units, Win (Stahlberger) by arrangement

300. Graduate Seminar: Theory of the Novel—Studies of fiction as representation, social institution, and verbal structure. Discussions will relate Western theories (Gombrich, Auerbach, Frye, Barthes, Lukács and others) to selected Russian novels. A seminar for graduate and advanced undergraduate students. Prerequisite: consent of instructor.
4 units, Spr (Todd) M 1:15-4:05

For additional offerings in literature, see Comparative Literature.

SOCIAL THOUGHT AND INSTITUTIONS

Chairman: Charles Drekmeier
Committee: Barton Bernstein, Robert McAffee Brown, St. Clair Drake, John Felstiner, Raymond Giraud, R. Hamerton-Kelly, Halsted Holman, Henry Levin, Robert North, H. Pierre Noyes, George Pegelow, Martin Perl, Kent Smith, Charles Stein, Wilfred Stone
STATEMENT OF PURPOSE

As an interdisciplinary honors program, Social Thought and Institutions is designed to meet the needs of students wishing special preparation in areas of study which draw on the materials of two or more of the social sciences. It aims at a clearer understanding of the contributions the social sciences are able to make to one another and to a specific problem, an awareness of differences and agreements in their theoretical assumptions, and facilitation of communication among these disciplines. It seeks to combine rigorous training with the breadth of knowledge interdisciplinary study provides.

The Program is organized around the study of a particular idea or problem. During the next several academic years the topic will be peace and the seminars will be concerned with conflict analysis, techniques of conflict resolution, the preconditions of peaceful and just relationships at the interactional and institutional levels, and similar considerations. The objective is a balanced and comprehensive program responsive to student interest in the role of values in social life, responsive to the social need for informed institutional analysis and innovative recommendations for social change, and the academic need for closer association of theory and research with short- and medium-range proposals and policies.

REQUIREMENTS

Two year-long seminars (Social Sciences 101–103 and Social Sciences 111–113) will be offered. Students wishing honors work will enroll in Soc. Sci. 101, which has a stronger philosophical emphasis than the other series, and will be expected to complete an honors thesis in the area of peace, conflict, and social change studies. From five to fifteen units of credit will be allowed for the thesis, and no more than five units may be taken in any single quarter. After the student’s plans for an honors project have been approved by the administrative committee, he or she will be assigned an adviser. In most cases the committee will arrange for the appointment of a second adviser in the major field. It is customary for the student to take the 101 sequence in the junior year and write the thesis in the senior year. (Approximately fifteen students are admitted to the seminar each year.)

Students interested in a peace studies concentration but not desiring an honors program may take the 111–113 series. This seminar will have a somewhat more practical orientation, with opportunities for field projects. In addition to the seminar, students wishing certification in peace studies must complete at least three courses relevant to the themes of the seminar.

Though the Honors Program is intended to supplement a regular departmental major, there may be areas of study which cannot be related to a department in this way. In such instances a major may be offered under the supervision of the committee and requirements for graduation will be determined by the committee in consultation with the student’s advisers. No more than two or three students will be accepted as majors in Social Thought and the usual expectation is that they will complete between seventy and eighty units of social science and philosophy courses by the time of graduation.

Students not in the honors seminar are not eligible for the major.

ADMISSION TO THE PROGRAM

Students wishing admission to the Honors Program should provide evidence of superior academic achievement (at least a 3.0 average). All students may apply in the spring quarter of the freshman or sophomore years or during the following fall registration. Mr. Brown, Mr. Stone, or Mr. Drekmeier may be consulted about admission to the Honors Program (Mr. Drekmeier’s office is in the Department of Political Science). Students interested in the 111 series may apply for admission to the program at the first meeting of that seminar.

SPECIAL COURSES OF INSTRUCTION

The following is only a representative list of offerings. Consult the Time Schedule for details.

4 units, Aut, Win, Spr (Drekmeier and Staff) by arrangement

4 units, Aut, Win, Spr (Staff)

121. Knowledge, Technology and Power.  
4 units, Aut (Perl)
131–33. Work and Social Change.
   4 units, Aut, Win, Spr (Levin and Staff)
141–42. Peace and Conflict: Comparative Approaches.
   4 units, Aut, Win (Staff)
151. Social Ethics.
   4 units, Aut (Hamerton-Kelly)
193. Senior Thesis and Directed Reading.
   1 to 5 units, any quarter (Staff)
      by arrangement
197A,B,C. Prospect for Survival.
   1 to 3 units, Aut, Win, Spr (Cooper, McWhorter and Staff)

SOCILOGY

Emeriti: Richard T. LaPiere, Charles N. Reynolds (Professors)
Chairman: Dudley Kirk
Associate Professors: Elizabeth G. Cohen, Michael T. Hannan, Jr., John W. Meyer
Assistant Professors: Patricia R. Barchas, Francesca M. Cancian, Anne M. McMahon, Stephen M. Olsen, William G. Ouchi (by courtesy), Nancy Tuma, Barbara Rosenblum. Acting: Barry J. Edmonston (by courtesy) Gerald Talley

PROGRAMS OF STUDY

BACHELOR OF ARTS

OFFERINGS AND FACILITIES

The Department of Sociology offers courses appropriate for most students. Some courses help to equip the student for his interactions in large and small social systems. Other courses aid the student in professional work such as law, medicine, journalism, business, architecture, education, service work with people, and public policy areas in which assessment of social science knowledge is necessary.

A wide range of specialities and course offerings is represented in our faculty, but three major concentrations are:

a) Comparative Sociology: organization and change in societies and institutions.

b) Formal Organizations: functioning of large-scale formally-structured associations oriented to the pursuit of specialized goals, e.g. schools, hospitals, corporations and political bureaucracies.

c) Social Psychology and Interpersonal Behavior: the social organization of individual identity, beliefs and behavior, and with the organization of behavior in interpersonal interaction.

Pre-professional students may find some offerings particularly useful. Suggested courses from which pre-professionals may create a concentration are:

Pre-Medicine: Soc. 131, 140, 150, 200, 210, 242 and 260;
Pre-Law: Soc. 130, 131, 132, 150, 151, 152, 240, 241, 260;
Pre-Social Work: Soc. 120, 130, 131, 200, 210, 229, 242, 251;
Pre-Business: Soc. 150, 151, 200, 210, 251, 260, 261, 262 and 263;
Pre-Education: Soc. 120, 150, 160, 243, 260 and 261.

Students may pursue degrees in Sociology at the Bachelors, Masters, or Doctoral level. The Department has formal ties with Psychiatry, Education, Human Biology, the School of Business and the School of Law. Laboratory and computer facilities are accessible.

Bachelor's degree students are required to take 45 units including Sociology 80, 280, and three courses numbered above 200. To develop necessary technical skills, students are encouraged to take the Statistics sequence 60, 61 and 62. Related courses in other departments, if approved by the department adviser, may fulfill up to 15 units for the degree. Students are encouraged to arrange tutorials and to work closely with individual advisers.

Courses numbered 0–200 are open to all students without prerequisites. Courses numbered from 200–300 are intended for undergraduates with previous exposure to Sociology, for majors, and for graduates.

HONORS PROGRAM IN SOCIOLOGY

The Honors Program is designed for those energetic and interested students who are capable of carrying out an intensive, indi-
vidualized program of study. Such programs usually involve close contact with one or more faculty as the student carries out an independent research project. The student submits an Honors Thesis, for which ten units of credit are granted. Honors students may be admitted to graduate level courses. There is no fixed number of course credits in Sociology to fulfill an Honors Program; rather, the courses of study are individually planned.

MAJOR IN SOCIAL SCIENCES (SOCIOLGY)

This degree is designed for students interested in interdisciplinary work with some emphasis on Sociology. The requirements for the Bachelor degree in Social Science (Sociology) are 45 units of course work with thirty units from Sociology including an introductory course in Sociology and a course in methodology (Sociology 180, for example). The remaining fifteen units are chosen from related departments (Communication, Economics, Political Science, Psychology, Anthropology, and Linguistics).

GRADUATE STUDY

Admission to Graduate Standing

Although it is desirable to have had undergraduate preparation in sociology, the Department does consider for admission to its graduate program students without such preparation. Admissions forms and forms for requesting financial assistance may be obtained from the Office of Graduate Admissions and, once completed, should be returned to that office. Applicants are required to submit results of the Graduate Record Examination, both the quantitative and the verbal tests. The GRE Advanced Test in Sociology may also be taken, but is not mandatory.

MASTER OF ARTS

Ordinarily, the Department does not admit students who are candidates solely for the Master's degree in Sociology. This degree is granted as a step toward the fulfillment of Ph.D. requirements. To receive it, the student must complete 45 units of approved work with an average grade of B or better. All course work should be at level 200 or greater and at least 30 of the course units must be taken within the Department.

Graduates enrolled in law, medicine, business, education or any other advanced degree program at Stanford may wish to obtain a Masters in Sociology. In such cases the usual admission requirements are waived. Interested students should contact the department secretary for further information. Students may also apply for the co-terminal Masters program as described in the Degrees section of this catalogue. Information may be obtained from the department secretary.

DOCTOR OF PHILOSOPHY

The Department presumes that all students admitted will be recommended for admission to candidacy. For the first three quarters in residence all students have probationary status. During the Spring Quarter the Department decides whether each student not yet admitted to candidacy will be (1) admitted to candidacy, (2) terminated, or (3) continued on probation for an additional year. This decision is made by the entire faculty of the Department and is based upon whether the student is making satisfactory progress toward the goal of a professional career of teaching and research in Sociology. The decision to admit the student to candidacy implies that the student's position in the Department is secure, subject only to continued satisfactory progress toward completion of remaining departmental and University requirements.

After admission to candidacy for the Ph.D., the student must: (a) have a Master's degree or its equivalent; (b) complete a Research Apprenticeship, working at least two quarters in a faculty research program and collaborating in associated publications or preparing a report of professional quality based on his or her experiences; (c) complete a Teaching Apprenticeship, working at least two quarters as a teaching assistant under the supervision of a faculty member; and (d) develop a thorough grounding in sociological theory and research methods. To accomplish this, five graduate courses are required: Sociology 281, 370, 371, 381, and 382 or 383. In addition, students entering with little background in statistics are required to take an elementary course in the first quarter after entering. (e) Finally, each student must select two fields in Sociology as his or her areas of special competence, and pass written examinations in these fields in order to complete the requirements for candidacy. Examples of such fields are Small Groups, Socialization, Family and Kinship, Sociology of Education, and Comparative Institutions.
Theory or Methods may be offered as a field only when the candidate has an exceptional grasp of material in the area, since competence is assumed for all graduate students.

Finally, the student must pass the University Oral Examination, and following this, complete a doctoral dissertation.

**Master of Arts in Teaching**

This degree is offered jointly by the Department and the School of Education. The degree is intended for candidates with a teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education.

**Joint Program with the Law School**

The faculties of the Law School and the Department of Sociology conduct joint programs leading to either a combined J.D. or J.M. degree with an A.M. degree in sociology or to a combined J.D. or J.M. degree with a Ph.D. in sociology.

Normally, the student interested in pursuing an A.M. degree in sociology will complete one full year of his or her Law School program, applying for admission to the Department of Sociology during the first year of Law School. If admitted, the student would be expected to complete 45 semester units (for the J.D. degree) in the Law School and meet the Sociology Department requirements. Applications for a joint program must be approved by the Research and Interdisciplinary Studies Committee of the Law School and by the Sociology Department. Faculty advisers from both the Department and the School will participate in the planning and supervise the study program of students admitted to joint degree status.

The joint J.D.-Ph.D. degree program is designed for students who wish to prepare themselves for research or teaching careers in areas relating legal and sociological concerns. Participation in this program requires application for admission to both the Law School and the Department of Sociology and acceptance by each. Upon admission, the student may elect to begin his or her study program in either the Law School or the Sociology Department. Normally, the student will spend the first full year in one program and the second full year in the other. Thereafter, the student may take courses concurrently until requirements for both degree programs have been met.

**Courses Open to All Students**

1. **Introduction to Sociology**—A review of basic concepts, theories and principles that enable us to explain human behavior in various social contexts. Emphasis will be given to what sociologists actually do and how they think about social life.
   
   5 units, Aut (Dornbusch) MWF 11; one section by arrangement
   
   Win (Meyer) MTWThF 11
   
   Spr (Staff) MTWThF 11

4. **Social Problems: Or How to Read a Newspaper**—This course takes some of the central ideas of sociology and applies them to some current social problems. Abstract principles are related to concrete experiences in today's world. Materials drawn from daily newspapers are used to develop such topics as social inequality, crime, racial conflict, ritualistic conformity, and bureaucratic inefficiency.

   3 to 5 units (Dornbusch) given 1976-77

50. **Introduction to European Societies**—This course will provide a concrete introduction to the contemporary social structures of several European national societies. The historical emergence of these societies, their relations with one another, and their location and interaction in the larger world capitalist system will also be covered. Lectures will be given by sociologists with special knowledge of each national society from a comparative point of view.

   5 units, Spr (Staff) MTWThF 10

80. **Departmental Seminar for Undergraduate Majors**—Designed to introduce students to Sociology as an academic discipline, to acquaint them with career opportunities in the field, and to expose them to current faculty research interests. Required of all sociology majors.

   2 units, Aut (McMahon) T 4:15-6:05

110. **The Structure of Social Encounters**—An introduction to theories and research results on the study of interpersonal behavior. The topics covered include: affiliation, social perception and social comparisons, conformity and persuasion, and social exclusion.

   3 units, Spr (McMahon) MWF 11
110A. Structure of Social Encounters Laboratory — Optional laboratory to 110. Laboratory and field investigation of a number of topics addressed in 110. Prerequisites: concurrent enrollment in 110.

2 units, Spr (McMahon) TTh 11

SERIES OF PROBLEMS IN CONTEMPORARY SOCIETY

120. Childhood and Modern Society — A study of the ways the lives of children are organized in modern society, the ways in which this situation is changing and the relation of this situation to views of how childhood experiences affect adult life.

3 to 5 units, Aut (Meyer) MWF 2:15

122. Causes of Women's Liberation Movement — Many American women are joining together to redefine themselves and to acquire more power and status. What social conditions explain this movement? We will study Women's Liberation in the U.S. and other countries, and compare it with other social movements such as Black Power, Gay Liberation and the Labor Movement.

3 to 5 units, Win (Cancian) MW 2:15-4:05

130. Poverty and Public Policy — Why does large-scale poverty persist in America and what are the effects of poverty on the individual? The course will consider conflicting views on the two questions and relate the issues to current public policy.

3 to 5 units, Spr (Hannan) MWF 1:15


3 to 5 units, Spr (Rosenblum) TTh 9:00-10:30

132. The Criminal Law and the Criminal System — (Same as Law 107 and Political Science 174.) Exploration of the purposes and processes of the criminal law, with emphasis on the actual operation of the system, and the application of theory to contemporary problems. Topics will include the police, bail, trial, sentencing, corrections, crime rates, and "non-victim" crimes.

5 units, Spr (Kaplan) MWF 1:15

134. Aggression in Small Groups — Evaluates data bearing on aggression and external conditions, effect of housing, sex differences, dominance, early experiences, and normative influences from several conceptual vantage points.

3 to 5 units, Spr (Barchas) MT 7-10 p.m.

135. Physiological Sociology — An examination of evidence and theory fragments which bear on the question of how physiologic processes both reflect and have impact upon the social system in which the individual is embedded.

3 to 5 units, Win (Barchas) MT 7-10 p.m.

140. Doctors, Patients, and Medical Care Settings — An introduction to social processes and structures as they bear on the development and definition of disease, the seeking of care, the training and behavior of practitioners, and the social structures within which medical care is delivered.

3 to 5 units, Win (Staff) by arrangement

144. The Social Structure of Science — The objective of this course is to analyze science as a social institution. The course is designed to introduce the student to sociological analysis and also to acquaint the student with some general features of science.

5 units (Cohen) given 1976-77

150. The World of Organizations — Talking to people about organizations is like trying to talk to fish about water. We are sufficiently immersed in them that we hardly recognize their presence. Life was not always like this. Bureaucratic organizations came into existence as a solution for certain problems. They, in turn, have created new problems which require new solutions. New organizations with novel structures are coming into being that represent important modifications of the bureaucratic model. The old and new world of organizations will be explored using novels, selections from the sociological classics and recent empirical studies. Regular lectures will be enriched by guest speakers and case discussions.

3 to 5 units (Scott) given 1976-77

151. Control over Organizations: Power in a Bureaucratic Society — Examination of the conditions which affect the balance of power between individuals and organizations in modern society.

3 to 5 units, Win (Staff) TTh 10-13

152. Power Elites in American Society — Analysis of the conflicting views on the real-
ity and importance of power elites in American society.

3 to 5 units, Win (Zelditch) MWF 11

160. Ethnic Relations in Modern Society—Examination of the relations among ethnic and racial groups in industrial societies. Focus on the causes of large-scale ethnic movements and of ethnic violence and the consequences of ethnic conflict. Cases considered include the “Black movement” in the U.S. and Britain, the religious conflict in Northern Ireland and the rise of the “blue-collar ethnic” in the U.S.

3 to 5 units, Win (Olsen) MWF 9

162. Asian Americans: Introduction — An introductory sociological survey of Asian Americans in the United States. Major consideration will be given to immigration patterns, the socio-cultural formation of Asian American culture(s) and a historical analysis of the contemporary Asian American movement.

3 to 4 units, Win (Seid) M 7-10 p.m.

163. Asian Americans: Contemporary Issues — A socio-psychological analysis of Asian Americans as an ethnic and racial minority. The course will examine the present status of Asian Americans in the issue-areas of education, employment, women’s rights, social services, media, social development, and cultural identity.

3 to 4 units, Spr (Seid) M 7-10 p.m.


5 units, Win (Kirk, Edmonston) MTWTh 9

181. Law and Social Science—(Same as Law 311.) The purpose of this course is to broaden the approach to law by examining some major problems which law shares with other social sciences. Consideration will be given to definitions of law attempted by various social sciences, the impact of law on behavior of various kinds, the social forces that mold law, the influence of the legal system on the various actors within it, and theoretical efforts to explain the relationship of law and society.

3 to 5 units, Aut (Friedman) by arrangement

183. Politics and Society—(Same as Political Science 180L.) An analysis of the relationship of sociological structures to political behavior. This course will deal with topics such as social stratification, mass movements and the political roles of academic intellectuals.

5 units, Win (Lipset) MWF 10

190. Undergraduate Directed Research.

1 to 6 units (Staff) by arrangement

COURSES INTENDED FOR UNDERGRADUATES WITH PREVIOUS EXPOSURE TO SOCIOLOGY, FOR MAJORS, AND FOR GRADUATES

SMALL GROUPS AND SOCIAL PSYCHOLOGY

200. Interpersonal Behavior—An examination of research in such areas as power and prestige structures in small groups; status characteristics in social interaction; deviance, conformity, and social control.

5 units, Aut (Berger) MWF 10

210. Social Psychology—A survey of selected problem areas in social psychology chosen from such topics as: attitudes and attitude change; balance and exchange processes; conformity and deviance; status and role; perception of self and others; socialization. Prerequisite: previous work in social psychology or consent of instructor.

5 units, Win (McMahon) TTh 10-12

211. Personality and Social Structure—(Same as Education 208.) Lectures and discussion of leading ideas, theories, and research on the relations of personality and social systems, with special emphasis on the ways in which personality modes influence the functioning of institutions. Among the
issues reviewed are suicide, juvenile delinquency, recruitment to and performance in school and job, socialization, and political participation. Undergraduates with some background in personality theory or sociological analysis will be accepted. Enrollment limited to 65.

3 to 5 units, Win (Inkeles) TTh 3:15–5:05

220. Collective Behavior and Social Movements—Crowds, riots, demonstrations, rumors, fads, fashion, cults, mobs, social movements—these are some examples of what comes under the heading of collective behavior. The impact of media will be examined: how did TV help turn the complaints of a few Los Angeles housewives into a national meat boycott?

5 units (Rosenblum) given 1976–77

225. Values, Identities and Social Structure—A research seminar that will explore how values and beliefs are involved in social movements to change society. Our main activity will be doing research. Possible topics include: (1) What structural conditions favor the development of revolutionary consciousness among workers? (2) What structural changes have resulted from the redefinition of women's identity by the Women's Movement? Open to advanced undergraduates and graduates in the social sciences.

5 units, Spr (Cancian) M 2:15–5:05

226. Sociological Perspectives on Crime and Delinquency—The course will survey sociological theory and research concerning behavior, legally defined or treated as criminal or delinquent. Types and sources of data, methods of research, and their bearing on various theoretical perspectives will be examined. These perspectives will, in turn, be assessed in terms of empirical adequacy and implications for social control through law and other institutions.

5 units, Aut (Short) MW 11:00–12:15

227. Seminar on Expectation States Theories—This lecture seminar will concern itself with the analysis of some recently developed expectation-states theories and the results of experiments carried out in connection with these theories. Among the major substantive problems that will be treated are: the ways in which diffuse status characteristics (age, sex, race) determine an individual's interpersonal behavior; how status inconsistencies are resolved; and how diffuse status characteristics come to be constructed as objects of social reality.

5 units, Win (Berger) W 2:15–5:05

228. Experimental Study of Interpersonal Power—A seminar on the experimental literature on power and conflict. First, the seminar reviews in some detail various theories of interpersonal power relations. Second, it reviews the experimental literature relevant to these theories. Third, it focuses on one unsolved problem in this literature, the study of "nondecision-making," and attempts to formulate a theory and method of investigating this process. Students may, meanwhile, work on either this or any other unsolved problem in this literature for their own papers.

5 units, Spr (Zelditch) M 2:15–5:05

229. Interpersonal Processes in the Family—Consideration of small group processes in the context of family interaction.

5 units (Berger) given 1976–77

COMPARATIVE SOCIAL ORGANIZATIONS AND INSTITUTIONS

231. Human Ecology—(Same as Food Research 136.) This course is an introduction to the complex and varied systems of interaction between human populations and the living and nonliving environment. The social science perspective is used to approach the study of human ecology. Principles of human ecology are presented in the context of the relationships of population, organization, and technology within the human environment. Particular attention is given to the ecological aspects of food and population.

5 units, Aut (Edmonston) TTh 1:15–3:05

233. Family and Childhood in Chinese Communities—A comparative view of the family as a unit of socialization, caretaking and authority in contemporary China, Taiwan and Hong Kong, and in Chinese-American communities. Special emphasis on the way families fit into a larger social environment, including neighborhoods, ethnic communities, schools and the state.

3 to 5 units, Spr (Olsen) MWF 1:15

240. Class, Status, and Power—Analysis of stratification in simple and complex groups and societies. General theories of stratification are analyzed and evaluated.

5 units, Spr (Zelditch) TTh 10–12
241. Political Sociology—Empirical and theoretical studies of political structure, political organization, and individual political behavior, particularly in modern industrial societies. Prerequisite: previous work in Sociology or Political Science.
5 units, Aut (Meyer) MWF 9

242. Family and Kinship—This is an introduction to: (1) the relation between the family and the larger social system in tribal, peasant, and modern societies; and (2) role relationships within the family, especially parent-child and husband-wife. We will consider U.S. family organization in different social classes, ethnic groups, and in utopian communities.
5 units, Win (Olsen) MWF 1:15

243. Education and Society—The political and economic determinants and effects of educational systems. Structural connections between the social status "student" and other social institutions and their consequences for the organization, behavior, and socialization of students. Prerequisite: previous work in sociology.
5 units, Spr (Meyer) MWF 1:15

245. Seminar: Topics in Political Sociology—(Same as Political Science 282.) An analysis of differing approaches based on reading the works of major figures such as Lasswell, Mannheim, Marx, Michels and Weber.
5 units, Win (Lipset) T 4:15

246. Seminar in the Sociology of Art—An examination of art as a major social institution in America. Topics to be considered are: artists' careers; the "art world"; systems of rewards; distribution of art products; conventions and innovations in art styles.
5 units, Spr (Rosenblum) T 2:15–5:05

COMMUNITIES

251. The City—An introduction to understanding the city: (a) man and the city, focusing on distinctive aspects of the behavior of "urban man," (b) the city and its environment, including the immediate physical environment, other cities, and the larger society, and (c) the internal affairs of the city, including the distribution of power and privilege, voluntary and official community organizations, and neighborhoods.
5 units, Spr (Olsen) MWF 9

253. Comparative Urbanism—(Same as Anthropology 146.) Course of lectures designed to place problems and pathologies of contemporary urbanism in comparative perspective. African and Asian cases are utilized as well as those from the Western world. Emphasis is given to stratification and to the integration of ethnic minorities.
5 units, Win (Drake) MW 1:15

ORGANIZATIONS

260. Formal Organization—An introduction to the sociological literature on formal organizations. The structural characteristics of organizations (e.g., the power and status arrangements) are examined as are selected factors which affect them (e.g., characteristics of the environment, task performed). Competing perspectives for analyzing the structure of organizations are described and evaluated. Prerequisite: consent of instructor.
5 units, Spr (Hirsch) MWF 9

261. Organizational Behavior—Continues the analysis of organizations begun in 105A but emphasizes social psychological processes relevant to the analysis of organizations. Personality and organizations; power, influence, and leadership; production and morale; intraorganizational conflict; stability and change. Prerequisite: 260 or consent of instructor.
5 units, Win (McMahon) MW 3:15–5:05

262. Leadership in Organizations—(Same as Education 333 and Political Science 102.) The problems of leadership in complex organizations, such as universities, schools, hospitals, business firms, armies, and public bureaucracies. Special attention to the role of major executives.
4 units, Spr (March) MW 1:15–3:05

263. Organizational Decision Making—(Same as Education 120 and Political Science 103.) An examination of the process of decision making in modern complex organizations, such as universities, schools, hospitals, business firms, armies and public bureaucracies. The impact of information, power, resources, organizational structure, and the environment. Alternative models of choice and their implications.
4 units, Win (March) MW 1:15–3:05

THEORY

270. Introduction to Sociological Theory—An examination of some basic theoretical
issues such as the integration of the individual and society, social classes, and alienation. Readings include Durkheim, Goffman, Marx, Parsons, and Weber. Required of all sociology majors. Prerequisite: previous work in the social sciences.

5 units, Aut (Cancian) TTh 11:00–12:15

271. Introduction to Models in Social Science—(Same as Education 110 and Political Science 185.) An introduction to models in social science. Models of choice, exchange, adaptation, diffusion, and structure are used to make predictions in a variety of situations involving human behavior. Emphasis is placed on the invention and application of models more than on the testing of them.

4 units, Aut (March) MW 1:15–2:05; sections M 10, 11 or 12

272. Mathematical Models of Social Structure—An introduction to abstract treatments of structure and process with particular attention to problems of application to large scale, complex social systems. Substantive topics include: Stratification and social mobility, organizational behavior, and vacancy chains. Prerequisites: 1 and some background in calculus.

5 units (Tuma) given 1976–77

273. Computer Models of Social Behavior—(Same as Computer Science 127, Education 218, Political Science 180M, and Psychology 154.) Models of human behavior in social situations. Particular attention is given to specifying simulation models, determining their properties, and testing them. Enrollament limited to 20. Prerequisites: knowledge of at least one programming language; advanced courses in social science; consent of instructors.

4 units, Win (Feigenbaum, March) M 3:15–5:05

274. Theories of Interpersonal Processes—An examination of balance and exchange as major approaches to interpersonal behavior, applying these to such topics as power, affiliation, conformity, and socialization.

4 units (Barchas) given 1976–77

275. Sociology of Knowledge—An introduction to the basic issues and classical thinkers in this branch of inquiry. Topics to be covered include: Where do ideas come from (the social origins of knowledge)? Where do ideas go (the social distribution of knowledge)? How do ideas maintain or challenge the existing power structure (the social uses of knowledge)? We will also discuss the role of the intellectual and the university in legitimizing and disseminating knowledge.

5 units, Aut (Rosenblum, Cancian) TTh 2:15–4:05

Methods

280. Introduction to Sociological Research—The aim of this course is to provide the consumer of social research with standards by which to evaluate the findings of sociological studies; to present a critical analysis of some basic notions and theories used in sociological analysis. Lectures and laboratory exercises consider problems of collecting observations, constructing theory, testing hypotheses and generalizing research results. Required of all sociology majors.

5 units, Aut (Cohen) MWF 11; one 3-hour lab by arrangement

281. Statistics for Sociological Research—An introduction to the rationale and application of methods of statistical analysis for both experimental and nonexperimental research in the social sciences. Computer exercises illustrating the practical usage of various statistical methods are included. Prerequisite: Stat. 60 or equivalent.

6 units, Spr (Tuma) MWF 11:00–1:00

282. Field Work Methods—A practical, "how-to" course providing the student with experience in a field setting. Each student will select an area of interest (student culture, hospitals, police work, behavior in public places, etc.) to study for the term. Class discussion will center on sharing field problems, particularly the changes a field worker goes through during the research process. Readings will concentrate on recording, coding and analyzing qualitative data.

5 units, Aut (Rosenblum) TTh 10–12

290. Individual Study.

(Staff) by arrangement

291. Honors Seminar—Colloquium focusing on problem selection, formulation, and research design for honors students preparing to carry out individual research leading to a senior thesis.

2 units, Spr (Staff) by arrangement

292. Undergraduate Research Apprenticeship.

1 to 10 units (Staff) by arrangement
293. Senior Thesis.
3 to 10 units (Staff) by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

300A,B,C. Graduate Proseminar — Limited to first-year graduate students in Sociology.
2 units, Aut (Staff) T 12
Win (Staff) T 12
Spr (Staff) T 12

301. Interpersonal Evaluation—Evaluation of self and others as a fundamental social process. This seminar will attempt to bring together knowledge from psychology, anthropology and sociology in order to try to develop an integrated theory of interpersonal evaluation across levels and fields.
5 units, Spr (Dornbusch) W 2:15-5:05

315. The Social Psychology of Modernization—(Same as Education 309.) Exploration of the impact of political, economic, and socio-cultural change on the individual in developing countries. Review of standard works in the scientific literature, with special emphasis on data from the Project in Social and Cultural Aspects of Economic Development in Six Developing Countries, and presentation of results from research of advanced students. Education, mass communication, community development, technical innovation and political participation are illustrative of the topics on which students work. Enrollment will be limited to fifteen, the selection, if necessary, to be made at the first meeting.
3 to 5 units, Spr (Inkeles) Th 4:15-6:05

316. The Social Psychology of Organizational Settings—(Same as Education 308.) An exploration of the human response to social climates, this seminar will treat the differential response which individuals and groups make to variation and alteration in the form of social organization in which they are involved. The participants will review available evidence in search of the answer to questions of this type: Do open classrooms increase teacher motivation and foster student development? Does a less restrictive atmosphere in prisons insure fewer riots and lower rates of recidivism? Can cooperative farming give traditional villagers a greater sense of personal efficacy? Settings to be studied will include, among others: schools, colleges, hospitals, factories, co-operative farms, housing developments, and villages. Strong emphasis will be placed on the theory and method for studying organizational climates and for judging the personal response to those climates. Open to graduate students with some preparation in sociology and psychology.
3 to 5 units, Spr (Inkeles) T 4:15-6:05

331. Population Problems—(Same as Food Research 235.) For graduate students. See 170.

332. Seminar: Demography of the Developing Countries—(Same as Food Research 285.) The demographic situation of each of the major regions—Latin America, tropical Africa, Islam, India, and East Asia—in relation to economic and social development. Population forecasts and prospects. Present and possible policies for restricting population growth. Each student will be required to lead a seminar and prepare a paper based on a term project. Prerequisite: 331 or consent of instructor.
5 units (Kirk) given 1976-77

340. The Social Sciences and Educational Administration: Introduction to the Sociology of Education — (Same as Education 220C.) An analysis of the links between education and the stratification systems in the United States. Topics include: structure of class systems, social mobility and education, barriers to educational and social opportunity with a special focus on race and sex, and the recent debates over the meaning and existence of equality of educational opportunity.
4 units, Spr (Staff) by arrangement

341. Research Problems in the Sociology of Education—(Same as Education 310/210.)
4 to 6 units, Aut (E. Cohen) MW 9-11

342A. The Low Status Student: Race and Social Class—(Same as Education 312A.) This course provides an attack on a problem of great contemporary interest in education from the point of view of sociological theory, research and analysis. The relationship of research to policy formulation will be stressed. Relevant sociological theory and research will be covered from the areas of stratification, socialization, and race relations. Applications to "education for the disadvantaged" will be made. Because students must be prepared to contribute analyses and research formulations in their class presentations,
Education 310 or its equivalent is a prerequisite.

4 units, Spr (E. Cohen) M 7–9 p.m. and by arrangement

342B. Interaction Processes in Education—(Same as Education 312B.) With increased use of group work as a classroom technique and the new developments in team teaching, the educational researcher can benefit from selected theory and research by sociologists and social psychologists in the small group setting. Topics will include the social processes of evaluation, influence, and role differentiation. The student should acquire skills in selecting theory and research from a heterogeneous behavioral science area that have some promise for problems in the educational setting. Methods for studying interaction in educational settings will be included. The course will involve some field work in observation and scoring of small groups in the educational setting. Because students must be prepared to contribute analyses and research formulations in class presentation, Education 310 or its equivalent is a prerequisite.

4 units, Spr (Staff) TTh 3:15–5:05

365A,B,C. Advanced Research in Organizational Theory I, II, III—(Same as Education 418A,B,C and Political Science 304A,B,C.) A research seminar for advanced graduate students. Emphasis is placed on developing original theoretical formulations of major concepts in organization theory. Prerequisites: advanced courses in organizations, research methods, consent of instructor.

4 units, Aut, Win, Spr (March, Staff) by arrangement

370. Theory Construction — Prerequisite: consent of instructor.

5 units, Win (Berger) T 2:15–5:05; lab Th 7:30–9:30 p.m. by arrangement

371. Basic Problems in Sociological Theory — Selected sociological problems are pursued from their origins in the classical literature through to contemporary formulations. Prerequisite: consent of instructor.

5 units, Aut (Zelditch) W 2:15–5:05

381. Design and Analysis of Sociological Research—A consideration of the principles of experimental and nonexperimental design and analysis from a causal inference perspective. Prerequisites: 280, 281.

5 units, Win (Hannan) T 2:15–5:05

382. Causal Models in Social Research—Sociological applications of structural equation methods with special emphasis on path analysis, confirmatory factor analysis, and models with unobservable variables. Prerequisite: 381.

5 units, Spr (Hannan) T 2:15–5:05

383. Problems of Cumulative Research Strategies—This course will consider limitations on the usefulness of single empirical studies, the necessity for cumulative research programs and some of the key issues in the development of a research strategy.

5 units, Win (Cohen) W 2:15–5:05

384. Demographic Methods — (Same as Food Research 286.) Methodology of population analysis, including actuarial procedures, fertility measurement, stable population analysis, cohort analysis, population projection, and construction of demographic models.

3 to 5 units, Spr (Edmonston) TTh 10–12

385. Survey Design and Analysis—(Same as Education 327.) A basic course in the design of surveys for social science research, including educational problems. Topics include: basic research cycle and judgments about when surveys are appropriate; variable language and indicators; construction of questionnaires (including simple indexes); strategies for interviewing and for mail questionnaires. A data analysis clinic will begin at the first of the course using existing data and will continue throughout the course. Prerequisite: basic statistics course.

5 units, Aut (Staff) by arrangement

GRADUATE INDIVIDUAL STUDY

390. Graduate Individual Study.
(Staff) by arrangement

391. Special Colloquia.
(Staff) by arrangement

392. Graduate Research.
(Staff) by arrangement
393. Teaching Apprenticeship.
   (Staff) by arrangement

394. Research Apprenticeship.
   (Staff) by arrangement

   (Staff) by arrangement

SPANISH AND PORTUGUESE

Emeriti: Aurelio M. Espinosa, Jr., Juan B. Rael, Isabel Magaña Schevill (Professors); Grace Knopp (Assistant Professor)

Chairperson: Jean Franco

Professors: Fernando Alegria, Jean Franco, Bernard Gicovate, Ronald Hilton

Associate Professor: Joaquim-Francisco Coelho

Adjunct Professor: Phillip Petersen

Assistant Professor: Rina Benmayor. Acting: Robert Ball, Gustavo Valadez

The Department of Spanish and Portuguese accepts candidates for the degree of Bachelor of Arts, Master of Arts in Spanish and Portuguese and Doctor of Philosophy in Spanish and Portuguese, and for certification as high school and junior college teachers. Special consideration is given to the needs of those who intend to make teaching their profession.

PROGRAMS OF STUDY

BACHELOR OF ARTS

Candidates are expected to complete a minimum of 45 units from courses in this Department numbered 100 or higher. Language competence equivalent to Spanish 113 is required.

For students in the Honors Program in Humanities, up to six units of that program may be applied toward completion of the Spanish major.

Extended majors in Spanish and Portuguese may be arranged through the adviser with other Departments by taking a minimum of 40 units (instead of the required 45) in Spanish and Portuguese plus 15 or 20 units in a related field.

Candidates for the B.A. in Spanish and Portuguese have the opportunity to select any one of the following areas of concentration, without, however, limiting their choices exclusively to that area. It is important that intending majors request from the Department the name of an adviser who will be responsible for helping them select courses.

1) Language. Students primarily interested in Spanish and/or Portuguese as language should take courses in language and linguistics above the 150 level.

2) Literature. Students concentrating on Spanish or Latin American literature should take courses from the Spanish 230 to the 290 series, in sequence if possible. In consultation with the adviser, they may also take courses in the 300 series.

3) Hispanic Studies or Latin American Studies. The aim of the program, which permits maximum flexibility, is to allow students to plan a more broadly based major than is possible in other areas of concentration. The student can combine the study of the Spanish, Portuguese or Latin American language and civilization with such fields as Political Science, History and Anthropology. The requirements are (a) 35 units to be taken within the Department (b) 25 units of courses outside the Department but in the Spanish, Portuguese, and Latin American field to be planned and presented to the Department by the student.

4) Spanish for Chicano Students. In consultation with an adviser, students will be required to take courses in Language, Literature, Linguistics and History and may also select from optional courses on Chicano culture. (Further details may be obtained from the Chairperson of the Department.)

5) Combined Major in Spanish and Portuguese.

Extended Major in English and Spanish Literature. Candidates for the A.B. in English and Spanish Literature should register with the Department of English.

STANFORD SPANISH PROGRAM
IN SALAMANCA

Majors in Spanish and allied disciplines may spend two quarters in Spain as participants in the Stanford Program at the University of Salamanca. Students reside in residencias de estudiantes and attend University courses and courses given and organized by the Director in Residence. Application forms may be obtained from the Department.

Courses Taught at Salamanca. Spanish
Civilization; Spanish Literature from 1870 to the Present; History of Spain. Students also enroll in courses given in the Facultad de Filosofía y Letras at La Universidad de Salamanca.

**INTENSIVE SUMMER PROGRAM**

Stanford University offers intensive study at various levels in both Spanish and Portuguese during the summer.

**TEACHING CREDENTIALS**

For information concerning the requirements for teaching credentials, consult the “School of Education” section of this bulletin and the Credentials Secretary, School of Education.

**MASTER OF ARTS IN TEACHING SPANISH**

The degree of Master of Arts in Teaching Spanish is offered jointly by this Department and the School of Education. The degree is intended for candidates who have a teaching credential and who wish further to strengthen their academic preparation. The program consists of a minimum of 45 quarter units of graduate study, 36 of which must be completed at Stanford. A minimum of 25 units of courses taken must be in the teaching field and at least 12 units must consist of graduate courses in the School of Education at Stanford.

For general requirements, see School of Education.

**Specific requirements:**

- Language Study: Advanced Conversation, Grammar, and Composition
- Literature: Chosen from courses in Hispanic Literature or Civilization numbered from 220 up
- Language Laboratory 215
- Methods: Spanish 301
- Courses in Education

**GRADUATE PROGRAM IN HUMANITIES**

The Department of Spanish and Portuguese participates in the Graduate Program in Humanities leading to a joint Ph.D. degree. For a description of that program see the section “Humanities Special Programs” in this bulletin.

Additional courses in literature of interest to graduate students in Spanish may be found in the section “Comparative Literature” and “Modern Thought and Literature” in this bulletin.

Students who choose a minor in Comparative Literature should consult Professor Bliss Carnochan, Chairman, Committee on Comparative Literature, Room 34A. Students who choose to minor in Modern Thought and Literature should consult Albert J. Guerard, Chairman, Committee on Modern Thought and Literature.

**MASTER OF ARTS IN SPANISH**

This program is designed for those students who do not intend to continue their studies through the Ph.D. degree. By University regulation, students desiring the A.M. degree must complete a minimum of 45 units, 36 of which must be completed at Stanford.

Requirements for A.M.

1. A reading knowledge of one foreign language other than Spanish or Portuguese.
2. Advanced Grammar and Composition
3. Introduction to Literary Theory or equivalent courses
4. Two courses each from two of the following areas (making four courses in all):
   - Linguistics, Spanish Literature and Civilization
   - Spanish American Literature and Civilization
   - Luso-Brazilian Literature and Civilization
5. Two courses in Spanish or Romance linguistics

Students with no teaching experience will be required to take 301. Methods of Teaching Spanish.

In addition, students may take additional units of graduate level courses in Spanish or Portuguese and/or approved courses in related fields such as Linguistics, Comparative Literature, Philosophy, History of Art.

**DOCTOR OF PHILOSOPHY**

The requirements of the Ph.D. are (1) a minimum of 36 graduate units during the first year of graduate study and a minimum of 9 units per quarter during six quarters following the first year; (2) a reading knowledge of one foreign language other than Spanish and Portuguese; (3) the writing of a dissertation.

In consultation with the adviser, students will select one major field of study from the following: (1) Philology and Linguistics, (2) Spanish Literature up to 1700, (3) Spanish Literature from 1600, (4) Spanish American Literature, (5) Latin American Studies, (6) Luso-Brazilian Literature. In addition candidates will also select two secondary areas of study outside the major field from one of the following: (1) Spanish Medieval Literature, (2) Spanish Literature of the Golden Age, (3) Modern Spanish Literature, (4) Por-
tuguese Literature, (5) Brazilian Literature, (6) Linguistics, (7) Spanish American Literature of the colonial period, (8) Spanish American Literature from Independence, (9) Chicano Literature, (10) Literary theory, (11) Hispanic Civilization, (12) Portuguese and Brazilian Civilization. One secondary area of concentration may be taken outside the department in consultation with the adviser.

At the end of the first year of study, a preliminary examination will be taken, consisting of an oral examination and an examination in practical criticism. All Ph.D. candidates must fulfill the requirements for the A.M. before proceeding to the qualifying examination.

After the preliminary examination, students concentrate on the major field of study. After completion of course work requirements at the end of the third year of study they will take the qualifying examination, which is based on a comprehensive list of reading in the candidate's major field.

A University Oral Examination will be taken usually one or two quarters after taking the qualifying examination. This examination will cover (1) the field of concentration (as defined by the student and the student's adviser); (2) plans for the dissertation based on a prospectus approved by the adviser.

The candidate should file a formal application for candidacy as prescribed by the University no later than the end of the second year. As early as possible Ph.D. candidates will be expected to find a topic requiring extensive original research and to seek out a member of the Department as his or her adviser. The adviser will request the Chairperson to appoint a committee to supervise the dissertation. The committee may well advise extra preparation within or outside the Department, and time should be allowed for such work. Ph.D. dissertations must be completed and approved within five years from the date of filing the application. Candidates taking more than five years will be required to reinstate their candidacy by passing the written qualifying examination again.

The dissertation must be submitted to the adviser in rough draft but in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive the Ph.D. degree. Dissertations may not be submitted during the summer quarter.

**GENERAL COURSES (A)**

These courses, taught usually every other year, are open to all students. When registering, students are advised to prefix the identifying letter A to the course number.

75. Don Quixote in Translation. 3 units

120. Languages, Politics and Society in the Contemporary World—Advanced and graduate students register under Spanish 220. Spanish and Portuguese majors wishing to count this course toward their major will concentrate on the Iberian Peninsula and Latin America. 3 to 5 units, Win, Spr (Hilton)

121. The Literature of Travel and Exploration—Advanced and graduate students register under Spanish 221. Spanish and Portuguese majors wishing to count this course toward their major will analyze works about the Iberian Peninsula or Latin America. 3 to 5 units, Win, Spr (Hilton)

122. Countries and Issues in the Contemporary World—Advanced and graduate students register under Spanish 222. Spanish and Portuguese majors wishing to count this course toward their major will analyze works about the Iberian Peninsula or Latin America. 3 to 5 units, Win, Spr (Hilton)

171. Spanish Literature in Translation—Analysis, discussion of works of Federico Garcia Lorca. 3 to 5 units, Spr (Gicovate) given 1976–77

175. Spanish-American Literature in Translation: Contemporary Mexican Writers—(Same as English 62A.) 20th-century Mexican literature in translation. 5 units, Spr (Islas) TTh 2:15

176. Spanish American Literature in Translation—20th century prose. 3 to 5 units, Win (Valadez) given 1976–77

180. Portuguese Literature in Translation—Analysis, discussion of representative works. 3 units
185. Brazilian Literature in Translation—Analysis, discussion of representative works.  
3 units

**SPANISH COURSES**

**FIRST- AND SECOND-YEAR**

(Under the Direction of Robert Ball)

*Note*—Students registering for the first time in a first- or second-year course must take a placement test if they have had any training in Spanish before entering Stanford. Bilingual students will take a special placement test. See department secretaries for time and place of placement exams.

Students who have taken the Advanced Placement Test do not have to take the Stanford Placement Test.

**Courses Numbered 1 Through 99 are Introductory Language Courses**

1. First-Year Spanish, First Stage  
5 units, Aut, Win, Spr, Sum (Staff) MTWThF, plus additional work in the Language Laboratory

2. First-Year Spanish, Second Stage—Continuation of 1.  
5 units, Aut, Win, Spr (Staff) MTWThF, plus additional work in the Language Laboratory

3. First-Year Spanish, Third Stage—Continuation of 2.  
5 units, Aut, Win, Spr (Staff) MTWThF, plus additional work in the Language Laboratory

5. Intensive First-Year Spanish — Offers preparation in comprehension, speaking, reading, and writing the language. Since classes are limited to 15, applicants should consult the Department as soon as possible.  
15 units, Sum (Staff) MTWThF 8:00-9:30 and 10:30-12:00. Language Laboratory by arrangement

10. Reading Spanish—Accelerated course for beginners, particularly for those seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to seniors and graduate students only.  
4 units, Spr (Staff) MTWTh

22. Second-Year Spanish—Prerequisite: 3 or equivalent.

3 units, Aut, Win, Spr (Staff) MWF, plus additional work in the Language Laboratory

3 units, Aut, Win, Spr (Staff) MWF, plus additional work in the Language Laboratory

9 units, Sum (Staff) MTWThF 8 and 11

50. Intermediate Spanish Conversation — Prerequisite: 23 or equivalent. Enrollment limited to 10 per class.  
3 units, Aut, Win, Spr (Staff) MWF

52. Second-Year Spanish — Prerequisite: 3 or equivalent.  
5 units, Aut (Staff) MTWThF, plus additional work in the Language Laboratory

52B. Intensive Second-Year Spanish—Especially designed for bilingual students. Prerequisite: 3 or equivalent.  
5 units, Aut (Staff) MTWThF, plus additional work in the Language Laboratory

53. Intensive Second-Year Spanish — Continuation of 52.  
5 units, Win (Staff) MTWThF, plus additional work in the Language Laboratory

53B. Intensive Second-Year Spanish—Especially designed for bilingual students. Continuation of 52B.  
5 units, Win (Staff) MTWThF, plus additional work in the Language Laboratory

54B. Intensive Second-Year Spanish—Especially designed for bilingual students. Continuation of 53B.  
5 units, Spr (Staff) MTWThF, plus additional work in the Language Laboratory

99. Individual Reading — Enrollment only by special consent. Prerequisite: 23 or 53.  
1 to 5 units, any quarter (Staff) by arrangement

**THIRD- AND FOURTH-YEAR**

Courses Numbered 100 Through 199 Are Third and Fourth Year Language and Beginning Literature and Civilization
100. Advanced Spanish Conversation — Prerequisite: 23 or equivalent. Enrollment limited to 10 per class.
   3 units, Aut, Win, Spr (Staff) MWF 1:15

101. Advanced Spanish Conversation — Continuation of 100. Enrollment limited to 10 per class.
   3 units, Aut, Win, Spr (Staff) MWF 1:15

111. Third-Year Spanish — Intermediate grammar and composition. Prerequisite: 23 or equivalent.
   3 units, Aut (Staff) MWF 10

111B. Third-Year Spanish — Intermediate grammar and composition. Especially designed for bilingual students. Prerequisite: 54B or equivalent.
   3 units, Aut (Valadez) MWF 11

112. Third-Year Spanish — Continuation of 111.
   3 units, Win (Staff) MWF 10

112B. Third-Year Spanish — Continuation of 111B. Especially designed for bilingual students.
   3 units, Win (Staff) MWF 11

113. Third-Year Spanish — Continuation of 112.
   3 units, Spr (Staff) MWF 10

113B. Third-Year Spanish — Continuation of 112B. Especially designed for bilingual students.
   3 units, Spr (Staff) MWF 11

135. Spanish Cultural Readings — The geography, history, art and music of Spain. Prerequisite: 23 or equivalent.
   3 to 5 units, Spr (Staff)

138. Spanish-American Cultural Readings — Prerequisite: 23 or equivalent.
   3 to 5 units, Aut (Staff) given 1976–77

140. Introduction to Hispanic Literature — An introduction to literary texts and to the analysis of genre. Prerequisite: 23 or equivalent.
   3 to 5 units, Spr (Staff)

151. Selected Works of Spanish Literature I — Readings of poetry, drama, and novels of the Golden Age. Prerequisite: 23 or equivalent.
   3 to 5 units, Win (Staff)

152. Selected Works of Spanish Literature II — Readings of poetry, drama, and novels of the 19th and 20th centuries. Prerequisite: 23 or equivalent.
   3 to 5 units, Spr (Valadez)

161. Selected Works of Spanish American Literature I — Prerequisite: 23 or equivalent.
   3 to 5 units, Win (Staff) given 1976–77

162. Selected Works of Spanish American Literature II — Prerequisite: 23 or equivalent.
   3 to 5 units, Spr (Valadez) given 1976–77

   4 units, Sum (Staff)

199. Individual Work — May be repeated for credit. Open only to majors in Spanish.
   1 to 12 units, any quarter (Staff)
   by arrangement

Courses Numbered 200 through 299 Are Courses in Language Literature and Civilization
Open to Advanced Undergraduate and Graduate Students

   3 units, Aut (Ball) TTh 1:15

202. Advanced Grammar and Composition II — Analysis of structural patterns. Prerequisite: 201 with grade of B or equivalent.
   3 units, Win (Valadez)

203. Advanced Grammar and Composition III — Prerequisite: 202 with grade of B or equivalent.
   3 units, Spr (Benmayor)

205. Translation Workshop — Problems and methods of translation from Spanish to English, English to Spanish. Prerequisite: 113 or equivalent.
   3 units, Spr (Staff)

   3 units, Spr (Petersen) TTh 10
   Sum (Petersen) MWF 10

212. History of the Spanish Language.
   3 units, Win (Petersen)

216. Bilingualism in the Chicano Community — (Same as Linguistics 146.)
   3 units, Spr (Hernández)
217. Areal and Social Dialectology—(Same as Linguistics 249.)
   4 units, Aut (Hernández)
220. Languages, Politics, and Society in the Contemporary World—(See under General Courses, Spanish 120.)
   3 to 5 units, Win, Spr (Hilton)
221. The Literature of Travel and Exploration—(See under General Courses, Spanish 121.)
   3 to 5 units, Win, Spr (Hilton)
222. Countries and Issues in the Contemporary World—(See under General Courses, Spanish 122.)
   3 to 5 units, Win, Spr (Hilton)
223. The Civilization of Spain, Portugal, and Latin America—(See under General Courses, Spanish 123.)
   3 to 5 units, Win, Spr (Hilton)
230. Spanish Literature I—Medieval didactic literature through representative works of poetry and prose. Open to majors in Medieval Studies.
   3 to 5 units (Benmayor)
231. Spanish Literature IA—Medieval poetry: the Spanish narrative and lyric traditions, from 1040 to 1500. Open to majors in Medieval Studies.
   3 to 5 units, Aut (Benmayor) given 1976–77
232. Spanish Literature IB—Medieval prose: historical, didactic and fictional composition, including early Renaissance fiction, from 1250 to 1550. Open to majors in Medieval Studies.
   3 to 5 units, Win (Benmayor) given 1976–77
   3 to 5 units, Win (Ball) given 1976–77
241. Spanish Literature IIA—Golden Age poetry: from Garcilaso to Quevedo.
   3 to 5 units, Spr (Ball)
242. Spanish Literature IIB—Golden Age drama: from Gil Vicente to Calderón.
   3 to 5 units, Win
   3 to 5 units, Aut (Benmayor) MW 2:15
   3 to 5 units, Spr (Ball) given 1976–77
   3 to 5 units, Win (Benmayor) given 1976–77
252. Spanish Literature III — Survey of Spanish literature from 1800 to 1898.
   3 to 5 units, Aut (Valadez) given 1976–77
   3 to 5 units, Spr (Gicovate) given 1976–77
   3 to 5 units
   3 to 5 units
   3 to 5 units, Aut (Valadez)
   3 to 5 units, Win (Valadez)
265. Introduction to Spanish-American Poetry.
   3 to 5 units, Spr (Franco)
   4 units, Aut (Franco)
272. Spanish Literature in a Social Context II—(Same as Comparative Literature and Modern Thought 272.) The poet and the people in the 1930’s — Lorca, Alberi, and Cernuda.
   4 units, Win (Franco)
274. Latin-American Literature in a Social Context II—(Same as Comparative Literature and Modern Thought 274.) Cultural nationalism: Indigenismo and Afro-Cubanismo.
   4 units, Aut (Franco) given 1976–77
275. Latin-American Literature in a Social Context I—(Same as Comparative Literature 275 and Modern Thought and Literature 275.) The elites and culture in a dependent society: Romantics, positivists, and Arielists.
   4 units, Win (Franco) given 1976–77

276. Latin-American Literature in a Social Context III—(Same as Comparative Literature and Modern Thought 276.) Art and social change: Problems of commitment from the Mexican to the Cuban Revolution.
   4 units, Spr (Franco)

   3 to 5 units, Spr (Benmayor)

278. Chicano Literature—(Same as English 62.) An intensive study of the emergence of a new literature.
   4 units, Aut (Islas) MTTh 2:15

   3 to 5 units, Win (Valadez) given 1976–77

280. Creative Writing: A Workshop.
   3 to 5 units, Win, Spr (Alegria)

   3 to 5 units, Win (Valadez) given 1976–77

   3 to 5 units, Win (Alegria) given 1976–77

290. Individual Work—May be repeated for credit. Open only to majors in Spanish.
   1 to 12 units, any quarter (Staff) by arrangement

Courses Numbered 300 Through 399 Are Graduate Seminars in Literature, Linguistics and Civilization. Open to Undergraduates, with Permission

300. Hispanic Bibliography—Bibliography and library research methods for the study of Spanish literature.
   3 to 5 units, Spr (Benmayor) given 1976–77

301. Methods of Teaching Spanish—(Same as Education 292.) See also Language Laboratory 215.
   2 units, Aut (Petersen) TTh 10
   Sum (Petersen) MTWThF 11

302. Historical Spanish Phonology.
   3 units, Aut (Petersen) given 1976–77

303. Historical Spanish Morphology.
   3 units, Win (Petersen) given 1976–77

304. Literary Theory and Hispanic Literature (taught with other members of faculty) —Readings in contemporary literary theory, with special application to the practical criticism of Hispanic literature.
   3 to 5 units, Win (Ball) MW 2:15–4:05

318, 319. Proseminar in Problems and Methods of Research in Hispanic Literature.
   3 to 5 units, Aut, Win (Gicovate)

321. Critical Analysis of Selected Books—This seminar trains Graduate Students in research techniques and writing.
   3 to 5 units, Aut, Win, Spr (Hilton)

328. Chicano Workshop for Graduate Students.
   3 to 5 units, Aut, Win, Spr (Franco, Staff)

334. Seminar on the Libro de Buen Amor and the courtly love tradition—Open to majors in Spanish and Medieval Studies with permission of instructor.
   3 to 5 units, Win (Ball) given 1976–77
339. Seminar on La Celestina—Open to majors in Spanish and Medieval Studies with permission of instructor.
   3 to 5 units, Win (Benmayor)

345. Seminar on Cervantes: Don Quijote and the Theory of the Novel—(Same as Comparative Literature 345.) A close reading of Don Quijote in the light of recent theories of the novel.
   3 to 5 units, Spr (Ball), given 1975–76

346. Seminar on Quevedo.
   3 to 5 units, Aut (Ball) given 1976–77

   3 to 5 units, Spr (Valadez)

357. Graduate Seminar in Hispanic Literature: Juan Ramón Jiménez and European Symbolism.
   3 to 5 units, Spr (Gicovate)

   3 to 5 units, Spr (Gicovate) given 1976–77

374. Seminar on Spanish-American Literature: Mario Vargas Llosa.
   3 to 5 units, Spr (Valadez) given 1976–77

   3 to 5 units, Aut (Alegria)

382. Seminar on Contemporary Latin-American Literature II: Alejo Carpentier.
   3 to 5 units, Win (Alegria)

   3 to 5 units, Aut (Alegria) given 1976–77

   3 to 5 units, Win (Alegria) given 1976–77

389. The Shorter Narrative—(Same as Comparative Literature 389.) A seminar on critical approaches to the shorter narrative with special reference to Spanish-American writers.
   3 to 5 units, Win (Franco)

399. Individual Work — Exclusively for Graduate Students in Spanish working on thesis or engaged in special work.
   1 to 12 units, any quarter (Staff) by arrangement

PORTUGUESE COURSES

FIRST- AND SECOND-YEAR

1. First-Year Portuguese.
   5 units, Aut (Staff) MTWThF 1:15, plus additional work in the Language Laboratory

2. First-Year Portuguese—Continuation of Portuguese 1.
   5 units, Win (Staff) MTWThF 1:15, plus additional work in the Language Laboratory

3. First-Year Portuguese — Continuation of Portuguese 2.
   5 units, Spr (Staff) MTWThF 1:15, plus additional work in the Language Laboratory

9. Portuguese for Students of Spanish — Accelerated course for beginners with advanced knowledge of Spanish. Designed to give students of Spanish a reading knowledge of Portuguese for research purposes.
   3 to 5 units (Staff)

15. Intensive First-Year Portuguese—Equivalent to 1, 2, and 3 combined. Enrollment limited. Consent of instructor necessary.
   15 units, Sum (Staff) MTWThF 8:00–9:30 and 10:30–12:00

22. Second-Year Portuguese — Prerequisite: Portuguese 3.
   3 units, Aut (Staff) MWF 12

   3 units, Win (Staff) MWF 12

99. Individual Reading — Enrollment only by special permission. Prerequisite: 23.
   1 to 5 units, any quarter (Staff) by arrangement

131. Selected Works of Portuguese Literature.
   3 to 5 units

132. Selected Works of Brazilian Literature.
   3 to 5 units
ADVANCED UNDERGRADUATE AND GRADUATE

181. Advanced Portuguese.
3 units, Aut (Staff) MWF 1:15

182. Advanced Portuguese — Continuation of 181.
3 units, Win (Coelho) MW 2:15

3 to 5 units, Spr (Peiersen) given 1977-78

230. Portuguese Literature I—Survey of literary trends and authors of Portuguese Literature.
3 to 5 units (Coelho)

240. Portuguese Literature II—Survey of literary trends and authors of Portuguese literature.
3 to 5 units (Coelho)

250. Brazilian Literature I—Survey of literary trends and authors of Brazilian literature.
3 to 5 units, Aut (Coelho)

260. Brazilian Literature II—Survey of literary trends and authors of Brazilian literature.
3 to 5 units, Win (Coelho)

291. The Poem Itself—(Same as Spanish and Comparative Literature 291.) A course on practical criticism based on the famous poems of Spain, Portugal, Brazil, and Spanish America. Students will be expected to write short papers on the texts discussed. Classroom debates as well as poetry readings will be encouraged. Reading knowledge of Spanish and/or Portuguese required.
3 to 5 units (Coelho)

295. Introduction to the Lyrical Poetry of Camões—Study of the most significant lyrical poems of Camões, with emphasis on the sonnets.
3 to 5 units (Coelho)

299. Individual Work—May be repeated for credit.
1 to 12 units, any quarter (Staff) by arrangement

GRADUATE SEMINARS

302. History of the Portuguese Language.
3 to 5 units, Spr (Petersen)

356. Seminar on Fernando Pessoa—A study of the poetry of Fernando Pessoa, as well as the poems of his “heterónimos” Alberto Caeiro, Ricardo Reis, and Alvaro de Campos.
3 to 5 units (Coelho)

360. Seminar on Brazilian Modernism: Carlos Drummond de Andrade and the modern poetry of Brazil—A critical analysis of the main currents of Brazilian modern lyric through a detailed study of Drummond’s poetics. Reading knowledge of Portuguese required.
3 to 5 units (Coelho)

365. The Luso-Brazilian Short Story—A seminar on the shorter narrative of Portugal and Brazil with special emphasis on modern and contemporary writers. Reading knowledge of Portuguese required.
3 to 5 units (Coelho)

399. Individual Work—Exclusively for graduate students in Portuguese working on a thesis or engaged in special work.
1 to 12 units, any quarter (Coelho) by arrangement

STATISTICS

Emeritus: Quinn McNemar (Professor)
Chairman: Ingram Olkin
Professor of Biostatistics: Byron W. Brown
Professor of Educational Statistics: Rosedith Sitgreaves (by courtesy)
Associate Professor: Paul Switzer
Assistant Professors: Persi Diaconis, Ray Faith, Yashaswini Mittal, Sidney Resnick (on leave Aut, Win 1975–76), Thomas W. Sager

OFFERINGS AND FACILITIES

The Department’s goals are to acquaint students with the role played in science and technology by probabilistic and statistical ideas and methods, to provide instruction in the theory and application of techniques
that have been found to be commonly useful, and to train research workers in probability and statistics. There are courses for general students as well as for those who plan careers in statistics in government, business, industry, and teaching.

The requirements for a degree in statistics are flexible, depending on the needs and interests of the students. Some students may be interested in the theory of statistics and/or probability, whereas other students may wish to apply statistical and probabilistic methods to a substantive area. The Department has long recognized the relation of statistical theory to applications. It has fostered this by encouraging a liaison with other departments in the form of joint faculty appointments: Economics (T. W. Anderson), Education (I. Olkin, R. Sitgreaves, H. Solomon, P. Suppes), Electrical Engineering (T. Cover), Family, Community and Preventive Medicine (B. W. Brown, B. Efron, R. G. Miller, L. E. Moses), Geology (P. Switzer), Operations Research (G. J. Lieberman). The research activities of the Department reflect an interest in both applied and theoretical statistics and probability. In the applied area, for example, the Department is one of three centers to study statistics and environmental factors in health. The courses themselves generally tend to be theoretical. However, there are three practicum workshops, in biology-medicine, behavioral sciences, and environmental factors in health, in which graduate students may become involved in the analysis of actual problems in the field.

In addition to courses for statistics majors at the undergraduate or graduate level, the Department offers a number of courses designed for users in other departments. These tend to emphasize the application of statistical techniques rather than a theoretical development.

A candidate considering graduate work in statistics may be interested in the brochure "Careers in Statistics," which is available upon request from the American Statistical Association, 806 15th St., N.W., Washington, D.C. 20005, or from the Department.

For the doctoral program, a mathematical background at the level of advanced calculus or mathematical analysis is essential; a year of probability and statistics (at the level of Statistics 116, 119, 120) is needed. The Department offers a combination course 119-120 during the Summer Quarter; students who have not had this background are advised to try to make up the deficiency during the summer. However, promising students may remove the deficiency during the first year.

The Department awards approximately 10 to 15 graduate fellowships and assistantships for incoming doctoral students. It is advantageous for students who are able to obtain fellowships from other sources to do so. The Master's degree program is normally a full one-year program. The doctoral program is normally a four-year program — three years of course work and one year for the dissertation. However, it is advisable for the student to become involved in research projects early in the program.

Computer facilities are available at the Center for Information Processing, which maintains an IBM 360/67 computing system with high-speed disks for on-line storage of users' programs and data. For use in research and teaching, the Department maintains a terminal unit, a Hewlett-Packard 9810A computer, a Wang 2200, and a number of smaller calculators.

The Department has always been a center for visitors from other countries and universities. As a consequence, there is usually a wide range of seminars offered by both the visitors and our own faculty.

The Department of Statistics is located in its own building. Space for Ph.D. graduate students is provided adjacent to faculty offices.

**Programs of Study**

**Bachelor of Science in Mathematical Sciences**

The Statistics Department participates with the Departments of Mathematics, Computer Science, and Operations Research in a program leading to the degree of Bachelor of Science in Mathematical Sciences. For further information on this program, see Program in Mathematical Sciences in this bulletin.

**Bachelor of Science**

The following Departmental requirements are in addition to the University's basic requirements for the Bachelor's degree:

1. Mathematics 45 or equivalent, and Mathematics 113.
2. Computer Science 106.
3. Statistics 116, 119, 120, and four additional courses chosen from offerings in the Statistics Department (24 units). These will normally be taken from the group of courses 180, 203, 204, 205, 206, 207. Students can receive credit toward fulfilling this requirement for, at most, one of the following courses: Statistics 40, 50, 60, 70, or 110.

4. Four additional courses chosen from offerings in the Statistics Department or from authorized courses in other departments.

**MASTER OF SCIENCE**

The Department requires that the student take 45 units of work from offerings in the Statistics Department or from authorized courses in other departments. If advanced statistics courses are included in the program, the total number of units may be reduced (usually to 40–45 units, depending on the program). A thesis is not required.

Each student will normally fulfill the following requirements for the Master of Science degree:

2. Mathematics 113 and Computer Science 106. Substitutions of other courses in Mathematics and Computer Science may be made with consent of the adviser.
3. Three additional courses from offerings in the Statistics Department. These are normally taken from the group of courses 180, 203, 204, 205, 206, 207, 206, 209.
4. Additional units to complete the requirements chosen from offerings in the Statistics Department or from authorized courses in other departments.

Students who are interested in mathematical statistics should concentrate on more advanced courses in the Department.

Students interested in mathematical models in behavioral sciences can take 140, 180, 204, 208, 209, 250, 251, 257 within the Department, as well as authorized courses from other departments.

Students interested in Operations Research will normally be interested in the application of quantitative techniques to business and industrial technology. They may take 136, 180, 207, 240, 250, 251, 252, 257, 355, 358, 359 within the Department, as well as authorized courses from other departments.

Students interested in economics may easily relate courses in economics with statistics courses. They may take Statistics 136, 150, 180, 206, 207, 221, 222, 223 and 240 within the Department.

Students interested in sociology, political science, or communications may take 140, 150, 160, 161, 182, 180, 203, 204, 205, 206, 208, 209, 221, 222, 223, 257.

Students interested in computer science may easily arrange a program for a Master's degree in Statistics.

In general, combinations of courses may be arranged to suit particular interests in most fields.

A 2.75 grade point average will be required for all Statistics courses which are taken for a letter grade toward an M.S. degree, and all Statistics courses required for the M.S. degree (116, 217, 218, 219, 220, and 3 additional courses) which are offered for letter grades must be taken for letter grades.

**DOCTOR OF PHILOSOHY**

Candidates for the degree of Doctor of Philosophy in Statistics will follow such courses as are approved by the Department faculty, subject to general University regulations. Each student's program should be arranged to include work in pure mathematics, mathematical statistics, and the application of statistics to some particular field.

The relative amount of time allotted to study under each of these headings will vary from individual to individual, according to previous training and experience. In any case, the following requirements are stipulated:

1. **Mathematics.** Mathematics 205A and 206A (or equivalent) and one of the following alternatives: (a) two 200-level quarter courses in Mathematics, or (b) two doctoral level quarter courses in Mathematics, Computer Science or Operations Research together with demonstrated competence in topology and modern algebra as indicated by a grade of B or better in graduate or advanced undergraduate courses in these subjects. In general, it is advisable for students to obtain as strong a mathematical background as is feasible.

2. **Probability and Statistics.** Statistics 221, 230A,B,C, 236A,B,C. These courses provide familiarity with the mathematical theory of probability and the major divisions of statistical theory. In addition, a Ph.D. candidate must offer at least six quarter courses from the advanced courses offered in special-
ized fields such as Decision Theory, Sequential Analysis, Large Sample Theory, Multivariate Analysis, Non-parametric Inference, Time Series, Robust Estimation, Geometric Probability, Stochastic Processes, Pattern Recognition, Statistical Complexity. Other advanced topics may be offered with the consent of the adviser. Normally students should consider completing three to four of the basic advanced topic courses.

3. Examinations. Two written examinations in probability and statistics—an elementary examination based on Statistics 116, 217, 218, 219, 220, and an advanced examination based on Statistics 230A,B,C and 236A,B,C. These tests are intended to assess the student's problem-solving ability and mathematical ingenuity. As such they are designed to serve as prognostic tests of the student's chances of success in the program.

4. Experience. All students working for the Ph.D. are required as a part of their program to obtain experience including any or all of: research, consulting, teaching assistance. These duties are deliberately kept light enough to permit full-time study.

Doctor of Philosophy Minor—The Statistics Department will devise individual Ph.D. minor programs, but the department urges all graduate students in other fields who wish to have a subspecialty in Statistics to study for an M.S. degree instead. The unit requirement for an M.S. degree is 40-45 units, depending on the degree of difficulty of the courses, whereas the number of units required for a minor averages around 30. This difference of 10-15 units can be made up by the student including in the M.S. program courses from his or her own field which are related to Statistics or applications of Statistics.

FELLOWSHIPS AND ASSISTANTSHIPS

A variety of fellowships and assistantships are available for doctoral candidates. The duties are variable and may include any or all of, grading papers, tutoring or teaching problem or laboratory sessions, research and computation assistance to investigators. All applicants for financial assistance are required to take the Aptitude Test and the Advanced Test in Mathematics of the Graduate Record Examination. Applicants are urged to take the Graduate Record Examination between July and November in order to afford time for receipt of the scores before January 15. For details concerning this test see the Information Bulletin. Overseas applicants, who may not receive the Information Bulletin promptly, should write directly to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey 08540.

A. INTRODUCTORY COURSES

Introductory courses for general students with an interest in the problems of descriptive statistics and statistical inference are: Statistics 10, 40, 50, 60, 61, 65, 66, 70, 180. These courses have no mathematical prerequisites; they satisfy the Natural Science, Mathematics and Technology distribution requirement. Statistics 10 is designed to familiarize the student with the general ideas of descriptive and inferential statistics as used in daily life, e.g., newspaper and magazine reports, polls, etc. It is a terminal course and does not serve as a prerequisite for further work. Statistics 40 covers discrete probability theory and its applications in statistics. Statistics 50 studies the theory of making decisions in the face of uncertainty. The sequence 60, 61 emphasizes mainly the techniques and methods of statistical inference. The sequence 65, 66 is designed as an accelerated version of 60, 61 and should be taken by students who are more adept with quantitative methods. Statistics 70 is designed for students interested in biological and medical applications of statistics. Statistics 180 is designed to provide some guidance in the use and meaning of some of the statistical packages.

The courses 116, 119–120 (219–220), 217–218 are introductory but have a calculus prerequisite. Statistics 110 covers the most important techniques used in the analysis of experimental data in engineering and science. Statistics 116 provides a general introduction to the theory of probability. It may be followed by 119 and 120 (219, 220), which deal with statistical theory, or by 217 and 218, which deal with stochastic processes. The sequence 116, 119, 120 is a basic one-year course in mathematical statistics; the sequence 116, 217, 218 is a basic one-year course in probability theory.

10. Basics of Descriptive and Inferential Statistics—This course is designed for students who wish to gain familiarity with sta-
stistical ideas; it may be termed a course on statistical literacy. The emphasis will be on descriptive measures such as mean, median, mode, variance, and on computational techniques and graphic methods for representing data. The interpretation of examples of data which occur in daily life, e.g., in newspapers, magazines, polls, etc., will be stressed. This course is a terminal course and is not acceptable as a prerequisite for later courses.

4 units, Win (Solomon) MWF 1:15
Spr (Efron) MWF 2:15

40. Introduction to Probability and Its Applications — Designed as a precalculus course for the nonmathematical student who wishes to understand the ideas underlying probability models in other fields. Emphasis is on the use of probability in applied problems. Basic probability theory, random phenomena, special distributions, multivariate distributions, laws of large numbers, random walks, Markov chains. Applications drawn from the social, behavioral, physical, biological sciences. (Graduate students enroll in 140.)

3 units, Aut (Faith) MWF 10
Sum (——) by arrangement

50. Elementary Decision Theory — An introduction to decision-making in the face of uncertainty using statistical decision theory. This course is especially designed as an introduction to probability, utilities and risks, descriptive and inferential statistics for non-statistics majors. Emphasis will be placed on the evaluation of alternative courses of action facing the industrialist, administrator, and layman. (Graduate students enroll in 150.)

5 units, Aut (Sitgreaves) MTWThF 9
Sum (——) by arrangement

60. Introduction to Statistical Methods I— Especially designed as a nonmathematical study of statistical methods used in the social and behavioral sciences. Although specific computational techniques will be taught, the emphasis will be on the ideas underlying statistical techniques. Organization of data and methods of summarization, including averages and measures of variability and association. Statistical inference based on a brief introduction to probability theory, including tests of hypotheses, estimation, and confidence intervals. The computer and statistical packages will be used to carry out some of the analyses. (Graduate students enroll in 160.)

5 units, Aut (Staff) MTWThF 2:15
Spr (Staff) MTWThF 1:15
Sum (Staff)

61. Introduction to Statistical Methods II— Continuation of Statistics 60. Treats in detail the rationale and application of the most useful statistical methods, tests of significance, estimation of parameters, and analysis of data. Chi-square tests, the analysis of variance, least squares methods in regression, correlation, nonparametric methods, sample surveys, elementary design of experiments. Prerequisite: Statistics 60 or consent of instructor. (Graduate students enroll in 161.)

5 units, Win (Staff) MTWF 2:15

65, 66. Statistical Methods I—These courses are similar in content to 60, 61, but are taught at a more accelerated pace. Students who have some quantitative background should elect these courses instead of 60, 61. (Graduate students enroll in 165, 166.)

65. 5 units, Aut (Sager) MTWThF 11
66. 5 units, Win (Olkin) MTWThF 11

70. Biostatistics— (Enroll in Family, Community and Preventive Medicine 202.) Introduction to statistical reasoning, with applications to research in biology and medicine. Estimation and significance testing; frequency tables; correlation; analysis of variance; retrospective and prospective studies; clinical trials. Prerequisite: high school algebra.

3 units, Aut (Brown) MTW 3:15-4:05

110. Statistical Methods in Engineering and the Physical Sciences—Designed as a first course for the study of the most important statistical techniques commonly used by engineers and physical scientists, with the use of each technique illustrated by examples drawn from these fields. Provides a thorough grounding in the necessary fundamentals of probability theory required for an understanding of statistics. Statistical decision-making as approached from the viewpoint of designing and analyzing experiments. Point and interval estimation, tests of hypothesis, nonparametric methods, curve fitting by least squares, analysis of variance and elementary experimental design. Prerequisite: one year of calculus.
116. Theory of Probability — Probability spaces as models for phenomena with statistical regularity. Discrete spaces (e.g., binomial, hypergeometric, Poisson) and combinatorics. Continuous spaces (e.g., normal, exponential) and densities. Random variables, expectation, independence, conditional probability. Distribution theory: standard probability laws and transformation of variables techniques. Introduction to the Laws of Large Numbers and Central Limit Theorem. Examples from genetics, quality control, traffic situations, gambling, and the social sciences. Prerequisite: Mathematics 44 or equivalent.

4 units, Aut (Mittal) MTWF 10
Win (Stein) MTWF 10
Spr (Johns) MTWF 10
Sum (——) MTWThF 11

116E. Theory of Probability — A course similar to 116 designed especially for engineering students. Prerequisite: Mathematics 44.
3 units, Aut (Diaconis) MWF 11

119, 120. Statistical Inference — Designed as a first course in the theory of mathematical statistics. Modern statistical procedures are derived from a mathematical framework, with the use of each technique illustrated with practical examples. Review of probability theory, statistical inference, decision theory; point and interval estimation, tests of hypotheses; Neyman-Pearson theory, Bayesian analysis, large sample theory, non-parametric methods, sequential analysis, least squares methods in regression, correlation, elementary analysis of variance and design of experiments. Prerequisite: 116. (Graduate students enroll in 219, 220.)

119. 4 units, Win (Solomon) MWF 9
120. 4 units, Spr (Solomon) MWF 9

119–120. 8 units, Sum (Haley) MTWThF 8:00-9:50

140. Introduction to Probability and Its Applications — For graduate students. Lectures same as 40.

3 units, Aut (Faith) MWF 10
Sum (——) by arrangement

150. Elementary Decision Theory — For graduate students. Lectures same as 50.

5 units, Aut (Sitgreaves) MTWThF 9
Sum (——) by arrangement

152. Introduction to Operations Research I — (Enroll in Operations Research 152.) Introduction to deterministic models in operations research. Linear, non-linear, and dynamic programming. Network analysis, inventory theory, simplex method, transportation problem, dual theorem, convex programming, integer programming, structure of deterministic dynamic programming problems, minimax theorem. Matrix notation will be introduced. Not open to graduate students. See 252. Prerequisite: Mathematics 43.

3 units, Win (Eaves) TTh 4:15–5:30


3 units, Spr (Lieberman) MW 4:15–5:30

160. Introduction to Statistical Methods I — For graduate students. Lectures same as 60.

5 units, Aut (Staff) MTWThF 2:15
Spr (Staff) MTWThF 1:15
Sum (——) by arrangement

161. Introduction to Statistical Methods II — For graduate students. Lectures same as 61.

5 units, Win (Staff) MTWF 2:15

165, 166. Statistical Methods II, III — For graduate students. Lectures same as 65, 66.

165. 5 units, Aut (Sager) MTWThF 11
166. 5 units, Win (Olkin) MTWThF 11

180. Statistical Computer Packages — How to choose, use, and evaluate statistical computer packages. Computer-based data analysis. Topics in numerical methods for statistical computation. Interpretation of output from packages. Statistical problems that arise in using packages, including simultaneous inference, model identification, and stepwise procedures. Statistical methods to be discussed will include descriptive statistics, correlation, regression, analysis of variance, discriminant analysis, and factor anal-
ysis. Students will be assigned computer exercises in which several packages will be studied and compared. Major emphasis will be placed on consumer protection. Prerequisite: a first course in Statistics or consent of instructor.

3 units, Win (Thisted) MWF 9
Spr (McKeown) MWF 10

199. Independent Study — For undergraduates.
(Staff) by arrangement

B. COURSES PRIMARILY FOR STUDENTS IN OTHER DEPARTMENTS AND FOR MASTER’S CANDIDATES

Courses in this category have been designed for particular use in applications, either by professional statisticians or by researchers in other fields. The core courses for the Master’s degree program are 116, 217, 218, 219, 220, plus additional courses. These will normally be from the following group.

136. Introduction to the Theory of Games—Game trees, strategies, equilibrium points; two-person zero-sum games, matrix games, min-max solutions, infinite games, games of timing (duels); non-zero-sum games, the Nash solution; n-person games, the Shapley value. Pre- or corequisites: 116 and Mathematics 113.

3 units, Spr (Resnick) MWF 2:15

200. Statistics for Scientists, Mathematicians, and Engineers—Will discuss statistical methods of wide use in data analysis: linear models, correlation and regression, maximum likelihood estimation, analysis of variance, t and F tests, discriminant analysis, principal components, nonparametric tests, chi-squared and binomial regression models. The emphasis will be on a broad understanding of statistical methodology rather than on deep theoretical analysis or the details of specific applied areas (though some real applications will be used for illustration purposes). Prerequisites: a good understanding of matrix algebra at the level of Mathematics 113, multiple integration at the level of Mathematics 46, and elementary probability theory at the level of Statistics 116.

3 units, Aut (Diaconis) MWF 1:15

203. Introduction to Analysis of Variance and Design — The analysis of variance ("ANOVA") is the most widely used statistical technique in both the sciences and social sciences. Its purview includes the proper design and interpretation of experiments as well as the understanding of observational data. Topics will include regression, t tests, F tests, one- and two-way factorial experiments, orthogonality, matching, proper error estimates. Prerequisites: a basic course in statistics (Statistics 61, 66, 110, or 120).

3 units, Spr (Solomon) MWF 1:15

204. Sampling from Human Populations—An introduction to the theory of sampling from finite populations. Simple random sampling, stratified sampling, cluster sampling, efficiency of various designs, with particular emphasis on applications. Projects include carrying out and analyzing an actual survey. Prerequisites: a basic course in statistics (Statistics 61, 66, 110, or 120). (Undergraduates enroll in 104.)

3 units, Sum (——) MTWTh 9

205. Introduction to Nonparametric Statistics—Nonparametric methods are designed to deal with "messy" data that are difficult to analyze with the standard parametric models. They have proved particularly useful in biology, psychology, sociology, etc. Presentation will include nonparametric analogs of the one- and two-sample t tests and the analysis of variance: the sign test, median test, Wilcoxon's tests, Kruskal-Wallis test, and permutation methods in general. Goodness-of-fit tests, including chi-square, contingency tables, and Kolmogorov-Smirnov methods may also be discussed. Prerequisites: a basic course in statistics (Statistics 61, 66, 110, 120, or 200). (Concurrent registration in 120 is permitted.)

3 units, given 1976–77

206. Applied Multivariate Analysis—Multivariate methods are necessary when several correlated measurements are made on each experimental unit. These methods are much used in education, psychology, sociology, genetics, and other areas. Topics: bivariate and multivariate normal distributions, quadratic forms, Hotelling's $T^2$ and other hypothesis tests, factor analysis, and multiple regression. Prerequisites: A basic course in statistics (Statistics 61, 66, 110, 120, or 200). Knowledge of matrix theory is helpful. (Concurrent registration in 120 is permitted.)

3 units, Spr (Solomon) MWF 1:15
207. **Introduction to Time Series Analysis**—
Time series models are used extensively in economics, engineering, physics, geology, and other sciences. Topics will include trend fitting, autoregressive schemes, moving average models, periodograms, second order stationary processes, and spectral analysis. Prerequisites: Stat 116 and a basic course in statistics (Statistics 61, 66, 110, 120, or 200). (Concurrent registration in 120 is permitted.)

3 units, Win (Faith) MWF 1:15

208. **Mathematical Models in Behavioral Sciences: Psychometrics** — Examination of mathematical models arising in or pertaining to psychometrics. Illustrative topics are factor analysis, mental testing, latent structure analysis, scaling theory, clustering and classification, multidimensional contingency tables. Prerequisite: Statistics 120.

3 units, given 1976–77

209. **Mathematical Models in Behavioral Sciences: Sociometrics** — Examination of mathematical models in social and psychological processes; equilibrium states, Poisson processes, and related topics. Prerequisite: Statistics 120.

3 units, given 1976–77

211A,B. **Advanced Statistical Analysis in Educational Research** — (Enroll in Education 351A,B.) Applied multivariate analysis including multiple regression, canonical analysis, discriminant analysis, factor analysis, cluster analysis. Prerequisites: Statistics 220 or equivalent and consent of the instructor.

211A. 4 units, Aut (Sitgreaves) MWF 11:00–12:30

211B. 4 units, given 1976–77


217. 3 units, Aut (Miller) MWF 2:15

218. 3 units, Win (Miller) MWF 2:15

Spr (Faith) MWF 3:15

217–218. 6 units, Sum (——) MTWTh 10:00–11:50

219, 220. **Statistical Inference**—For graduate students. Lectures same as 119, 120.

219. 3 units, Win (Solomon) MWF 9

220. 3 units,Spr (Solomon) MWF 9

219–220. 6 units, Sum (Haley) MTWThF

251. **Stochastic Models in Operations Research** — (Enroll in Operations Research 251.) Formulation, solution, and analysis of stochastic models in operations research, including those of queueing theory, inventory, Markov processes, simulation, reliability theory. Prerequisites: 116 and 218 (concurrently), Operations Research 250.

3 units, Spr (Hillier) TTh 4:15–5:30

Sum (——) MW 1:15–3:00

252. **Operations Research**—(Enroll in Operations Research 252.) For graduate students who have not had the equivalent of Operations Research 152 and 153. Prerequisites: Calculus and Statistics 40 or 110 or 116. May be taken concurrently.

4 units, Win (Jacobs) TTh 4:15–5:30

Sum (——) TTh 3:15–5:30

257. **Simulation**—(Enroll in Operations Research 257.) Random number generators, discrete-event simulations, simulation languages, statistical analysis of the output of simulations, and applications to stochastic models in operations research.

3 units, Spr (——) TTh 2:45–4:00

Sum (——) MW 3:15–5:30

299. **Literature of Statistics** — Intensive study of literature of any special topic, usually culminating in the preparation and presentation of reports upon topics studied.

Any quarter (Staff) by arrangement

C. **Courses Primarily Designed for Doctoral Students**

The 230A,B,C and 236A,B,C sequences comprise the fundamental sequence which serves as a general introduction to and prerequisite for further work. Subsequent courses are special topics courses and delve more deeply into these areas.

221. **Analysis of Variance I**—Theory of gen-
eral linear models for the normal distribution. Study of maximum likelihood estimates and their associated tests and confidence intervals. Analysis of variance for standard statistical designs (e.g., one-way and two-way classifications, latin square). Various techniques of simultaneous inference; analysis of covariance. Prerequisite: 120 and knowledge of matrix algebra, or consent of instructor.

3 units, Win (Sager) MWF 10

222. Analysis of Variance II—Random effects and mixed model analysis of variance. Permutation tests and randomization basis of inference. Study of the effects on statistical inference of departures from the assumptions of normality, equal variances, and independence. Prerequisite: 221.

3 units, Spr (Sager) MWF 10

223. Data Analysis — Statistical analysis of actual case material. Topics include: Exploratory methods based on graphical techniques and transformations, contingency tables, multiple regression. Use of the computer is anticipated. Prerequisite: 222 or consent of instructor.

3 units, given 1976–77


230A. 3 units, Aut (Mittal) MWF 1:15
230B. 3 units, Win (Mittal) MWF 1:15
230C. 3 units, Spr (Mittal) MWF 1:15

236A. 3 units, Aut (Cover) MWF 11
236B. 3 units, Win (Cover) MWF 11
236C. 3 units, Spr (Stein) MWF 11

240. Linear Programming—(Enroll in Operations Research 240.) This course will survey linear programming, emphasizing standard model formulation, fundamental theorems, variations of the simplex method and parametric programming. Corequisite: Mathematics 113.

3 units, Aut (Choatal) TTh 1:15–2:30
Sum (——) TTh 1:15–3:00


3 units, Win (Cottle) TTh 4:15–5:30

260A,B,C. Workshop in Biostatistics — Applications of statistical techniques to current problems in medical science. Problems are often presented by medical faculty, and tentative or final statistical analyses are proposed and discussed by biostatistics faculty, graduate students, and visitors. Intended primarily for doctoral students in statistics. Enrollment for credits may involve extra reading or consulting and requires permission of the instructor.

260A. 1 to 5 units, Aut (Brown, Efron, Miller) Th 1:15–3:05
260B. 1 to 5 units, Win (Brown, Efron, Miller) Th 1:15–3:05
260C. 1 to 5 units, Spr (Brown, Efron, Miller) Th 1:15–3:05

261A,B,C. Workshop in Behavioral Science Statistics—Practicum in consulting on behavioral science problems, emphasizing both the theoretical and practical aspects of the problem. A team of students will function as a consultant; they meet with consultee and try to arrive at a solution to the problem. This is then presented to the group. Open to doctoral students. Prerequisite: consent of instructor.

261A. 1 to 3 units, Aut (Olkin, Sitgreaves) M 3–5
261B. 1 to 3 units, Win (Olkin, Sitgreaves) M 3–5
261C. 1 to 3 units, Spr (Olkin, Sitgreaves) M 3–5

262A,B,C. Workshop in Environmental Factors in Health—A seminar dealing with statistical aspects of pollution and related health effects. There will be interaction with specialists in the field of pollution and health, as well as discussions of current literature. One goal is the development of new statistical methodology for the analysis of pollution and health data.

262A. 1 to 3 units, Aut (Diaconis, Sager, Switzer) by arrangement
262B. 1 to 3 units, Win (Diaconis, Sager, Switzer) by arrangement
262C. 1 to 3 units, Spr (Diaconis, Sager, Switzer) by arrangement

314. Matrix Analysis and Inequalities—(Enroll in Operations Research 314.) A study of various topics in matrix theory and inequalities having applications in computer science, operations research, and statistics. The subjects covered will be chosen from the following list: matrix factorizations, patterned matrices, determinants, pivot theory, special classes of matrices; linear inequalities, matrix inequalities, moment inequalities, stochastic inequalities, condition number inequalities, unification of certain types of inequalities, extremal problems; integrals and functional equations with matrix argument. Prerequisites: Mathematics 102 or 113, and approval of an instructor.

3 units, Aut (Cottle) MWF 9

324A,B. Multivariate Analysis—General theory of multivariate distributions; specific distributions: multivariate exponential distribution; multivariate normal distribution and related distributions such as the Wishart distribution and Hotelling's $T^2$. Statistical inference related to the multivariate normal distribution: tests for means, variances and covariances, multivariate analysis of variance, multiple regression, principal components, canonical correlations. General problems of classification and clustering of high-dimensional data. Discussion of estimation of the mean of the multivariate normal distribution from a decision-theoretic point of view. This course may differ depending on whether the approach uses coordinates or is coordinate-free.

324A. 3 units, Aut (Anderson) MWF 2:15

324B. 3 units, Win (Anderson) MWF 2:15

326. Sequential Analysis—The Wald sequential probability ratio test, operating characteristics and applications; Bayes sequential decision problems; asymptotic shapes; sequential design of experiments; special topics. General theory of optimal stopping with applications to sequential statistical decision problems.

3 units, Spr (Efron) MWF 3:15

328A,B. Non-Parametric Statistical Inference—Statistical inference without strong model assumptions; hypothesis testing and estimation using permutations and ranks; nonparametric model-fitting, tolerance limits, discriminant analysis, and analysis of variance.

328A. 3 units, given 1976–77
328B. 3 units, given 1976–77

330. Stochastic Processes—Topics in stochastic processes to be announced. Typical choices have included: Martingales and their applications, branching processes, extreme values and regular variation, weak convergence, Brownian motion, additive processes and regenerative phenomena, point processes, stationary processes. Prerequisites: 230A,B,C.

3 units, Spr (Resnick) MWF 11

332. Asymptotic Methods in Statistics—Many non-classical problems in statistics involving distributions other than the normal distribution may be dealt with by approximate methods. Such approximations may be obtained by investigating the behavior of estimators and test statistics when the sample sizes become large. Topics considered include the asymptotic efficiency of maximum likelihood estimators, best asymptotically normal (BAN) estimators, asymptotic behavior of likelihood ratio tests, optimal designs and empirical Bayes procedures.

3 units, Aut (Johns) MWF 11

333. Robust Estimation—The concept of "robust" statistical procedures (i.e., procedures which continue to be effective when the parametric assumptions under which they are "optimal" are violated) will be developed with particular emphasis on the estimation of location for symmetric distributions. Examples from the recent literature will be treated in detail. Robustness in hy-
Hypothesis testing and regression analysis will also be discussed. Prerequisites: 236A, B, C.

3 units, Win (Johns) MWF 11

335. Isotonic Regression—Statistical inference under order restrictions. In practice, the statistical parameters of a problem are often known or assumed to be either increasing or decreasing. This additional information can be exploited by using the tools of isotonic regression. Topics selected from basic isotonic regression, computational algorithms, restricted maximum likelihood estimation, conditional expectation given a signa-lattice, testing the equality of ordered means, estimation of ordered distributions, isotonic tests for goodness-of-fit.

3 units, MWF 2:15

336A-B. Decision Theory and Statistical Inference — Minimax theorem, admissibility and complete class theorem, formulation of statistical decision problems, sufficient statistics, testing hypotheses, estimation, comparison of experiments, and sequential problems.

3 units, MWF 3:15


3 units, MWF 10

351A-B. Geometrical Probability and Applications—Distribution of points in Euclidean space, random lines in a plane and in space, coverage problems, packing problems, measure and density for sets of geometrical objects, integral geometry for functions of convex plane figures and surfaces. Emphasis in the course will be on breadth of the fields of application (for example, astronomy, atomic physics, biology, crystallography, physical chemistry, traffic).

3 units, given 1976–77


3 units, TTh 1:15–2:30

358. Queueing Theory — (Enroll in Operations Research 358.) Structure of queueing processes, limit theorems for single and multiple server queues in light and heavy traffic. Emphasis will be on nonparametric assumptions and classical limit theorems. Prerequisite: 359.

3 units, TTh 2:45–4:00


3 units, TTh 11:00–12:15


3 units, MWF 10

363. Statistical Complexity—(Same as Electrical Engineering 477.) Statistical complexity measures. Interaction of degrees of freedom, complexity of classification algorithms, and sample size. Kolmogorov complexity; Schnorr Martingale test for randomness. A goal of this course will be to consider and develop universal statistical tests. Prerequisite: Statistics 116.

3 units, given 1976–77

399. Research — Research work as distinguished from independent study of nonresearch character listed in 199 and 299.

Any quarter (Staff) by arrangement
Dean: Thomas Ehrlich  
Professors: Marc A. Franklin, Lawrence M. Friedman, John Kaplan, Victor H. Li, Robert L. Rabin, David Rosenhan  
Lecturer: Inga Markovits  

THE WORK OF THE LAW SCHOOL

The School of Law was established as a department of the University in 1893. Its purpose is to provide a thorough legal education for students who are fitted by their maturity and their previous academic training to pursue professional study under university methods of instruction. The curriculum leading to the first professional degree in law (J.D.) constitutes an adequate preparation for the practice of law in any English-speaking jurisdiction. Graduate work leading to the degrees of Master of the Science of Law and Doctor of the Science of Law is also offered. (For full Law School Curriculum and Faculty see the School of Law Programs of Study.) The Law School is on a two-term academic calendar. Registration for the autumn term will be held on September 3, 1975, and classes for spring term will terminate on June 4, 1976.

COURSES

GRADUATE

The following courses are open to qualified graduate students of other departments of the University upon permission of the instructor:

231. History of American Law—This course will deal with selected topics in the development of American legal institutions with special emphasis on the 19th century. The course will treat such subjects as legal aspects of slavery and race relations; legal control of the economy and its relationship to the development of a distinctively American social order; crime, violence, lawlessness and criminal justice in the American past; and changing concepts and functions of the legal profession. Friedman, A History of American Law (1973).

3 term units, Aut (Friedman)

243. China, Law and Society in the People's Republic of—This course examines the questions: What norms of behavior do the Chinese leaders want the people to adopt? How are these norms articulated and communicated to the people? What means are used to get the people to follow these norms? What happens to those who refuse to follow? For all these questions, an effort is made to identify the ideological, cultural, and other factors which affect the choices made by the Chinese leaders. A portion of this course will focus on the criminal process and the control of anti-social behavior. The second part of the course will deal with the effort to implement a positive social program: the Marriage Law and its effect on the status of women. Special emphasis is placed on comparing Chinese and Western legal concepts, institutions, and practices. Cohen, The Criminal Process in the People's Republic of China, 1949-1963: An Introduction (1965) and mimeographed materials.

3 term units, Spr (Li)

311. Law and Social Science—(Same as Sociology 181.) The purpose of this course is to broaden the approach to law by examining some major problems which law shares with other social sciences. Consideration will be given to definitions of law attempted by various social sciences, the impact of law on behavior of various kinds, the social forces which mold law, the influence of the legal system on the various actors within it and theoretical efforts to explain the relationship of law and society.

3 term units, Aut (Friedman)

307. Law in East and West Germany—(Same as German Studies 233A.) The seminar will analyze the legal systems of East vs. West Germany with the purpose of ascertaining the typical ways in which a socialist state differs from a bourgeois state in the use of law as a means of social transformation. We will focus in particular on those areas of law which either directly confront the individual with state authority or require a ranking between state and individual interests; constitutional law, certain areas of administrative law, procedure, etc. The different functions of individual rights in these areas (protecting the individual
against infringement by the state in the Federal Republic, educating and inducing the individual to contribute to socialist progress in the GDR) will be contrasted with the fairly similar functions of individual rights in horizontal relationships in both states, e.g., civil law, family law, etc.

3 units, Aut (I. Markovits)

323. Legal Systems of Western Europe and Latin America—The purpose of this course is to examine the traditions, attitudes, institutions and processes that are shared by the legal systems of major Western European and Latin American nations—the so-called civil law nations—and to understand some of the more important ways in which they differ from the Anglo-American common law. Cappelletti, Merryman, and Perillo, The Italian Legal System: An Introduction (1967) and Merryman, The Civil Law Tradition (paperback ed.).

3 term units, Aut (Cappelletti)

336. Seminar in Psychology and Law—The implications of psychological research and theory for law and legal process will be explored. Issues to be examined include the notions of responsibility and intention, the reasonable man, reasonable doubt, and insanity; the implications of equity theory and the "just world" hypothesis for pretrial detention; group processes and their effects on juries; stereotyping and arrest; witness reliability; introductory materials on the social psychology of institutions; the implications of dissonance theory for torts and bankruptcy.

2 term units, Aut (Rosenhan)

NONPROFESSIONAL

The following nonprofessional courses, open to juniors and seniors, as well as to graduate students in other departments, may be counted toward the A.B. degree but not toward professional degrees in law.

102. The Bill of Rights—(Same as Political Science 174K and Sociology 132.)—An inquiry into the problems of interpreting the Bill of Rights of the U.S. Constitution. Attention will be directed to the First Amendment guarantees, including the issues of advocacy of unlawful conduct, obscenity, libel and slander, access to private and to public forums, and free exercise of religion; Fourth, Fifth and Ninth Amendment aspects of the right to privacy; and Fifth and Fourteenth Amendment prohibitions on racial and sexual discrimination.

5 units, Aut (Kaplan)

104. Courts and the Legal Process—This course is designed for students who do not intend to undertake the professional study of law. Its purpose is to provide insight into how the law and legal institutions function as one important means of social control. The primary focus is on courts—a philosophical and functional study of their role and their relationships with other branches of government. Though not ignoring constitutional law, our main concern is with courts in their nonconstitutional role. We will explore this in a context relevant to communication: the law of defamation, privacy, government regulation of broadcasting, and free speech. Court opinions and readings provide the basis for class discussion.

5 units (Franklin) given 1976–77

107. The Criminal Law and the Criminal System—(Same as Political Science 174 and Sociology 157.) Exploration of the purposes and processes of the criminal law, with emphasis on the actual operation of the system, and the application of theory to contemporary problems. Topics will include the police, the trial, sentencing, corrections, and "non-victim" crimes. (Open to all undergraduate and graduate students.)

5 units (Kaplan) given 1976–77

110. The Administrative Process—This course has two principal objectives: (1) to develop an understanding of the role administrative agencies are currently playing in the resolution of major issues of socioeconomic conflict, and (2) to explore the inherent practical and theoretical limitations, if any, on the administrative process as a tool for implementing social change. The core of the course is an examination of the impact of various constituencies in shaping administrative policy in areas such as broadcasting, consumer protection, and conservation. In addition, special emphasis will be placed on the role of the courts in developing a body of administrative law.

4 units, Spr (Rabin)

149. Communication Law—(Same as Communications 149.) This course introduces non-law students to the issues surrounding government regulation of the mass media.
These issues emerge in virtually every aspect of the operation of the print and broadcast media—getting permission from the FCC to begin broadcasting; what media may do to obtain desired information; legal controls on what media may publish—or must publish; constraints on dissemination of the final product. Major attention will be given to decisions of the Supreme Court involving First Amendment issues. (May not be offered 1976–77.)

5 units, Spr (Franklin) TWTh 8:30–9:50
Dean: Clayton Rich

The School of Medicine was established as a department of the University in 1908, when the Cooper Medical College, which had been operating in San Francisco, was transferred to Stanford. Until 1959 clinical teaching and some teaching of the basic medical sciences were carried out in San Francisco, while the remainder was conducted on the University campus near Palo Alto.

In 1953 the Trustees of the University determined that the School of Medicine should be consolidated on the University campus in new facilities. Following many months of planning and preparation, the development of a new program of medical education, and the construction of the Stanford Medical Center buildings for teaching, research and patient care activities, the School began its operation at Stanford in September 1959.

The purposes of the School of Medicine are to provide a basic education in medicine for students working toward the Doctor of Medicine degree, to offer advanced work in the basic sciences leading to the Doctor of Philosophy degree, to provide training in clinical medicine and in research for medical graduates, and to conduct research programs to advance knowledge of the medical and related sciences and to apply that knowledge to problems of illness and health.

The curriculum offered students in the M.D. Program of the School of Medicine is an outgrowth of the Stanford Plan of Medical Education that was implemented at the time the Medical School moved from San Francisco to the University campus near Palo Alto. The goals of the Stanford Plan are:

1. To bring medical education into the University environment as a continuation of general education and to relate knowledge of the medical sciences to other fields of knowledge.
2. To provide all students with fundamental knowledge of the medical sciences, while simultaneously encouraging each student to develop as an individual in line with his abilities and interests.
3. To emphasize the unity of the medical sciences.
4. To promote in students awareness of the place of medicine in society, and of the patient and physician as members of society.
5. To produce practitioners of medicine who are trained in the scientific method, who acquire excellence in clinical skills and clinical judgment, and yet who maintain a humanistic approach to patients.
6. To encourage interested students toward academic medicine as a career.
7. To foster a graduate approach to medical education.

The School believes that the goals of the Stanford Plan of Medical Education are best achieved if each student can plan his or her curriculum within a flexible educational system in which the diversity of students' career goals and educational backgrounds is recognized. Accordingly, in 1968, curricular changes were introduced which provide each student with maximum flexibility in formulating an individualized curriculum that best takes into account the student's past experience and future career goals. Under this plan students need not take courses in areas in which they feel they already have adequate knowledge. In addition, students are encouraged to take advantage of curricular offerings on the University Campus as well as in the School of Medicine. The duration of the curriculum varies depending upon background and career goals. It may be as short as nine quarters for students who have already completed appropriate graduate work, to as many as eighteen quarters for students who include extensive research experience. Students interested in combined M.D.-Ph.D. programs must first apply for admission to the M.D. Program. Subsequent and separate application to a specific department is then required for candidacy for the Ph.D.

Provided an applicant to medical school has completed the basic courses in physics, chemistry and biology, the choice of an undergraduate major may reflect other interests, including the arts and humanities. Course work in mathematics and the behavioral sciences is highly recommended because of its importance in understanding medicine. Extracurricular activities and breadth of interests and experiences play
an important role in the selection of students from among those applicants having superior academic records. The general requirements for admission are in the Medical School Bulletin. For application materials write to: Chairman, Committee on Admission, Stanford University School of Medicine, Stanford, California 94305.

ALLIED MEDICAL SCIENCES

DIVISION OF PHYSICAL THERAPY

Emeritae: Lucille Daniels (Professor), Sarah Semans (Associate Professor)

Director: Helen Blood

Clinical Associate Professor: Catharine Graham

Adjunct Professors: Helen Blood, Barbara E. Kent

Lecturers: Gay L. Raymond, Katharine B. Robertson, Katherine F. Shepard


OFFERINGS AND FACILITIES

The Division of Physical Therapy in the Stanford University School of Medicine offers a Master's degree curriculum for students entering the field of physical therapy. The program encompasses two academic years (6 quarters) and a summer internship between the two, and includes basic courses required for state licensure. Students must complete one of three specialty areas, Administration and Community Health, Curriculum Development and Instruction or Pediatric Physical Therapy, as well as research requirements.

Classes are held at the Stanford Medical Center, which houses physical therapy lecture, laboratory, seminar and research rooms and a library. Students have two- and three-week periods of directed clinical experience at Stanford Hospital and affiliated health facilities during the first year, a full-time assignment during the summer quarter, and a four-week advanced internship in the spring of the second year. The sequence of clinical periods provides students with the opportunity to move toward full utilization of their clinical skills in planning and administering treatment programs.

The curriculum is approved by the Council on Medical Education of the American Medical Association in collaboration with the American Physical Therapy Association.

ADMISSION

Requirements for admission are a Baccalaureate degree, completion of prerequisite courses, filing of an application including scores from the Aptitude Test of the Graduate Record Examination by January 15, and, upon request of the Division, a personal interview, and completion of supplemental admission tests and forms.

Students are admitted autumn quarter each year. Dates for registration and general information will be found in the Information Bulletin of the University.

TRAINEESHIPS, SCHOLARSHIPS, AND LOANS

The resources for traineeships and scholarships awarded by the Scholarship Committee of the Division of Physical Therapy are limited and vary from year to year.

The Marian Williams Memorial Scholarship is awarded each year by the Committee, and a few private agencies offer special scholarships for physical therapy students.

The Western States (including Hawaii and Alaska) without a physical therapy program provide part of the tuition of legal residents through WICHE (Western Interstate Commission for Higher Education).

The Stanford Information Bulletin lists the long-term loan policies of the University and the details of the National Defense Student Loan Program.

PREREQUISITES AND OTHER COURSES

Basic prerequisites are courses in biology, chemistry, human anatomy, human physiology, psychology (2), sociology, and statistics. Mathematics, physics, and courses in oral and written communication are highly recommended. Each student's academic background will be reviewed on an individual basis for admission.

As part of the physical therapy program, students will enroll in courses offered by oth-
er departments in the Medical School and other schools in the University. Electives related to the student's program may be selected primarily in the second year.

Graduate students from other departments may attend courses in the Division with the consent of the instructor. Any one of the following courses may not be offered if an insufficient number of students enroll.

COURSES

220. Human Motion and Therapeutic Procedures I—Functional anatomy; biomechanics of body motion, analysis and practice of therapeutic exercise procedures; tests for and evaluation of physical disability, prosthetics and orthotics, and basic medical lectures in pathology, medicine, surgery, and specialty areas, with emphasis on problems of patient care.
   4 to 6 units, Aut (Kent, Staff) MW 8:00-11:50; F 8:00-9:50

221. Human Motion and Therapeutic Procedures II—Continuation of 220.
   4 to 6 units, Win (Kent, Staff) MW 8:00-11:50; F 8:00-9:50

222. Human Motion and Therapeutic Procedures III—Continuation of 220, 221.
   3 to 5 units, Spr (Staff) MWF 8:00-10:50

225. Neurophysiological Basis of Human Motion I—Basic neuroanatomical and neurophysiological principles of normal and pathological motor control, pre- and post-natal development of motor activity and related assessment skills; current treatment principles for the infant and adult neurological patient; evaluation, treatment, and program planning for patients with neuromuscular disabilities.
   3 units, Aut (Raymond, Staff) TThF 10:00-11:50

226. Neurophysiological Basis of Human Motion II—Continuation of 225.
   5 units, Win (Raymond) TTh 8:00-11:50; F 10:00-11:50

227. Neurophysiological Basis of Human Motion III—Continuation of 225, 226.
   4 units, Spr (Raymond) TTh 8:00-11:50; F 10:00-11:50

230. Physical Agents—Analysis of the principles underlying the use of electrotherapy, massage, and hydrotherapy; practice of essential techniques.
   3 units, Aut (Robertson, Staff) MW 1:15-3:05

   3 units, Aut (Robertson) by arrangement

232. Clinical Electromyography—Clinical application of procedures and techniques.
   3 units, Win (Robertson) by arrangement

244. Directed Clinical Experience in Physical Therapy I—Students are assigned for a select period full time during a portion of the quarter to health care facilities for a clinical laboratory; includes ethics and selected basic skills.
   1 to 5 units (Kent, Staff) by arrangement

245. Directed Clinical Experience in Physical Therapy II—Continuation of 244.
   1 to 5 units (Kent, Staff) by arrangement

247. Internship in Physical Therapy—Students are assigned to treatment facilities for full-time clinical experience.
   1 to 9 units (Kent, Staff) by arrangement

248. Advanced Internship in Physical Therapy—A practicum in an approved clinical facility planned by the student, adviser and preceptor.
   3 units (Staff) by arrangement

250. Social and Psychological Aspects of Illness and Disability—Special problems related to reactions to illness and disability, patient-therapist relationships; emphasis on total needs of the patient as related to his unique life style.
   4 units, Spr (Shepard) MWF 1:15-2:05

251. Family Focus—Clinical study of the patient as a unique personality who lives in a family, who in turn lives in a society with distinctive ethnic and socio-economic characteristics. Intensive work with selected patients and their families in both in-hospital and out-of-hospital settings.
   2 units (Shepard) by arrangement

257. Organizational Behavior and Physical Therapy—Interpersonal and inter-professional relationships, leadership styles, group dynamics and related areas and the application to physical therapy.
   3 units, Win (Shepard) T 1:15-3:05; Th 1:15-2:05
258. Special Topics — Current issues and problems related to developing physical therapy knowledge, techniques and practice.

3 units, Win (Staff) MW 8:00–9:50

259. Organization and Delivery of Health Care — Basic concepts of organization and delivery of physical therapy in relation to total health care; includes budgeting, supervision, consultation, and regulation.

3 units, Aut (Blood, Daniels) MW 10:00–11:50

SPECIALTY AREAS

Courses listed between 260 and 285 are related to the present specialty areas. Students must complete one of the following groups:

Administration and Community Health—260, 261 and 262
Pediatrics—265, 266 and 267
Curriculum Development and Instruction—275, 276 and 277

260. Administration and Community Health in Physical Therapy I — Program planning, budgeting, cost analysis, selected management techniques; systems for delivery of health care; community strategies; economic, sociocultural, legal, and political impacts on care. Includes projects and field work.

3 units, Aut (Daniels, Blood) by arrangement

261. Administration and Community Health in Physical Therapy II — Continuation of 260.

3 units, Win (Blood) by arrangement

262. Administration and Community Health in Physical Therapy III — Continuation of 260 and 261.

3 units, Spr (Blood) by arrangement


3 units, Aut (Raymond) by arrangement

266. Pediatric Physical Therapy II — Continuation of 265.

3 units, Win (Raymond) by arrangement

267. Pediatric Physical Therapy III—Continuation of 265 and 266.

3 units, Spr (Raymond) by arrangement

275. Curriculum Development and Instruction in Physical Therapy I—Learning theory; objectives, content and evaluating of courses and curricula; directed teaching in selected areas.

3 units, Aut (Staff) by arrangement


3 units, Aut (Staff) by arrangement


3 units, Spr (Staff) by arrangement

282. Directed Teaching.

1 to 5 units, any quarter (Staff) by arrangement


1 to 8 units, any quarter (Staff) by arrangement

RESEARCH COURSES

Research requirements of the Division must be satisfied by completing either 291 or 292.

290. Seminar in Research—Basic principles of research with emphasis on material applied to physical therapy.

3 to 5 units, any quarter (Staff) by arrangement

291. Research.

1 to 10 units, any quarter (Staff) by arrangement


1 to 10 units, any quarter (Staff) by arrangement

ANATOMY

Emeriti: Donald J. Gray, William W. Greulich, Hadley Kirkman, Robert S. Turner (Professors)

Acting Chairman: Lawrence H. Mathers, Jr.

Visiting Professors: Gershon Gitlin, Otto Mortensen, Roy Peterson

Associate Professor: Donald L. Stilwell, Jr.

Visiting: Bernard Tandler

Assistant Professors: Gerald R. Cunha, Lawrence H. Mathers, Jr. Acting: Sylvia Friedberg, Otto M. Sokol, Carmo Trindade
Acting Instructors: Marta Martner, Robert Fisher
Clinical Lecturers: Reuben Stutch, Bernard O. A. Thomas

PROGRAMS OF STUDY

Instruction in the Department of Anatomy is planned primarily to meet the needs of students in medicine, but, insofar as facilities permit, all of the courses are open to other properly qualified third- and fourth-year undergraduate and graduate students. Those who are not registered in medicine but wish to take work in the Department should make arrangements in advance with the instructors concerned.

Facilities are available for a limited number of doctors of medicine, or others with equivalent training, who may wish to do special dissections or pursue work on problems within the scope of the Department. Graduate study may be undertaken in such aspects of anatomy as are indicated by the courses listed. Programs combining work in anatomy and other fields of biology or medicine may be arranged.

ADVANCED DEGREES

Students desiring to become candidates for advanced degrees in anatomy should consult the general University regulations regarding such degrees, which are summarized in the section "Degrees" in this bulletin. It is to be noted that this Department requires the Graduate Record Examination, plus the advanced test in Biology. Candidates for the degree of Doctor of Philosophy will be expected to have done the equivalent of at least the basic work offered in the Department. All programs leading to an advanced degree in anatomy must be worked out individually and approved by the Department faculty. It is expected that an average grade of B will be maintained. Approval must also be obtained by graduate students in other departments who wish to elect anatomy as a minor.

COURSES

101. Practical Anatomy — Brief survey of the human body by dissection, study of anatomical preparations, lectures. Enrollment limited to those for whom this course is required, e.g., students of pre-nursing, pre-physical therapy, and physical education.
5 units, Aut (Cunha)

201. Human Anatomy—Dissection, demonstrations, lectures. Enrollment normally limited to medical students.
4 units, Win (Mortensen, Gitlin, Peterson, Sokol, Stilwell, Trindade)

202. Human Anatomy — Continuation of 201. Prerequisite: 201.
4 units, Spr (Mortensen, Gitlin, Peterson, Sokol, Stilwell, Trindade)

1 unit, Win-Spr (Vistnes)

204. Histology — Structural and functional organization of cells, tissues and organs, as seen with the light and electron microscopes.
6 units, Aut (Friedberg, Kirkman, Martner, Tandler)

205. Histology—Continuation of 204.
2 units, Win (Friedberg, Kirkman, Martner, Mathers, Tandler)

208. Advanced Practical Anatomy — Lectures and prosected material used in a survey of human anatomy. Emphasis is placed on the functional anatomy of limbs and vertebral column. Intended for students of physical medicine.
2 units, Aut–Win (Peterson, Trindade)

209. Human Nervous System—Study of the human nervous system, with prepared slides, dissections, and lectures. Enrollment of non-medical students by consent of instructor. Prerequisite: Histology.
5 units, Aut (Mathers, Stilwell, Fisher)

210. Medical Embryology.—A survey of the normal and abnormal development of the human organism. Emphasis on mechanisms of development, tissue interactions, as well as descriptive embryology. Understanding of congenital defects from the viewpoint of the developmental sequence is stressed.
1 unit, Aut–Win–Spr (Cunha, Gitlin)

225. Physical Therapy (Joint with Anatomy) — Neuroanatomy and physiology of human motion.
3 units, Aut (Raymond, Mathers)

296. Individual Work — Specialized work
carried on under supervision of one or more members of the staff.

Any quarter (Staff) by arrangement

299. Research—By individual arrangement, approved by Department faculty.

Any quarter (Staff) by arrangement

305. Current Topics in Neuroanatomy (Joint with Neurology) — Modern techniques in neuroanatomy including lectures and limited laboratory exercises. Given alternate years, 1974–75.

2 units, Spr (Mathers, Chow)

306. Comparative Neuroanatomy (Joint with Neurology) — Extensive coverage of selected topics in the structure and function of the nervous system as revealed by an evolutionary approach. Given alternate years, 1975–76.

3 units, Spr (Mathers, Chow)

BIOCHEMISTRY

Chairman: I. Robert Lehman
Assistant Professors: Douglas Brutlag, Ronald W. Davis
Consulting Professor: Abraham White
Lecturer: Carl Rhodes

PROGRAMS OF STUDY

The Department offers a first-year course in modern biochemistry open to medical students, qualified graduate students, and advanced undergraduates. Also a series of advanced courses is given by the Department; these are open to students who have completed the first-year course. (Additional qualifications are necessary for certain courses.)

ADVANCED DEGREES

The degree of Doctor of Philosophy is given by the Department. Remission of fees and a personal stipend are available to those students accepted. For further information, applicants should write to the Department of Biochemistry. A strong undergraduate background in chemistry (both physical and organic) is recommended. General University regulations about the Ph.D. degree are summarized in the section “Degrees” in this bulletin; the requirements of the Biochemistry Department are tailored to fit the background and interests of the student. Graduate students in other departments who wish to choose Biochemistry as a minor must obtain the approval of the Department.

Postdoctoral research training is available to graduates holding a Ph.D. or M.D. degree. Several fellowships, carrying stipends at current national levels, are awarded by the Department. Qualified graduates may apply to the departmental executive for further information. At present the chief research interests of the Department are in nucleic acids and proteins: their enzymatic synthesis, chemical structure, physical chemistry, and biochemical functions; in the biochemistry of viral infection; in the biochemistry of the nervous system; in the biochemistry and control of developmental processes; and in the structure and function of membranes.

COURSES

200, 201. General Biochemistry — Deals with basic biochemistry, and with special biochemical aspects of the various life processes. Open to medical, graduate, and advanced undergraduate students. Prerequisites: cell biology, organic and physical chemistry.

200. 5 units, Aut (Staff) MTWThF 1:15
201. 5 units, Win (Staff) MTWThF 1:15

202. The Teaching of Biochemistry—To be taken by all graduate students acting as teaching assistants in Biochemistry 200–201. Emphasizes practical experience in teaching on a one-to-one or small group basis, as well as in problem set design and analysis. Familiarization with current lecture and text material is expected, as well as assistance in evaluating the final examinations. Prerequisites: enrollment in the graduate program in the Department of Biochemistry, and Biochemistry 200–201 or its equivalent.

3 units, Aut, Win (Rhodes) by arrangement

204. DNA Replication.

3 units (Kornberg) given 1977–78
205. Mechanism and Control of Transcription in Bacterial and Higher Cells.

3 units (Davis) given 1976–77

210. Molecular Basis of Disease—Emphasis on topics of interest to medical students. A tentative list of subjects to be discussed includes: disorders of lipid and carbohydrate metabolism, mechanism of blood clotting, antibiotic action, and hormone-receptor interaction. Taught by Biochemistry Department faculty as well as a number of guest lecturers. Enrollment limited to 125 students, with preference given to medical students. Prerequisites: Biochemistry 200-201 or its equivalent.

3 units, Spr (Staff) by arrangement

211. Molecular Biology of Development—Prerequisites: Biochemistry 200 and 201.

3 units (Kaiser) given 1976–77

213. The Arrangement of Information in Chromosomes.

3 units (Hogness) given 1976–77

214. Physical Chemistry of Proteins and Nucleic Acids — Discussion, from a physico-chemical point of view, of the structures and structural transformations of proteins, nucleic acids and complex assemblies such as chromatin. Prerequisites: a first-year course in physical chemistry and consent of the instructor.

3 units, Aut (Baldwin) MW 9:00

217. Advanced Tutorial in Special Topics—Readings in special topics conducted under the guidance of advanced graduate students and postdoctoral fellows. Areas covered will include: membrane biochemistry, enzyme mechanisms, chromosome structure, biochemical genetics, animal tumor viruses, nucleic acid enzymology.

1 to 3 units, Aut, Win, Spr (Staff) by arrangement

270. Seminar.

By arrangement

299. Research and Special Advanced Work.

By arrangement

GENETICS

Chairman: Joshua Lederberg

Professors: L. L. Cavalli-Sforza, Leonard A. Herzenberg, Joshua Lederberg, Eric M. Shooter

Associate Professors: H. Cann, A. T. Ganesan (on sabbatical 1975–76)

Adjunct Professors: Elliott C. Levinthal, G. Loew

PROGRAMS OF STUDY

The Department offers courses for graduate students in Ph.D. and M.D. programs as well as for advanced undergraduates; programs of study and research training leading to a Ph.D. in Genetics and for medical students in the course of an M.D. program; and postdoctoral research experience for holders of the Ph.D. or M.D. The Department also participates in an interdepartmental program leading to a Ph.D. in Neuro- and Biobehavioral Sciences.

The Department of Genetics is interested in applicants for the Ph.D. degree who have an interest in fundamental aspects of biology. It welcomes applicants with a background in biology, biochemistry and also chemistry, physics and mathematics or computation. The Department administers a Ph.D. program of unusual flexibility which makes special provision to support training in biology for students whose main background is in the physical sciences. Courses available in the Genetics Department and also in the Biochemistry, Biology, and other departments provide a broad basis for overall training.

The Genetics Department is also part of the Lt. Joseph P. Kennedy, Jr. Laboratories for Molecular Medicine, which have been dedicated to further basic research in the etiology of mental retardation and the pathology of intellectual development. These facilities offer unusual opportunities for research and study in the fields of molecular biology, heredity, neurobiology, and developmental medicine. The program of the Laboratories together with courses in the various neurological sciences divisions of the Medical School and in the Biology Department cover the requirements of the Ph.D. degree in Neuro- and Biobehavioral Sciences.

An Instrumentation Research Laboratory, in the department was founded with NASA support for basic research in exobiology. In collaboration with other faculty, students have access to advanced instrumentation for chemical and biophysical analysis with sophisticated computer support. Besides labo-
ratory instrumentation, the department supports research in the quantum theoretical analysis of biologically important molecules.

The department is also the seat of the SUMEX-AIM computer system. This is a new facility sponsored by the NIH Biotechnology Resources Branch, designed to serve the local research groups as well as a national community of investigators in the field of artificial intelligence as applied to biomedical research. It offers unusual opportunities for training in advanced applications of computers in areas like the emulation of scientific reasoning and the design of experiments in biochemistry and genetics.

The principal areas for which research training is available at the present time are the function of DNA in bacteria, genetics of hemoglobin, genetic and cellular immunology, biochemical neurogenesis, biochemical genetics of mental disease, interactions of cultural and biological evolution, the investigation of extraterrestrial life, application of new physical methods and of quantum theory to biochemical analysis, cell detection and sorting procedures, genetic demography, and population genetics.

Financial support is available from an NIH training grant, for details of which application should be made to the department. In addition, some support opportunities exist through appointments as part-time research or teaching assistants, which can also carry tuition benefits. Applicants are also strongly encouraged to apply independently for National Institutes of Health, National Science Foundation, or any other fellowships. Predoctoral applicants are encouraged to take the Graduate Record Examination in Biology, Chemistry, or Physics. Further inquiries should be directed to the Graduate Student adviser (predoctoral applicants) or the appropriate faculty member (postdoctoral applicants).

For further information on the availability of the following courses, consult the quarterly Time Schedule, or inquire at the Department Office. Additional courses in genetics are included in the listings of the Department of Biological Sciences and the Program in Human Biology.

**COURSES**

**130. Human Genetics —** Human genetics viewed in the light of population genetics. To include equilibrium conditions under heterosis and other conditions leading to balanced polymorphisms, kinetics of selection, estimation of mutation rates, loads, population structure, genetic drift, and genetic demography, genetics of complex loci, polygenic inheritance, social aspects of human genetics, interactions between cultural and biological evolution. Prerequisite: basic knowledge of genetics and statistics.

4 units, Aut (Cavalli-Sforza) MWF 2:15

**201. Medical Genetics —** Case presentations and lectures on applications of genetics to human disease, and other issues of human evolution and social policy. Prerequisite: consent of instructor for nonmedical students.

3 units, Win (Cann, Staff) MWF 9

**208. Human Gytogenetics and Its Clinical Applications —** After a review of normal human chromosome structure and normal chromosome segregation in mitotic and mitotic divisions, abnormal patterns of chromosome segregation and abnormalities of chromosome morphology are discussed. Present knowledge of gene action and gene mapping of human chromosomes are reviewed. Human clinical syndromes related to chromosomal abnormalities of both sex chromosomes and autosomes are presented together with available information on the epidemiology of such syndromes and their patterns of inheritance. Modern experimental approaches to cytogenetic problems are discussed. Concurrent with the seminar sessions, there is opportunity for practical demonstrations in the laboratory and presentation of patients with chromosomal diseases. Limited to 20 students, minimum of 5. Prerequisites: biology and basic genetics, or consent of instructor.

2 units, Spr (Luzzatti, Ganesan) by arrangement, alternate years, given 1976-77

**213. Mechanism of Antibody Synthesis: Genetic, Molecular and Cellular Considerations —** Structure and genetics of immunoglobulins, cellular and molecular events in antibody induction and synthesis, theories of antibody formation, genetics of the immune response. Minimum 6 students. Prerequisites: Biochemistry 200, 201, Biology 10, Medical Microbiology 200, or equivalents, or consent of instructor.

3 units, Win (Herzenberg, McDevitt) MW 4:15-5:30
217. Computers in Medical Statistics—The course is designed to give instruction in computer use, and an understanding of the statistical methods employed in the analysis of complex data. Special attention will be paid to problems of computerized assistance to diagnosis.

3 units, Spr (Buchanan, Brown) by arrangement

218. Quantum Chemistry: Molecular Biology—This course is designed to illustrate the application of theoretical chemistry to a number of biomedical problems. Specific applications to be discussed include ion containing proteins, oxidative drug metabolism, chemical carcinogens, DNA structure and structure activity studies of families of drugs. Theoretical studies will be correlated with optical and magnetic spectrometric measurements.

3 units, Win (Loeiv) by arrangement

260. Supervised Study — Prerequisite: consent of the instructor.

Any quarter (Staff) by arrangement

270. Genetics Seminar.

Any quarter (Staff) by arrangement

299. Individual Research.

Any quarter (Staff) by arrangement

HEALTH SERVICES ADMINISTRATION
(MASTER OF SCIENCE PROGRAM IN)
DEPARTMENT OF FAMILY, COMMUNITY AND PREVENTIVE MEDICINE

Acting Director: Alain C. Enthoven, Ph.D., Eccles Professor of Public & Private Management, Graduate School of Business and Professor, Department of Family, Community and Preventive Medicine

Professor: John P. Bunker, M.D.

Assistant Professors: John C. Hershey, Ph.D. (on leave 1975–76), Harold S. Luft, Ph.D.

Affiliated Faculty: 15 faculty members from the Schools of Medicine, Business, Engineering and Humanities and Sciences

The Master of Science degree in Health Services Administration is an interdisciplinary program training students in administrative and analytic skills for careers in the growing health industry as innovative health managers, planners, systems analysts and policymakers. Students concluding their first year of graduate study at Stanford are eligible to apply for the degree which is granted by the Department of Family, Community and Preventive Medicine in Stanford's School of Medicine. The degree may be pursued concurrently with the second and subsequent years of graduate study and is awarded upon completion of approximately 45 units of course work. Each student's program is planned to meet individual interests in health services in addition to fulfilling HSA core course requirements.

A limited number of candidates for the M.S. in Health Services Administration will be accepted each year. Students from all graduate schools at Stanford are eligible to apply and emphasis will be placed on preserving the interdisciplinary nature of the program.

For additional information, address inquiries to the Program Administrator, Health Services Administration Program, Dept. of Family, Community and Preventive Medicine, School of Medicine, Stanford University, Stanford, California 94305.

COURSES

The following are selected courses offered through the Health Services Administration Program which are open to graduate students at Stanford. Information on additional courses can be obtained by contacting the Program Administrator.

225. Clinical Overview of Health Care Services—The objectives of the course are to expose non-medical students to clinical decisionmaking at the bedside and, in addition, expose them to the major components of the medical care delivery system. The course will be composed of observation of specific health settings and seminar discussions.

4 units, Aut (Bunker)

230. The Economics of Health—Provides an overview of the economic problems, and examples of the use of economic analysis, in the health sector. Topics include uncertainty and insurance, demand for health care, supply and distribution of physicians' and other
providers' services, production functions and behavioral models for various types of health care institutions, and roles of government and third parties.

4 units, Aut (Luft)

240. Systems Analysis and Operations Research in Health Care—The course is organized around four topic areas: (a) systems analysis in hospitals, (b) management control systems, (c) cost effectiveness analysis, and (d) health planning and implementation. It makes possible an understanding of the range of problem areas dealt with in the health sector applying operations research, systems analysis, and quantitative methods.

4 units, Win (Sondik)

250. Health Sociology and Organization—An introduction to medical sociology with an overview of topics, concepts, and examples of current research. The course covers social factors in the illness process: etiology, symptoms, seeking care, medical care organization, therapy, course of disease, and outcome. Emphasis on formal organizations in the health setting (hospitals, clinics, group practices), interorganizational relations, and professionals in health organizations. An attempt is made to relate sociological material to health planning and administration.

4 units, Win (Staff)

280. Management of Hospitals and Other Health Care Institutions—Covers various administrative aspects of health care institutions. Among those discussed are: organizational elements of hospitals, administration, financial issues and problems, hospital departmental relationships, quality of patient care, principal external pressures (both governmental and non-governmental), consumerism, and community influence.

2 units, Win (Hofmann) MF 3:15-5:05

295. Health Sector Policy and Implementation—This course examines a number of health services problems at both the micro and macro levels. The focus will be on identifying the essence of each problem, proposing a solution strategy, and outlining its implementation. It will bring together various analytical tools drawn from economics, operations research and systems analysis, and sociology.

4 units, Spr (Enthoven, Staff)
minor program are specified and administered by the department in which the minor is taken. The student will take a qualifying examination prior to admission to the University oral examination. The University oral examination will be focused on the dissertation. The general University requirements for the doctorate are followed as they apply to residence, application for candidacy, etc. (See the section "Degrees" in this bulletin.)

For further information write to the Director.

**COURSES**

200. Individual Study—Study under direction in fields or subjects of special interest. Prerequisite: consent of instructor.

1 to 3 units, any quarter (Staff)

by arrangement

212. Phonetic Theory—(Same as Linguistics 216.) Consideration of the fundamental assumptions implicit in phonetic descriptions and of the evidence available for assessing their validity; the concept of universal phonetics; the relative roles of articulatory, acoustic, and auditory parameters. Consent of instructor.

4 units, Win (Bush) by arrangement

230. Physiology of Speech Production — Study of the structure of the speech mechanism and its function. Includes laryngeal control in the production of segmented and prosodic features of speech as well as articulatory coordinations and control.

4 units, Win (Huntington) by arrangement

231. Speech Perception — Perceptual and physiological correlates of the acoustic constituents of speech.

3 units, Spr (Huntington) by arrangement

268. Assessment of Animal Auditory Behavior—(Same as Psychology 229.) Review and critique of laboratory studies of auditory-governed behaviors in, primarily, cats and monkeys. Emphasis on comparisons of experimental techniques and results across species, including man.

4 units, Aut (Dewson) by arrangement

281. Seminar in Animal Communication—(Same as Biological Sciences 200 and Psychology 228.) A general survey of the communicative aspects of social behavior of animals, including man. Emphasis will be placed upon diversity of signal systems and the contrasts between these systems and human linguistic behavior.

4 units, Win (Dewson) by arrangement

292. The Auditory Process—(Same as Psychology 231.) A systematic survey of our current knowledge of the operation of the auditory system. Emphasis is placed on acquiring a knowledge of the acoustic signal, and on an understanding of the methods of measuring a sensory process.

3 units, Aut (Schubert) by arrangement

300. Independent Study — Advanced individual study under direction in fields or subjects of special interest. Maximum 12 units in any one quarter.

Any quarter (Staff) by arrangement

301. Research — Individual research projects under direction. Maximum 12 units in any one quarter.

Any quarter (Staff) by arrangement

308. Special Topics in Speech Science.

3 to 4 units, Spr (Huntington, Bush) by arrangement

310. Experimental Phonetics — In-depth coverage of the motor, acoustic, and perceptual correlates of speech. Material will vary, hence may be repeated any quarter for credit. Prerequisite: consent of instructor.

4 units, any quarter (Huntington) by arrangement

370. Clinical Internship—In-service clinical practice and observation in selected speech and hearing centers.

1 to 12 units, any quarter (Staff)

by arrangement

390. Seminar in Neural Substrates of Human Communication—(Same as Psychology 230.)

4 units, Spr (Dewson) by arrangement

392. Selected Topics in Psychoacoustics — (Same as Psychology 232.) A detailed study of the normal auditory mechanism with particular emphasis on the use of psychoacoustic methods of analysis. Evaluation of current theories regarding auditory processing of information.

3 to 4 units, Win (Schubert) by arrangement

393. Peripheral Auditory Mechanisms — (Same as Psychology 233.) Study of the mechanics and electrophysiology of the middle
and inner ear. Analysis of the ear as a transducer and of the neural encoding process.

3 units, Spr (Schubert) by arrangement

394. Central Auditory Mechanisms—Anatomy and electrophysiology of auditory nervous system. Emphasis will be placed on a review of correlates to perceptual phenomena.

3 units, Spr (Dewson) by arrangement

400. Doctoral Research.

1 to 15 units, any quarter (Staff)

by arrangement

MEDICAL MICROBIOLOGY

Emeriti: Charles E. Clifton (Professor); Helen S. Thayer (Instructor)

Chairman: Sidney Raffel

Professors: Leonard Hayflick, Sidney Raffel, Carlton E. Schwerdt, Bruce A. D. Stocker

Associate Professors: Robert J. Roantree, Leon T. Rosenberg. Clinical: Orland A. Soave

Acting Assistant Professor: Abdul Matin

Adjunct Professors: Monroe D. Eaton, Esther M. Lederberg, John P. Steward

Lecturer: Alfred A. Amkraut

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

Requirements include: Biological Sciences, 15 quarter units; Chemistry, 19 quarter units (to include 13 in General Chemistry, 3 in Organic, and 3 in Physical); Physics, 12 quarter units. Specific course requirements are the following: Medical Microbiology 101, 102 or 200, 202, 204, 206, and 270; Biochemistry 200 and 201.

Students in this program can arrange to take units in research (see 199 — Special Problems).

ADVANCED DEGREES

MASTER OF SCIENCE

Preference in selection of students for available places is given to candidates for the Ph.D. degree. Under special circumstances candidates are occasionally accepted for the degree of Master of Science. They will be expected to have completed the preliminary requirements listed above for the B.S. degree. In addition, the candidate is expected to complete 45 quarter units of work related to microbiology; at least 15 of these units should concern research devoted to a thesis subject. The candidate is expected to pass written and oral examinations covering the fundamentals of general and medical microbiology, bacterial genetics, immunology, and virology at the end of the first year of work, and to complete a thesis.

DOCTOR OF PHILOSOPHY

A candidate for the degree of Doctor of Philosophy must meet the preliminary requirements listed for the Master’s degree and will follow a program designed for the candidate’s interests, subject to general University regulations covering this degree. Foreign language requirement can be satisfied by two college years of an acceptable language or examination during first year of graduate work.

The student is expected to maintain a B grade average in those departmental courses listed as required for the Bachelor of Science degree as well as Biochemistry 200 and 201, which are required courses. Formal departmental courses are to be graded by letter, not pass-fail. Grading of research and reading courses is optional for the faculty member concerned. In addition, courses in statistics (Community and Preventive Medicine 202, Psychology 60 or Statistics 50), principles of computer science (e.g., Computer Science 105 or 106, Genetics 217), and molecular biology (e.g., Biological Sciences 210, 250, 251, 257) should be taken. These general recommendations should be discussed with faculty advisers. Other recommendations contingent upon individual previous experiences and interests include: parasitology (Community and Preventive Medicine 204); histology (Anatomy 204, 205); genetics (e.g. Biological Sciences 249, 252; Genetics 201); biochemistry (e.g., Biochemistry 204, 205, 211, 212, 213, 214, 217); physical chemistry (e.g., Chemistry 171, 173); calculus (Mathematics 10, 11, 21, 22, 23); virology (Biological Sciences 213); pathology (Pathology 200); electron microscopy (Pathology 207, 281). The choice among these (or other) formal courses should be discussed with an adviser.
The student is expected to pass qualifying examinations at the end of the first year of graduate work. These will consist of an oral defense of a research proposal selected by the candidate and a written examination covering the general fields of the Department's offerings. Students entering the Department with advanced standing from other institutions are expected to take final examinations in such courses as may be stipulated, at the earliest time these examinations are regularly scheduled. Such students are required also to pass the qualifying examinations at the end of their first year of residence.

**COURSES**

101. General Microbiology—A lecture and laboratory course providing an introduction to the biology of bacteria, bacteriophages, and animal viruses. Coverage will include bacterial anatomy, genetics, and physiology, as well as antibiotic action, immunology, and host-parasite relationships. Prerequisites: Biological Sciences 1 and Chemistry 31, 33, and 35, or 41 and 43.

5 units, Aut (Roantree) MWF 2:15; lab. MWF 3:15-5:05

102. Principles of Immunology—The basic principles of host responses to "foreign" incursion will be covered in 20 lectures. The emphasis will be on responses to microbes. Medical Microbiology 101 may, but need not, be taken concurrently. Prerequisite: Biological Sciences 1 or 21 (or their equivalent).

3 units, Aut (Rosenberg) TTh 2:15

199. Special Problems—Individual study or research in microbiology by arrangement with a faculty member. Possible fields of study include: general bacteriology, bacterial genetics, mycoplasmology, microbial pathogenicity, immunology, virology, viral oncology, and cell biology including cell hybridization and human aging at the cellular level. (Appropriate backgrounds for these various areas are required; to be discussed with the faculty member concerned.)

2 to 15 units, any quarter (Staff) by arrangement

200. Immunology—Immunology as related to medicine is emphasized. Designed principally for medical, graduate, and advanced undergraduate students. Some background in biochemistry and histology is strongly recommended.

3 units, Win (Raffel, Rosenberg) MWF 11:00

202. Medical Microbiology—A course of lectures and laboratory exercises covering the fundamentals of pathogenic microbiology, with particular reference to bacteria and viruses. The course includes a discussion of some aspects of immunology, of laboratory diagnosis, and of preventive measures.

4 units, Spr (Staff) M 2:15-4:05; TTh 2:15-3:05; F 3:15-5:05

204. Bacterial Genetics—(Same as Biological Sciences 204.) A course of lectures (optional demonstrations, minilab) on inheritance in bacteria. Prerequisite: 101 (or equivalent).

3 to 4 units, Win (Stocker) MWF 9

206. Virology—Lectures on the general nature of plant and animal viruses, and their relationships with their hosts. Prerequisites: 101 or 202, and Biochemistry 200.

3 units, Aut (Schwerdt) MWF 9

210. Advanced Medical Bacteriology—A systematic coverage of pathogenic bacteriology in greater depth than that presented in 202. Minimum enrollment of six students. Prerequisite: consent of instructor.

2 units, Win (Roantree, Stocker) TTh 1:15

260. Literature Reviews—Review of literature on special topics to be assigned by instructor.

1 to 3 units, any quarter (Staff) by arrangement

261. Current Topics in Immunology—A review of the current literature in one or a few selected areas of interest. Prerequisite: consent of the instructor.

3 units, any quarter (Rosenberg) by arrangement

270. Seminar—Reports, discussions on selected topics by outside speakers. Required of all graduate students.

1 unit, Aut (Staff) by arrangement

299. Research—Students who have satisfactorily completed necessary foundation courses may elect research work in: bacterial genetics, microbial pathogenicity, immunol-
ogy, virology, viral oncology, aging, and cell biology.

15 units maximum, any quarter (Staff) by arrangement

NEURO- AND BIOBEHAVIORAL SCIENCES PROGRAM

Committee on Neuro- and Biobehavioral Sciences: Eric M. Shooter, Professor of Genetics and of Biochemistry, Chairman; K. L. Chow, Professor of Neurology; Raymond B. Clayton, Professor of Biochemistry in Psychiatry; Donald Kennedy, Professor of Biological Sciences; Seymour Levine, Professor of Psychiatry and of Psychology; David A. Prince, Professor of Neurology; two student members elected annually by the students in the program.

The Neuro- and Biobehavioral Sciences Program is an interdepartmental program which offers instruction and research opportunities leading to a Ph.D. in Neuro- and Biobehavioral Sciences. The Faculty of the Program is drawn from the Departments of Biological Sciences, Psychology, Anatomy, Anesthesiology, Genetics, Neurology, Pathology, Pharmacology, Physiology, Psychiatry and Surgery.

PROGRAM OF STUDY

A small number of highly qualified applicants will be admitted to the Program each year. Applicants should present strong undergraduate background in four of the five following areas:

1. Mathematics (through integral and differential calculus)
2. Physics (the "50" series at Stanford or its equivalent)
3. Biology (the "20" series at Stanford or its equivalent)
4. General chemistry (through organic chemistry)
5. General psychology (through physiological psychology)

Occasionally a well-qualified student not having all the prerequisites may be allowed to make up deficiencies in previous training by taking the appropriate courses at Stanford during the first year. The requirements for a Ph.D. degree follow those of the University and in addition are tailored to fit the background and interests of the student.

The graduate course program consists of a series of course tracks defined for students who wish to emphasize the biochemical, neurophysiological, neuroanatomical or behavioral aspects of the neurosciences. Since students enter with differing backgrounds and the laboratories in which they may elect to work cover several different disciplines, the specific program for each student is worked out individually with his or her advisory committee and may cover more than one course track. It is anticipated that the required course work will be completed by the end of the second year. Successful passing of a comprehensive oral preliminary examination given by the student's advisory committee is required for admission to Ph.D. candidacy. This examination is usually taken in the second year of study and must be completed by the end of the second year. Students are strongly encouraged to begin research on entry or at the latest during the winter quarter of the first year. The student will be required to present a Ph.D. thesis which is the result of independent investigation and which contributes to knowledge in an area of neuroscience and to defend his or her thesis in a University oral examination, including a public seminar.

Medical students may also participate in this program provided they meet the prerequisites and satisfy all the requirements of the graduate program as listed above. The timing of their program may be adjusted to fit in with their special circumstances.

Courses included in the current tracks:

Anatomy 209. Neuroanatomy
Anatomy 214. Neuroanatomy Laboratory
Biochemistry 200, 201. General Biochemistry
Biochemistry 215. Regulatory Mechanisms
Biochemistry/Genetics 216. Selected Topics in Neurobiology
Biological Sciences 153. Physiological Basis of Behavior
Biological Sciences 253. Laboratory in Neurophysiology
Biological Sciences 280. Mathematical Modeling of Biological Systems
Neurology 204. Physiology of Mammalian CNS
Pharmacology 201. Principles of Pharmacology
Pharmacology 203. Pharmacology of the Nervous System
Physiology 203. Neurophysiology
Physiology 210. Neuroendocrinology
Physiology 260. Readings in Neurophysiology
Psychiatry 271. Neurochemical and Neurophysiological Mechanisms of Normal and Pathological Behavior
Psychology 190. Endocrines and Behavior
Psychology 208. Physiological Psychology: Brain and Behavior

PATHOLOGY

Emeriti: Bruno Gerstl, David Glick (Professors)
Chairman: David Korn
Professor of Clinical Neuropathology: Lysia Forno
Professor of Clinical Pathology: Jon Kosek
Adjunct Professor: Lawrence Eng
Associate Professors: Amico Bignami, Charles Carrington, Luis F. Fajardo, Mary M. Herman, Irving L. Weissman
Consulting Associate Professor: Thomas Hargreaves
Assistant Professors: David A. Clayton, Errol C. Friedberg, Gerald D. Levine, Klaus Lewin, Mahendra Ranchod, Howard H. Sussman
Acting Assistant Professors: Margaret E. Billingham, Michael Hendrickson
Attending Physician and Clinical Assistant Professor: Carl Grumet
Physician Specialist and Clinical Assistant Professor: Sharon DeWit
Physician Specialist and Clinical Instructor: Theodore Coonrod
Acting Instructor in Pathology (Neuropathology): Bruce Horten
Visiting Lecturers in Neuropathology: John Deck, Henry Urich
Research Associates: Doris Dahl, Klara Efron, David Sedwick, Teresa Wang

PROGRAMS OF STUDY

The Department of Pathology offers a sequence of basic courses in general pathology, special pathology, and neuropathology which are open to medical students and to qualified graduate students. In addition there are a number of advanced courses in selected aspects of pathology and three major clerkships which afford interested medical students the opportunity for full-time, intensive participation in diagnostic medical, surgical, and neuropathology. The Department does not offer advanced degrees in pathology, but qualified graduate students who are admitted to the Department of Biological Sciences may elect to pursue their thesis requirements in the research laboratories of the Pathology Department.

The discipline of pathology has traditionally served as a bridge between the preclinical and clinical sciences, and is concerned with the application of advances in the basic biological sciences both to the diagnosis of disease in man and to the elucidation of the mechanisms of abnormal molecular, cellular, and organ structure and function that manifest themselves in clinical disease. Accordingly, the research interests of the Department encompass a broad range that extends from fundamental molecular biology to clinico-pathological correlations. A primary emphasis of the departmental research program is in experimental oncology.

At the present time, the major areas of investigation in the Department include DNA replication and repair in prokaryotes and in cultured eukaryotic cells, genomic derepression in human neoplasms, structure of the mitotic spindle, ultrastructural and cytochemical studies of human tumors adapted to tissue culture, purification and characterization of marker proteins and lipids that are unique to the central nervous system, organelle dysfunction in central nervous system disease, developmental cellular immunology, tumor immunology, differentiation in human and experimental tumors of the nervous system, a variety of clinico-pathological studies with particular emphasis on diseases of the cardiovascular and lymphoreticular systems, and the control of plasmid replication in prokaryotes. Research training in all of these areas is available at the present time for qualified medical graduate students by individual arrangement with the appropriate faculty member.

COURSES

Pathology 200, 201A, and 201B, intended to provide the student with a basic under-
standing of disease, are prerequisites for all advanced and special courses.

200. General Pathology — Lectures and demonstration providing an introduction to general pathology.
   Win (Korn, Staff)

201A. Special Pathology — Lectures and clinico-pathological conferences considering the pathology of human disease based upon disordered structure and function of individual organ systems.
   Aut (Korn, Staff)

201B. Special Pathology—Continuation of 201A.
   Win (Korn, Staff)

202. Surgical Pathology — Covers the major areas of surgical pathology and emphasizes clinico-pathological correlation.
   Win, Spr (Dorfman, Kempson, Staff)

205. Clinico-Pathological Correlations — Correlation of clinical histories with autopsy material, including microscopy.
   Win (Kosek, Fajardo, Bignami)

206. Neuropathology — Systematic lectures and laboratory sessions on gross and microscopic lesions in diseases of the central and peripheral nervous system.
   Win (Rubinstein, Bignami, Forno, Herman) not given 1975–76

   Aut, Win, Spr (Haydon) by arrangement

208. Interpretation of Electron Micrographs.
   Spr (Haydon) by arrangement

210. Transplantation Biology.
   Spr (Weissman, Lucas) alternate years; given 1975–76

212. Systemic Pathology Laboratory.
   Aut, Win (Rather, Clinical Staff)

281. Practical Introduction to Electron Microscopic Techniques.
   Any quarter (Haydon) by arrangement

290. Research in Experimental Neuropathology.
   Spr (Bignami, Eng, Forno, Herman, Rubinstein) by arrangement

299. Research.
   Any quarter (Korn, Staff) by arrangement

300. Pathology Clerkship — Exposure to clinical and anatomical pathology through clinical pathological correlations in the autopsy room where students perform autopsies under supervision.
   (Stanford University Hospital—Lewin, Staff); (Veterans Administration Hospital—Kosek, Fajardo, Staff)
   full-time for six or twelve weeks

301. Neuropathology Clerkship—Participation in the neuropathological diagnostic service of the department and conferences for the members of the neuropathology unit.
   Aut, Win, Spr (Forno, Herman, Rubinstein) (Full-time for six or twelve weeks)

302. Surgical Pathology Clerkship — Participation in the surgical pathology diagnostic service.
   Any quarter (Kempson, Dorfman, Staff)
   full-time for six or twelve weeks

Immunology Literature Reviews—See Genetics 271.

CONFERENCES

Autopsy Demonstration.
   Any quarter (Korn) MTWThF 1:00

Brain Cutting.
   Any quarter (Rubinstein, Herman) W 2:00

Neuropathology Conference.
   Aut, Win, Spr (Rubinstein, Forno) W 5:00

Research Seminar.
   Aut, Win, Spr (Korn) T 4:30

PHARMACOLOGY

Emeriti: Robert H. Dreisbach (Professor), Leon Kolb (Clinical Associate Professor)

Acting Chairman: Lewis Aronow

Professors: Lewis Aronow, Avram Goldstein, Oleg Jardetzky, Sumner M. Kalman, Tag E. Mansour, Robert T. Schimke

Adjunct Professor: Dora B. Goldstein

Consulting Professors: Ralph I. Dorfman, Richard K. Richards

Assistant Professors: Henry F. Epstein, Leslie Wilson

Lecturer: Adolph P. Roszkowski
The Department presents a series of basic courses in contemporary pharmacology (201–203) and advanced courses open to qualified medical and other graduate students.

A program of study and research training is offered leading to the Ph.D. degree. Post-doctoral research training is available to graduates having the Ph.D. or M.D. degree. Research opportunities also exist for medical students and a limited number of undergraduate students during the summer.

The Ph.D. program is designed for students with a background in biology, chemistry, physics, or mathematics who wish to pursue a career of research in a field that lies between biology and medicine. Modern pharmacology is concerned with understanding the mechanisms of drug action at the cellular and molecular levels, and utilizing this knowledge for the rational development of new drugs, and their proper use in man. The major fields of research interest in the Department are molecular pharmacology, biochemical pharmacology, drug metabolism, and drug tolerance and drug addiction.

Research in molecular pharmacology seeks to extend our knowledge of the interactions of chemical agents with biological systems at the molecular level in order to shed more light on the precise mechanisms whereby drugs exert their specific effects. Present fields of investigation include: hormone actions on target cells and organs, cell regulatory mechanisms in carbohydrate metabolism, regulation of macromolecular synthesis in mammalian cells, mechanism of action of antimitotic agents and the biochemical and pharmacological properties of microtubules, genetic regulation and mutagenesis in higher organisms, nuclear magnetic resonance studies of the nature of the interactions between drugs and macromolecules, and biochemical mechanisms associated with drug addiction and tolerance. Research in drug metabolism and toxicology is directed toward gaining a better understanding of the variables that influence drug action in man in order to improve the clinical effectiveness of drugs and reduce their toxicity.

Students desiring to become candidates for advanced degrees should consult the general University regulations regarding such degrees, as summarized in the section “Degrees” in this bulletin. Further information can be obtained from the Department. Consult Time Schedule for additional advanced courses.

**Basic Courses**

Pharmacology 201, Medical Pharmacology, and its continuation courses, Pharmacology 202 and 203, will provide the medical and graduate student with a broad exposure to the principles of pharmacology and the properties of the major drug groups relevant to the proper use of drugs in man. Pharmacology 203 (Pharmacology of the Central Nervous System) is concerned specifically with drugs that affect the nervous system, and is offered for both medical students and students more specifically interested in behavioral sciences. Students may elect a program within this context that best meets their individual needs, and while many medical students will choose to take the entire sequence in their second year, others will defer or omit entirely certain of these courses.

201. Medical Pharmacology—A lecture and demonstration course on the principles of pharmacology and the major drug groups used in medicine. Major topics include the drug-receptor interaction, kinetic aspects of drug absorption, distribution and elimination, and a discussion of drugs affecting the peripheral nervous system, the cardiovascular system and the kidney. The emphasis will be on the mechanisms of action of drugs in relation to their use in man. Prerequisites: mammalian physiology and biochemistry.

3 units, Aut (Staff) MWF 1:15

202. Medical Pharmacology—Continuation of 201. Major drug groups to be considered include the chemotherapeutic agents and the hormones. Also to be considered are topics such as pharmacogenetics, toxicity, mutagenesis, teratogenesis, carcinogenesis, and drug interactions. Emphasis is on pharmacological principles in relation to the use of drugs in man. Prerequisite: Pharmacology 201.

3 units, Win (Staff) MWF 1:15

203. Pharmacology of the Central Nervous System—A lecture course on mechanisms of action and therapeutic use of drugs affecting the central nervous system. Drugs discussed include convulsants, anticonvulsants, anes-
therapeutics, sedatives, analgesics, tranquilizers, and other psychoactive drugs. Problems of drug abuse are also considered.

2 units, Spr (Staff) MW 1:15

**ADVANCED COURSES**

Advanced courses are open to students in all parts of the University, but the instructor's consent is required prior to registration. In general, these courses require as a prerequisite a good knowledge of physiology and biochemistry and sometimes of microbiology or genetics. Students are advised to consult with the instructor about the adequacy of their preparation.

213. Cellular Regulatory Mechanisms in Carbohydrate Metabolism — Lectures and discussions on the different regulatory processes that keep carbohydrate catabolic reactions in the cell in pace with its energy requirement and the effect of different hormones on carbohydrate metabolism at the cellular and subcellular level.

1 unit, Win (Mansour) by arrangement

215. Drug Metabolism — Lectures and discussions on the metabolic conversion of foreign compounds in the mammalian organism, including factors such as species, age, and genetic variability.

1 unit, Win (Aronow) 1976-77

216. Drug Addiction, Tolerance, and Physical Dependence — Lectures and discussions with emphasis on recent research into the biochemical basis of these phenomena.

1 unit, Aut (A. Goldstein)

217. Clinical Pharmacology: Principles of Therapeutics (Same as Medicine 217.) — A series of clinically oriented presentations on principles of drug use in humans. The course will consider various pharmacological, physiological and disease factors involved in the choice of appropriate drug therapy and its method of administration. Clinical evaluation of drug efficacy, therapeutic pitfalls, manifestations of drug toxicity and drug interactions will be included.

2 units, Spr (Staff of Pharmacology Department and Division of Clinical Pharmacology) F 1:15–3:05

219. Alcohol and Alcoholism — Lectures and discussions on the pharmacologic actions of alcohol and on various aspects of alcoholism.

1 unit, Win (D. B. Goldstein) 1976-77

221. Pharmacological, Biochemical, and Functional Properties of Microtubules — A lecture and seminar/discussion course for graduate students and advanced undergraduate students covering the structure, functional, chemical, and pharmacological properties of microtubules.

2 units, Aut (L. Wilson) 1976-77

225. Frontiers of Pharmacology — Lectures, discussions, and readings on the mechanisms of drug effects at cellular and subcellular levels. Emphasis on topics currently being explored.

1 unit, Spr (Mansour)


1 unit, any quarter (Staff) Th 4:15–6:05

280. Tutorial Program — Guided readings in the literature of any area of pharmacology. A critical review paper may be required. Primarily for graduate students in pharmacology.

Any quarter (Staff) by arrangement

299. Research.

Any quarter (Staff) by arrangement

**PHYSIOLOGY**

Emeritus: Jefferson M. Crismon (Professor)

Acting Chairman: Maurice E. Krahl

Professors: George A. Feigen, Frederick A. Fuhrman, Ronald Grant, Maurice E. Krahl, John G. Nicholls, Eugene D. Robin

Consulting Professor: F. Eugene Yates

Associate Professors: Denis A. Baylor, Julian M. Davidson. Visiting: Ardis J. Krahl

Consulting Associate Professor: Noël Thompson

**PROGRAMS OF STUDY**

The Department of Physiology offers required and elective courses for students in the School of Medicine, open also to other qualified postdoctoral or graduate students. The main emphasis is on training of medical and postdoctoral students. For a very limited number of highly qualified students, the Department offers the Ph.D. degree, but not the Master's or Bachelor's degrees.
GRADUATE STUDY

Students with undergraduate or Master's degrees who have completed a year each of college chemistry (including lectures in organic chemistry), physics, calculus (differential and integral), and biology will be considered for admission to graduate study. An applicant must submit a report of scores (aptitude and advanced biology) on the Graduate Record Examination as part of the application. In the case of certain students, especially those with degrees in engineering or physics, the Department will consider admission even if the above requirements have not been met. In those cases the students will be expected to complete the requirements during their graduate studies.

Emphasis is placed on providing all graduate students with a strong background in the laboratory study of major physiological phenomena, from which they may undertake highly individual courses of advanced research and study. The total course of study is expected to occupy four years, including three summers. Required courses for all students are: General Biochemistry 200 and 201 (without laboratory), Physical Chemistry (Chemistry 171 and 173), and Physiology courses 200, 201, 202, 203, and 214. In addition, students will take at least three other courses selected from Departmental or extradepartmental offerings. Courses in computer science, mathematics, statistics, chemistry, physics, biology, or engineering may be arranged by agreement between the student and the faculty supervisor.

At present the chief research interests of the Department are in Endocrinology, including the control functions of natural trace substances; in Neuroendocrinology and Neuropsychiatry; and in Immunophysics.

Qualifying examination — At the end of the second year in residence as a graduate student, each Ph.D. candidate will be given a written examination covering the material of the first two years of courses. This examination may be taken only after the respective course examinations have been successfully passed, and will be more comprehensive than the course examinations. Students may undertake individual programs of study after passing this examination, and the language examination.

Language examination — A reading knowledge of any one of the following languages is required: French, Russian, or German.

Dissertation and University Oral Examination — The results of independent, original work by the students are to be presented in a dissertation. The oral examination will be largely a defense of the dissertation.

FINANCIAL AID

Research assistantships are occasionally available to postdoctoral fellows, or graduate students who have completed substantial work toward the Ph.D. degree in Physiology. Tuition aid may be awarded to students holding research assistantships. Graduate students who are also medical students are eligible for financial aid from the Office of Student Affairs, Stanford Medical School.

In general, graduate students must expect to find the majority of their financial support outside the University.

COURSES

(Commencing autumn quarter, 1972, the course order in Clinical Physiology will be: Clinical Physiology 200, autumn; 202, winter; 201, spring.)


8 units, Aut (Krahl, Harrison, Perlroth) MWF 10-12

201. Clinical Physiology (Physiology and Medicine) — (Formerly 250.) This interdepartmental course examines normal and disordered function in the respiratory, renal, fluid and electrolyte, and acid base systems. Lectures, demonstrations, clinical presentations, laboratory projects are used.

8 units, Spr (Krahl, Robin, Maffly, Jamison) MWF 9-11; Th 8-10

202. Clinical Physiology (Physiology and Medicine) — (Formerly 251.) Endocrinology, reproductive and gastrointestinal function. An interdepartmental course.

7 units, Win (Krahl, Davidson, Reaven, Luetscher, Gray) MWF 9-11, T 8-9

203. Neurophysiology — Replaced by Interdepartmental course 200.)
205. Biological Systems Analysis — (Formerly 302.) A lecture course for biologists on
the mathematical approach to comparative mechanical, electrical and biological sys-
tems. Includes treatment of first- and second-order linear systems, forcing functions, La-
place transform and stability analysis. Pre-
requisite: one year of calculus.
3 units, Win (Thompson) W 4:15–6:05
and F 4:15–5:05, alternate years,
given 1976–77

207. Immunophysiology Laboratory—(For-
merly 304.) A laboratory course in quanti-
tative immunophysiology emphasizing basic
immunochemical phenomena such as iso-
lation and preparation of purified antigens and
antibodies, quantitative analysis of specific
precipitates, immunoelectrophoresis, im-
mune hemolysis, isotopic labeling, identifi-
cation of reactants by gel diffusion; quanti-
tative tissue anaphylaxis. Limited to 8 stu-
dents. Prerequisite: consent of instructor.
4 units, Aut(Feigen) T 7:30–9:00 p.m.;
lab. Th 9:00–4:05

208. Current Problems in Muscle Physiol-
ogy—(Formerly 306.) Discussion of selected
biophysical, pharmacological, and immuno-
logical aspects of muscle contraction; evalu-
ation of modern theories of contractility.
2 units (Feigen) by arrangement

210. Neuroendocrinology—(Formerly 308.)
A lecture and discussion course on selected
topics of current interest in the general area
of nervous and endocrine system interrela-
tionships. Special emphasis will be placed on
mechanisms for control of pituitary function
and behavioral aspects of neuroendocrinol-
y. Prerequisites: basic knowledge of neu-
rophyisology, neuroanatomy and endocrinol-
y; consent of instructor.
2 units, Spr (Davidson) M 7:30–9:30 p.m.,
alternate years, given 1976–77

211. Special Studies in Cardiovascular
Physiology — An in-depth physiology and
anatomy course. The material covered will
be limited to the cardiovascular system, but
within those limitations it will be very com-
plete. The anatomy, histology, function, and
fluid dynamics of the cardiovascular system
will be studied. Selected topics in pathol-
ogy will also be studied to bring out the
basis and effects on function of the altera-
tions produced. In addition to lectures there
will be anatomic, histologic and pathologic
demonstrations. Upon completion of this
course, the student will be able to function
independently in establishing meaningful
research projects involving the cardiovascu-
lar system.
3 units, Win (Thompson) TTh 4:15–5:30

213. Special Topics in Physiology—A semi-
nar course of guided reading and discussion
in both introductory and advanced physi-
ological topics. Topics are agreed upon by an
individual instructor and interested students.
Prerequisite: consent of instructor.
(Staff) by arrangement

214. Physical Chemical Principles in Phys-
iology—(Formerly 310.) A quantitative, ex-
perimental approach to problems in thermo-
dynamics, kinetics, transport, and bioelec-
tric phenomena. Restricted to Ph.D. candi-
dates in Physiology, or consent of the instruc-
tor.
2 units, Spr (Feigen) Th 9:00–4:05

215. Tutorial in Clinical Physiology —
Guided study, with readings and discussions
in both introductory and advanced physio-
logical topics, to supplement 200, 201, 202.
1 or 2 units, any quarter (Robin, Krael,
Staff) by arrangement

216. Laboratory in Circulatory Physiology
— Set laboratory exercises and discussions
to illustrate the basic functions of the mam-
malian heart and circulatory system. De-
signed for graduate students in physiology
but open to qualified persons in the basic
medical sciences. Prerequisites: Clin. Physi-
ology 200 and consent of instructor. Lim-
ted to 6 students.
4 units, Spr (Feigen) 9:00–5:05,
by arrangement

282. Marine and Amphibian Toxins—(Same
as Biological Sciences 282H.) Lectures, lab-
oratory work and discussion on the biology,
chemistry, and mechanism of action of tox-
ins from marine plants and animals and from
amphibians. Special emphasis will be given
to neurotoxins such as tetrodotoxin, saxi-
toxin, and batrachotoxin. The course will in-
clude discussion of the basic principles of
evaluation and mode of action of toxic sub-
stances in general, and a systematic presen-
tation of various aspects of marine and am-
phibian toxins. Marinostat Laboratory, HMS.
6 units, Sum (Fuhrman) See Hopkins
Marine Station Bulletin for days and
hours (June 16–July 19 MWF 9–5)
minimum 8 students
299. **Advanced Research** — Investigation sponsored by individual faculty members may be undertaken by interested, qualified medical or graduate students. The hours and units may be arranged by the student. The fields of research open to students include: endocrinology, neuroendocrinology, central nervous system function, immune reactions and anaphylaxis, reproductive physiology, chemistry and mechanism of action of toxins in marine biology, cybernetics (systems analysis and instrumental techniques).

*Any quarter (Staff) by arrangement*
AFRICAN STUDIES

Professors: Sanford M. Dornbusch (Sociology), St. Clair Drake (Anthropology and Sociology), Charles A. Ferguson (Linguistics), James L. Gibbs, Jr. (Anthropology), Joseph Greenberg (Anthropology), Bruce Johnston (Food Research Institute), Jacques Maquet (Anthropology, visiting), Robert B. Textor (Anthropology and Education)

Associate Professors: David B. Abernethy (Political Science), Scott R. Pearson (Food Research Institute), Elizabeth Traugott (Linguistics)

Assistant Professors: Don Dodson (Communication), J. Paul Irwin (History), Kennell Jackson, Jr. (History), Tetteh Kofi (Food Research Institute), William Leben (Linguistics), William Ochieng (History, visiting), Bridget O’Laughlin (Anthropology)

Lecturer: Elaine Kaufman (Linguistics)

Senior Fellows: Peter Duignan (Hoover Institution), Lewis Gann (Hoover Institution)

Overall planning and coordination of African Studies at Stanford is the responsibility of the Committee on African Studies. This Committee is a part of the Commission on International Studies at Stanford. The general aim of the Committee is to develop a broad program in African Studies so that students in a variety of departments can pursue undergraduate and graduate programs with a specialization in African Studies. The offerings are not intended in and of themselves to constitute the basis for an academic major.

The African Studies faculty is available to advise students on work in African Studies throughout the University. A sampling of courses is listed below. (Because of frequent changes and addition of courses, students are advised to consult quarterly Time Schedule.)

Peoples of Africa—(Enroll in Anthropology 108.) An introduction to the ethnography, languages and prehistory of sub-Saharan Africa; special attention will be given to the analyses of problems in the African literature which have led to theoretical advances within social anthropology.

5 units, Aut (O’Laughlin) MWF 9

Narrative Pattern in Oral Literature—(Enroll in Anthropology 251.) Seminar: problems and theories of origin, form, transmission and function of folktales and myths will be reviewed. Students will examine cross-culturally or from some other specific perspective patterns or collections of patterns primarily from native America, Africa, and Pacific Region. Reports on their findings will form the basis of discussion in the latter half of the quarter. Open to qualified undergraduate students.

5 units, Aut (Gerow) T 2:15–5:05

Art and Culture—(Enroll in Anthropology 134.) This course offers an anthropological approach to aesthetic visual phenomena. First, it is concerned with the elaboration of a cross-cultural notion of the aesthetic response of a subject to an object. Second, aesthetic phenomena are analyzed as cultural: their integration in a cultural system and their relationships with other elements of the system are considered. The empirical validation of hypotheses is stressed. The specific examples discussed will be chiefly African.

5 units, Spr (Maquet) dhr to be arranged

Seminar in African Systems of Production—(Enroll in Anthropology 150, 250.) The relationship of environmental, technological and historical processes in the social organization of production in selected societies of rural Sub-Saharan Africa. (Graduate students enroll in 309.)

5 units, Win (O’Laughlin) TTh 2:15–4:05

Languages of Africa—(Enroll in Anthropology 269, Linguistics 321.) A survey of the history of African linguistic investigation, characteristics of African languages, and sociolinguistics in Africa, including the formation of standard languages, language and educational policy, and language in connection with colonialism and national policy.

5 units, Win (Greenberg) TTh 4:15–6:05

Urbanization in African Societies—(Enroll in Anthropology 110.) Ancient centers for urbanism; types of cities arising from contact with Europeans; social problems incident to rapid urbanization; city planning and theoretical issues.

5 units (Drake) given 1976–77
Seminar on Socio-Political Integration in Contemporary Africa — (Enroll in Anthropology 111.) “Westernization,” “Modernization” as specific forms of the acculturation process; neocolonialism and decolonization since World War II; civilian and military elites in the resolution of conflicts arising from shifts in power, authority and legitimacy, and from the continuing viability of ethnic and kin loyalties as well as traditional political structures. (Graduate students enroll in 311.)

5 units, Spr (Drake) W 2:15-5:00

Myth and Ritual in Sub-Saharan Africa— (Enroll in Anthropology 111.) Analysis of particular systems of African folklore: myth, cosmology, tales, legends, epics, and science; the dialectic of transformations between belief and action systems; the mediation of ritual in such transformations.

5 units (O’Laughlin) given 1976-77

African Kingdoms, History and Societies— (Enroll in History 147.) The internal structure and dynamics of kingdom societies in the pre-Colonial states of sub-Saharan Africa. Emphasis on the nature of African kingships, the symbolism of the monarchies, the characteristic politics of the kingdoms, and the place of African kingdoms in world centralized-states history. The personalities and policies of particular kings, the slave-trade and the kingdoms, the role of Islam in the formation of West African kingdoms, and the place of European missionaries within kingdom societies will be some of the special topics presented in lecture sessions.

5 units, Spr (Jackson) MWTh 11

Undergraduate Colloquium: Realism, Romanticism, and the African Intellectual— (Enroll in History 247.) An intensive undergraduate colloquium which attempts to survey the two major trends in modern African intellectual thought. It deals mainly with the problem of how African intellectuals have conceptualized African cultures and societies in the period near the end of Colonial rule and in the post-independence era. Two groups of writers are explored: the romantics and the realists.

5 units, Aut (Jackson) M 2:15-4:05


5 units, Win (Jackson) M 2:15-4:05

Class and Stratification in Pre-Colonial African History— (Enroll in History 447A.)

5 units, Spr (Jackson) M 2:15-4:05

Linkages in Afro-American and African History—Common Topics— (Enroll in History 347A.)

5 units, Win (Jackson) M by arrangement

Graduate Seminar: Field Work in African History— (Enroll in History 447B.) This course will attempt to provide graduate students approaching a field work situation with the fundamental skills for creating and executing a non-archival historical research project. It will survey such topics as oral family histories, village censuses for the historian, phases of field research, and language materials in field work.

(Jackson) given 1976-77

Graduate Seminar: African Oral Historical Traditions— (Enroll in History 447.)

(Jackson) given 1976-77

Graduate Core Colloquium: The Interpretation of African History— (Enroll in History 348B.)

(Jackson) given 1976-77

Undergraduate Colloquium: The Political Career of Jomo Kenyatta— (Enroll in History 247W.)

5 units, Spr (Ochieng) T 2:15-4:05

Graduate Seminar: The Sources of Pre-World War II Kenya Nationalism— (Enroll in History 447W.)

5 units, Spr (Ochieng) W 2:15-4:05

Latin America and the African— (Enroll in History 182.) This course examines the economic, political and cultural ties that have existed between Latin America and Africa since the 16th Century. The current prospects for both cooperation and rivalry between the two areas are discussed in some detail.

4 to 5 units, Win (Bowser) MTWTh 11

The World and the West: The Impact of Europe on the Third World— (Enroll in History 67.) A survey, through case studies that illustrate general patterns of the relations between Western civilization and those of the Third World from the Spanish and Portuguese explorations of the fifteenth century to the present. Though diplomatic and military relations will be given consideration, the emphasis will be on broader patterns of
comparative development and cultural interchange.

4 to 5 units, Spr (Bowser, Irwin)
MTWTh 10

The History of West Africa—(Enroll in History 148A.)

4 to 5 units, Aut (Irwin) MTWTh 10

Graduate Colloquium: West African History—(Enroll in History 348.)
5 units, Aut (Irwin) W 2:15

Undergraduate colloquium: Religion and Social Protest in Colonial Africa
5 units, Spr (Irwin) T 2:15

Graduate Seminar: Colonial Africa—(Enroll in History 448A.)
5 units, Win (Irwin) Th 2:15-4:05

Political Change in Tropical Africa—(Enroll in Political Science 118A.) Examines the colonial situation, the growth of nationalism, the achievement of political independence, ethnic patterns in new states, civilian and military leadership, the role of party and bureaucracy, and problems in development planning, and efforts at Pan-African cooperation.

5 units, Win (Irwin) Th 2:15-4:05

Southern Africa: The Domestic and International Politics of Race—(Enroll in Political Science 118B.) Examines the political histories of ten countries with special attention to South Africa, Angola, and Mozambique. Stresses the interaction of domestic and international politics, through an analysis of apartheid’s international implications, regional transport networks, African liberation movements, the pattern of foreign investment, and military trends in the region.

5 units, Spr (Abernethy) MWF 9

Seminar in Comparative Politics: Africa—(Enroll in Political Science 227.) Examines the record of selected African states in formulating and implementing public policy, with special reference to rural development. Open to selected undergraduates who have taken an Africa-related course.

5 units, Spr (Abernethy) given 1976-77

International Dependency—(Enroll in Political Science 131C.) What is meant when we say that one state is dependent upon another, more powerful state? What are the implications of a dependency relationship for the domestic political economy of both parties? What occurs when a weak state tries to reduce its dependence on a strong state? These questions will be examined through an historical analysis of European colonialism and through contemporary case studies, including U.S.-Peru, U.S.-Canada, France-Senegal, and the Soviet Union-Czechoslovakia.

5 units, Spr (Abernethy) MWF 10

African Literature—(Enroll in English 165.) To introduce students to the field of African literature through a few selected texts.

5 units (Staff) by arrangement

Beginning Swahili—(Enroll in Linguistics 262A,B,C.)
5 units, Aut, Win, Spr (Kaufman, Hassan) MWF 1:15

Intermediate Swahili—(Enroll in Linguistics 263A,B,C.)
5 units, Aut, Win, Spr (Kivugo) by arrangement

Beginning Hausa—(Enroll in Linguistics 260A,B,C.)
5 units, Aut, Win, Spr (Leben) MTWThF 12

Intermediate Hausa—(Enroll in Linguistics 261A,B,C.)
5 units, Aut, Win, Spr, by arrangement

Beginning Yoruba—(Enroll in Linguistics 264A,B,C.)
5 units, Aut, Win, Spr (Kaufman, Ogundimu) by arrangement

(Other African languages such as Amharic and Twi may occasionally be taught on a tutorial basis if facilities are available.)

Tone Languages of Africa—(Enroll in Linguistics 285.) Survey of the tonal systems of selected African languages, with emphasis on the diversity of the accentual phenomena involved, followed by a consideration of possible laws governing the behavior of tone. Topics considered will include downstep, downdrift, “floating” tones, syllable and mora as prosodic units, and the origin of tone languages.

4 units, Spr (Leben)

Structure of Hausa—(Enroll in Linguistics 181.) Survey of the syntax and phonology of Hausa, with emphasis on ways in which it differs from Indo-European languages. Study of the linguistic literature on Hausa.

4 units (Leben) given on demand

Economic Development Problems of Third World Economies with Colonial Heritage I and II—(Enroll in Food Research 133,
OTHER DEPARTMENTS, INSTITUTES, AND PROGRAMS

134, or Economics 127A,B.) (May be taken as 233 or 234 by graduate students.) An analysis of development theories, problems and policies common to Third World economies, the evolution of these economies through the pre-colonial, colonial and post-colonial eras, categorization of empirical growth models and patterns in terms of basic internal structures and institutions and international influences. Topics include development models of closed and open economies, problems associated with monocoeonomies, land tenure systems, agricultural development, foreign investment and multinational businesses, industrialization, balance of payments and debt servicing, terms of trade and remunerative incomes from sales of primary produce, commodity agreements and related problems. Contemporary theories of economic imperialism and dependency models of development will be analyzed.

Research papers initiated in the first or second quarters will emphasize area studies or case studies of individual countries; hypotheses will be formulated and tested qualitatively or quantitatively.

3 units each quarter, Win, Spr (Kofi) TTh 4:15-6:05

The World Food Economy — (Enroll in Food Research 103, Economics 106 or Human Biology 121.) This course will examine the individual components essential to a macro-perspective of the world food economy. The biological and economic principles of food production will be used to explain the potential for food supplies. Next attention will be devoted to nutritional, social and economic factors that influence the consumption of major food groups. Techniques for measuring and evaluating nutritional well-being will be discussed briefly. The last part of the course will examine the world food economy in global perspective.

3 units, Spr (Johnston) MW 10

Trade and Development Problems of Tropical Africa—(Enroll in Food Research 160/260.) Analysis of selected international aspects of tropical African economic development. Topics include African—non-African international trade and economic relations (theoretical background, historical perspective, case studies of export-led growth and of the impacts of international capital flows) and intra-African trade and economic integration (customs union theory, historical perspective, case studies of African economic integration).

3 to 5 units, Spr (Kofi) MW 4:15-6:05

Economics of Tropical Agriculture—(Enroll in Food Research 365.) Selected topics in organization of production and marketing of agricultural products for home consumption and for export. Prerequisite: Consent of instructor.

5 units (Falcon) by arrangement

International Trade and Investment Policy—(Enroll in Food Research 162 or Economics 162.) This course is concerned with the formulation, implementation, effects, and possible improvement of selected governmental policies affecting international trade and foreign investment. Topics include policies affecting international trade in energy resources, influences of domestic agricultural policies on international commodity trade, issues underlying the international negotiation of reductions of barriers to trade, governmental responses to competition for imports, international implications of environmental control, special trade and investment arrangements for developing countries, and domestic and international impacts of multinational corporations. With respect to each topic, initial attention is focused on existing institutions and practices, and policy analysis is then carried out to suggest improvement in current regulations. Prerequisite: Economics 165 or consent of instructor.

5 units, Win (Pearson) TTh 2:15-4:05


5 units, any quarter (Gann or Duignanj

Seminar: Economics of Tropical Agriculture—(Enroll in Food Research 365.) Selected topics in organization of production and marketing of agricultural products for home consumption and for export.

5 units, Win (W. O. Jones) T 7:30-9:30 p.m.

Communication Media and Social Change—(Enroll in Communication 256.) Seminar on the communication problems of economic and social development, and on the uses
of the mass media for national integration, social change, and education in the developing countries. Special uses and difficulties of communication in these countries. Case studies and planning exercises.

3 to 5 units, Win (Mayo, McAnany)
T 4:15-6:05

Primate Behavior Workshop in Tanzania—
(Enroll in Human Biology 161.) An African elective; minimum 2 quarters. Prerequisite: Human Biology 160; limited to 8 Human Biology Majors per year.
15 units, Aut, Win, Spr, Sum
(Goodall) by arrangement

A three-quarter interdisciplinary seminar on the drought and famine in Africa’s Sudan-Sahel region will be conducted during the academic year 1974-75 by Stanford’s African Studies faculty, with time, place, and credits to be arranged. Further details can be obtained in the office of the Committee on African Studies, Building 460, Room 465.

ASTRONOMY COURSE PROGRAM


STATEMENT OF PURPOSE

Although Stanford University presently does not have a degree program in Astronomy, teaching and research in various branches of astronomy is an ongoing activity in several departments (Applied Mechanics, Applied Physics, Electrical Engineering, Geophysics, Physical Sciences, Physics). For the convenience of students interested in the general areas of astronomy, astrophysics and cosmology, a course program for undergraduate and graduate study is listed below.

Astronomy 15 and 25 are suited for the student who wishes to be informed about the field of astronomy without the need for prerequisites beyond high school algebra and physics. The Astronomy 100 series serves the student interested in an initial scientific study of astronomy; study equivalent to two years of college physics, chemistry, or engineering will be assumed. The courses numbered 200 and above are primarily for graduate students, subject to prior approval by the course instructor.

PROGRAMS OF STUDY

The University does not offer a separate undergraduate major in astronomy. Students who intend to pursue graduate study in astronomy are encouraged to major in Physics, following the advanced sequence if possible, or in Electrical Engineering if the student has a strongly developed interest in radioscience. The course descriptions for these basic studies are listed under the appropriate department sections. Students desiring guidance in developing an astronomy oriented course of study should contact the Chairman of the Astronomy Program Committee. The following courses are suitable for undergraduates interested in astronomy and are prerequisites for advanced study in astronomy: 101—Solar System Astronomy; 103—Stellar and Galactic Astronomy; 105—High Energy Astronomy; 150—Advanced Astronomy Laboratory. The following seminars are recommended for advanced astronomy undergraduate students: 193B—X-Ray Astronomy; 193C—Peculiar Stars and Close Binary Systems.

Graduate programs in astronomy and astrophysics and related topics are carried out in the departments of Applied Physics, Electrical Engineering, Geophysics, and Physics. Students should consult the course listings and research programs of these departments for more detailed information.

The following courses are recommended for students planning to conduct research in astronomy and astrophysics or related subjects: 360—Solar Terrestrial Relations; 361—The Sun and Solar Activity; 362—Physical Processes in Stars; 364—Radiation from Plasmas; 366—Cosmology and High Energy Astrophysics; 367—Physical Processes in the Galaxy; 368, 369—Gravitation.

COURSES

15. Topics in Modern Astronomy—The following three courses are addressed to students not majoring in the sciences. They are taught in different quarters by different instructors but are closely related in topic.
Students are advised against taking more than one of the courses.

**The Nature of the Universe**—(Enroll in Applied Physics 15.) This course is intended to familiarize undergraduates, with or without scientific background, with the structure, origin and evolution of our universe. It will describe our growing knowledge of the objects which make up the universe; galaxies, stars, planets, etc. Some enigmas of modern astronomy, such as quasars, X-ray sources and pulsars will also be discussed. The presentation will be non-mathematical and will be illustrated with slides and films. There will be opportunities for telescopic observations.

3 units, Aut (Petrosian) MWF 10

**Cosmic Evolution**—(Enroll in Physics 15.) This course proposes to familiarize the humanities or social science student with part of modern physics. After discussing the physical laws that govern the universe, its evolution will be traced from the initial primeval fireball, through the formation of galaxies, stars, and planets to the development of life. A feeling for astronomical distances and times will be developed, and exotic astronomical objects, such as quasars, pulsars, and black holes will also be discussed. No prerequisites.

3 units, Win (Will) TTh 2:15; discussion T 3:15

**Modern Astronomy**—(Enroll in Physical Sciences 15.) A review of current concepts and ideas regarding the nature of the solar system, galaxy, and extragalactic systems; essentially nonmathematical discussion of the basis for these concepts. Telescopic observations if possible.

3 units, Spr (Perkins) MWF 11

**25. Topics on Extraterrestrial Intelligent Life**—The following two courses treat similar subjects and students are advised against taking more than one of the courses.

**Extraterrestrial Civilization** — (Enroll in Astronomy 25.) This discussion of the possible existence of extraterrestrial civilization will be based on our knowledge of the physical universe and on the capabilities of technology as we can now assess them. Relevant astronomical information includes the structure of galaxies, star types, solar planets, evidence for planets on other stars and the interstellar medium. This is followed by discussion of the origin and evolution of life, intelligence and technology; interstellar communication via radio and other waves; possibilities of interplanetary and interstellar travel; and possible relation of the UFO phenomenon to extraterrestrial civilization. No prerequisites.

3 units, Aut (Sturrock) TTh 2:15–3:30

**The Galactic Club: Intelligent Life in Outer Space**—(Enroll in Engineering 25.) This course is concerned with the existence of intelligent life elsewhere in the galaxy, the significance of such life for human values and with relevant topics such as planetary formation, prebiological evolution, the origin of life, radio communication over interstellar distances, rocket travel, celestial mechanics, the colonization of interplanetary space and how to contact and communicate with non-humans. Views of Sagan, Velikovsky and von Däniken will be considered. No prerequisites.

3 units, Win (Bracewell) MW 2:15–3:30

**101. Solar System Astronomy** — Comparative properties of the terrestrial and Jovian planets; characteristics and evolution of planetary atmospheres and ionospheres; nature of planetary and satellite surfaces; characteristics of the rings of Saturn; planetary, satellite, and spacecraft orbits; properties of the interplanetary gas, dust, comets, and meteorites. Methods of observation with emphasis on recent results from space probe and radar experiments. Prerequisites: one year of college physics, chemistry, or engineering and calculus.

3 units, Aut (Eshleman) TTh 2:15–3:30

**102A,B,C. Astronomy Laboratory and Observational Astronomy**—Theory and use of an optical telescope and the interpretation of basic observational data to determine the physical properties of planets, stars, and galactic systems. The course consists of individual observations with a 16-inch Cassegrainian telescope (the laboratory portion of the course may be taken separately for one unit of credit) and lectures which include a discussion of astronomical coordinates, and the use of astronomical catalogs and charts. Laboratory programs include the photographic study of the moon, planets, nebulae, binary star systems, stellar clusters, and galactic systems; photometric studies of variable stars and close binary systems; and spectral studies of selected bright objects. Students may also develop additional instru-
Astronomy Course Program

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102A. 1 or 2 units, Aut (Walker) lecture M 4:15, laboratory by arrangement
102B. 1 or 2 units, Win (Walker) lecture M 4:15, laboratory by arrangement
102C. 1 or 2 units, Spr (Walker) lecture M 4:15, laboratory by arrangement

103. Stellar and Galactic Astronomy—(Enroll in Applied Physics 103.) Introduction to stellar and galactic astronomy: the sun as a star, solar activity and solar terrestrial relationships, other stars, galactic structure, interstellar medium, star formation. Modern developments, pulsars, x-ray stars, black holes. Techniques and technical problems. Prerequisites: one year of college physics, chemistry, or engineering, or Astronomy 101.

3 units, Win (Sturrock) TTh 2:15-3:30

105. High-Energy Astronomy—(Enroll in Applied Physics 105.) Introduction to cosmology, extragalactic astronomy and non-thermal phenomena of astrophysics: radio and X-ray radiation and the production of high-energy particles (cosmic rays) by the sun, neutron stars (pulsars), galaxies, and quasars. Discussion of models and evolution of the universe. Prerequisites: one year of college physics, chemistry, or engineering, or Applied Physics 103.

3 units, Spr (Petrosian) TTh 2:15-3:30

150A, B, C, D. Advanced Astronomy Laboratory—The purpose of this course is to train students to carry out independent research in optical astronomy using the 16-inch Cassegrainian telescope. Selected topics of study might include the photometry and astrometry of asteroids, UBV photometry of pulsating stars, the study of abundances in nearby stars, or the design of specialized instrumentation for the 16-inch Cassegrainian telescope. Ordinarily, observational programs will be carried out on weekends, or after midnight during the autumn, winter and spring quarters. During the academic year the course is accompanied by a lecture-discussion. During the summer quarter the observatory will be used exclusively for the Astronomy 150D course. Prerequisites: Astronomy 102. Open to qualified graduates and undergraduates on consent of the instructor.

150A. 3 units, Aut (Walker) lecture T 4:15, laboratory by arrangement
150B. 3 units, Win (Walker) lecture T 4:15, laboratory by arrangement
150C. 3 units, Spr (Walker) lecture T 4:15, laboratory by arrangement
150D. 3 units, Sum (Walker) laboratory by arrangement

193B. Senior Seminar, X-Ray Astronomy—The study of x-rays from the sun and from galactic and extragalactic objects has opened up a new field of astronomy. This course is intended to introduce the student to this important new field in astronomy. Topics will include mechanisms of x-ray emission; experimental techniques in x-ray astronomy; the solar corona, and evidence for coronae in other stars; galactic x-ray sources; supernovae remnants, pulsars, x-ray binaries; extragalactic x-ray sources; x-ray emission from normal galaxies, quasars, Seyfert galaxies, and clusters of galaxies. The implications of x-ray observations for a number of basic problems in astronomy, including the structure of the interstellar medium, galactic winds and the existence of the intergalactic medium, and advanced stages of stellar evolution will be discussed. Prerequisites: Astronomy 101 or 103 or 105 or consent of the instructor.

3 units, Spr (Walker) alternate years, given 1976-77

193C. Senior Seminar, Peculiar Stars and Close Binary Systems—Most stars are stable and their position on the temperature luminosity (H-R) diagram is determined primarily by their mass and the stage of chemical evolution of their interiors. This course is intended to introduce students to the observational characteristics and theoretical models of stars whose position on the H-R diagram does not fit the locus of normal stellar models. These peculiar stars include pulsating stars, such as the Cepheid variables and long term variables, stars with extended atmospheres such as planetary nebulae and
Wolf-Rayet stars, explosive variables such as dwarf novae, novae, and supernovae, and stars with anomalous abundances and strong magnetic fields. Recent models of some classes of peculiar stars ascribe their anomalous characteristics to the effect of mass transfer in close binaries on the normal course of stellar evolution, and these models will be reviewed. Prerequisites: Astronomy 101 or 103 or 105 or consent of the instructor.

3 units, Spr (Walker) W 2:15-4:05, discussion F 2:15, alternate years, given 1975–76

227. Atmospheric and Space Physics—(Enroll in Aeronautics and Astronautics 227.)
3 units, Spr (Spreiter) TTh 2:45-4:00

295. Physics of Planetary Interiors—(Enroll in Geophysics 295.)
3 units, alternate years, given 1976–77

350. Radioscience Seminar — (Enroll in Electrical Engineering 350.)
1 unit, Aut, Win, Spr (Staff) by arrangement

354. Theory and Application of Radio Wave Scattering.—(Enroll in Electrical Engineering 354.)
3 units, Aut (Tyler) by arrangement, alternate years, given 1975–76

360. Solar Terrestrial Relations—(Enroll in Applied Physics 360.)
3 units (Staff) alternate years, given 1976–77

361. The Sun and Solar Activity—(Enroll in Applied Physics 361.)
3 units (Staff) alternate years, given 1976–77

3 units, Win (Petrosian) alternate years, given 1976–77

364. Radiation from Plasmas—(Enroll in Applied Physics 364.)
3 units (Staff) alternate years, given 1976–77

366. Cosmology and High-Energy Astrophysics—(Enroll in Applied Physics 366.)
3 units, Win (Petrosian) MWF 11, alternate years given 1975–76

367. Physical Processes in the Galaxy—(Enroll in Applied Physics 367.)
3 units, Spr (Sturrock) TTh 2:15-3:30 alternate years, given 1975–76

368, 369. Gravitation — (Enroll in Physics 368, 369.)

368. 3 units, Aut (Will) MWF 11
369. 3 units, Spr (Will) MWF 11

450A,B,C. Radio Science Laboratory—(Enroll in Electrical Engineering 450, Sec. 1.) Students will be trained to operate the Stanford 5-element radio telescope and will participate in ongoing research programs. These include high-resolution studies of the sun and planets, galactic H α regions, radio galaxies, quasars, and X-ray stars. Results may be published with student as co-author. Open to graduate students and qualified undergraduates on consent of instructor.

450A. 3 units, Aut (Bracewell) by arrangement
450B. 3 units, Win (Bracewell) by arrangement
450C. 3 units, Spr (Bracewell) by arrangement

ATHLETICS, PHYSICAL EDUCATION, AND RECREATION

Emeriti: Maud L. Knapp (Professor); Allen Elward, Edward M. Twiggs (Directors); Margaret C. Barr, Luell W. Guthrie, Ernest P. Hunt, Marian S. Ruch (Associate Professors); C. Myron Sprague (Associate Director)

Director: Joseph H. Ruetz
Associate Director and Chairman of Physical Education: Pamela L. Strathairm
Associate Director of Athletics: Robert G. Young
Assistant Director for Finance: Donald J. Tobin

Professor: John E. Nixon (Director of Professional Education)
Associate Professors: Miriam B. Lidster, Wesley K. Ruff, Pamela L. Strathairm

Senior Teaching Associates: Carroll G. Diaz, William P. Fehring, Inga Weiss

Sports Directors: Jack Christiansen (Football), Marshall Clark (Cross Country), Joe DeMeo (Wrestling), Carroll G. Diaz (Women's Golf), Richard DiBiaso (Basketball), Charles E. Finger (Men's Golf), James Gaughran (Swimming and Diving),
The Department of Athletics, Physical Education, and Recreation is responsible for the development and administration of the University's programs in athletics, physical education, and physical recreation. These three programs encompass a spectrum of opportunities in aquatics, dance, exercise, and sports activity which extends from informal recreation through organized intramurals and basic instruction (including theory) courses to, and including, intercollegiate athletics.

Two major facility locations are utilized for students to elect enrollment in the activity and theory courses and intercollegiate athletics as well as participation in the club and recreation programs. Roble Gym near Lagunita Court includes facilities for: badminton, basketball, conditioning, fencing, field hockey, folk dance, golf, modern dance, posture, self defense, swimming, table tennis, tennis and volleyball with locker, shower and dressing rooms for men and women. The Encina Gym area includes facilities for: baseball, basketball, conditioning, football, gymnastics, handball, lacrosse, oriental martial arts, rugby, soccer, squash, swimming, tennis, track and field, volleyball, water polo, weight lifting and wrestling with locker, dressing and shower facilities for men and women. The Riding School, Stanford Golf Course and driving range are additional facilities available for student use.

Bowling lanes are located in the Tressider Union.

**ACADEMIC DEGREES AND TEACHING CREDENTIALS**

In cooperation with the School of Education, the Department provides faculty, facilities, and equipment necessary for the conduct of the professional physical education program which leads to graduate degrees and teaching credentials.

Although Stanford does not offer a Bachelor of Arts in Physical Education degree, undergraduate students interested in the credential and/or master's degree program at Stanford should declare their intent early in their undergraduate careers and enroll in selected courses offered by the Department and the School of Education. These courses will satisfy most requirements for eligibility for admission to the graduate program in dance or physical education. Students with a bachelor's degree or equivalent course work in physical education or dance from another accredited college or university may also apply for admission. Information is available upon request from Professor John Nixon, School of Education.

See the “School of Education” section of this bulletin or Professors Lidster, Ruff, or Strathairn or Miss Weiss for further information.

**INTERCOLLEGIATE ATHLETICS**

In keeping with our cultural heritage and American university tradition, Stanford offers a broad intercollegiate athletic program. The primary purpose is to provide talented male and female students with a variety of opportunities for participating in individual and team competition with other colleges and universities. As a member of the Pacific Eight Conference (Pac-8) and the National Collegiate Athletic Association (NCAA), Stanford fields men's varsity teams in baseball, basketball, cross country, fencing, golf, gymnastics, football, swimming and diving, tennis, track and field, water polo and wrestling. As a member of the Northern California Intercollegiate Athletic Conference (NCIAC) and the Association for Intercollegiate Athletics for Women (AIAW), Stanford fields women's varsity teams in basketball, fencing, field hockey, golf, swimming and tennis.

Additional opportunities in athletic competition is provided through junior varsity teams (for men and for women) in selected
In those varsity sports for which a women's team has not yet been developed, women are encouraged to demonstrate their interest and talent through advanced physical education classes, men's varsity teams or the club sports program.

A Varsity Club program has been created for men and women students desiring intercollegiate team status in sports which have not been traditionally carried and funded as a varsity sport at Stanford. Several sports are included in the varsity club program and, as such, may be eligible to compete in intercollegiate conference and national championships.

Physical Education

The physical education program is diverse to accommodate the interests and needs of undergraduate and graduate students in general. A wide variety of aquatic, dance, exercise, sports and theory courses are part of the academic curriculum. Here, the aims are to (1) increase understanding of the value and role of physical activities in developing and maintaining total fitness throughout life; (2) develop performance skills and to encourage, through satisfying learning experiences, the participation habit; (3) provide opportunities for discovering and/or expanding experience in aquatic, dance, exercise and sports activities as potentials for avocational and/or vocational utilization; and (4) develop leadership competence in the area of physical activities.

With few exceptions, as indicated by course descriptions, all courses are open for enrollment by male and female undergraduate and graduate students. Homogeneous skill groupings and limited class sizes enable the student, beginner through the advanced performer, to achieve success within the limits of individual motivation and potential. Prerequisite: ability and knowledge and space-availability during class-list signing are the only limitations.

Equipment—Specific information is available at the Department and during registration days.

Fees—Fees are charged for enrollment in golf, skin and scuba diving, and most suffix "C" courses.

Academic credit—Students are free to enroll in as many physical education courses as they would like. However, only 12 units of credit of the 1-unit activity courses will be accepted toward graduation requirements. On the other hand, no such limit is placed on the 2- to 5-unit courses.

Club Program

Students may initiate, organize and conduct physical activity clubs which supplement the Department's normal program. Specific guidelines for the establishment of these clubs, as affiliates of the Department, have been set by the Department. Clubs, which meet criteria for inclusion in the formal curriculum, may apply for academic credit through the Department. Clubs, which wish to compete as teams against other college, university and/or club groups may have this opportunity. For further information, contact the Department.

Intramural Sports

Students interested in recreational opportunities through intramural competition may receive information from Mr. Fehring. The full program includes formal tournament competition in many different sports leading toward the All-University Intramural championship as well as an informal program of scheduled competitions. Competing organizations, teams and individuals are urged to contact the IM Office at Encina Gym on Registration Day to obtain meeting dates and times to assure representation. Sign-up lists are often posted at the beginning of each quarter; early organization of competing groups is essential.

Recreation

The Department provides facility-use time for faculty, staff and students to participate in sports and dance for general recreation. General recreation hours are publicized each quarter. For additional information, contact the Department.

Courses

Aquatics Activity and Theory

All courses are coeducational.

48. Swimming I: Beginning — For non-swimmers or those who are so novice as to have self doubts. Includes instruction in the basic strokes and personal safety skills. Minimum goal is drown-proofing and optimum goal is to learn to enjoy swimming as a recreational activity.

1 unit, Aut (Hammett) MWF 11

49. Swimming II: Intermediate — Continued work on personal safety skills including
basic rescues and water safety. Refinement of the basic strokes and conditioning.

1 unit, Aut, Win (Weeks, Sackman)  
MWF 2:15  
Spr (Sackman) MWF 11

50. Diving: Beginning — Introduction to springboard diving.

1 unit, Aut, Win, Spr (Devine) MWF 2:15

51. Water Polo: Basic—Introduction to and refinement of skills used in the sport of water polo.

1 unit, Aut, Win, Spr (Hammett) TTh 11

52. Lifesaving—Content includes the Red Cross Basic Rescue and Water Safety and Advanced Lifesaving course requirements in preparation for Lifesaving certification. Prerequisites: strong basic strokes and skills test.

2 units, Aut, Spr (Weeks, Hammett)  
MWF 11 or 2:15  
Win (Hammett) MWF 2:15

148. Swimming III — Review and refinement of all strokes and personal safety skills. Extensive conditioning included.

1 unit, Aut (Sackman) MWF 2:15  
Win (Hammett) MWF 11  
Spr (Sackman) TTh 2:15

149W. Swimming Officiating — Principles and mechanics of organizing swimming meets and developing skills in duties of all officials. Practical experience; written and practical examination may be taken to become a rated official.

2 units, Aut, Win (Staff) by arrangement

149T. Competitive Swimming Theory and Technique—Prerequisite: ARC Water Safety Instructor’s Certificate.

2 units, Aut (Gaughran) by arrangement

151T. Water Polo Theory and Technique—Prerequisite: consent of instructor.

2 units, Spr (Lambert) by arrangement

152. Water Safety Instructor Course—Content is the Basic Swimming and WSI courses resulting in American Red Cross certification for successful course completion. Includes learning to teach swimming and lifesaving. Prerequisites: current Red Cross Advanced Lifesaving Certificate and good swimming skills.

3 units, Spr (Hammett, Weeks, Staff)  
MTWThF 3:15

153. Skin and Scuba Diving—A highly rigorous program for expert swimmers. Includes classroom lectures and a minimum of two skin and two scuba dives in open water. Extra fee assessed for equipment. Prerequisites: medical clearance and skill test.

3 units, Aut, Win, Spr (Hammett, Staff)  
TTh 1–3

248. Seminar on Swimming Pool Management—Prerequisites: current WSI certification and consent of instructor.

3 units, Win (Strathairn) by arrangement

DANCE ACTIVITY AND THEORY

All courses, except as indicated, are coeducational. Undergraduates intending graduate study in dance should confer with the dance advisers early in their undergraduate careers since a wise selection from among the following courses will fulfill most prerequisites for admission to and completion of the degree of Master of Arts in Education (Dance Specialization).

57. Tap Dance.

1 unit, Aut, Win (Williams)  
M 7–8:30 p.m.


1 unit, Aut, Win, Spr (Williams)  
W 8:30–10 p.m.

59. Dance for Men—Beginning approaches to the study of modern dance designed especially for men. Emphasis is given to increasing range of movement, with technical problems geared to strength potential. Some concern for improvisation and creative problems.

1 unit, Aut, Win (Cashion) MWF 10

60. Dance I—Analysis and performance of basic movement skills applicable to all dance. Development of simple rhythms and musical form with practical experience in simple drumming.

1 unit, Win, Spr (Valenzuela) TTh 9

61. Introduction to Basic Ballet and Preparatory Techniques for Dance—Basic classical and modern exercises for correct alignment and body placement, aiming for control and flexibility of movement. Elementary barre and center combinations introduce the beginning dance student to terminology of steps and concepts of line in relation to balance.

1 unit, Aut, Win (Staff) TTh 10
62. Modern Dance I — Development of flexibility, coordination, motor skills and modern dance techniques.
   1 unit, Aut, Spr (Staff) MWF 9 or 3:15
   Win (Staff) MWF 3:15

63. Modern Dance II — The extension of modern dance fundamentals to a clearly defined use of techniques and qualities based on the elements of movement in regard to rhythmic, directional, and dynamic changes in movements. Intermediate level.
   1 unit, Aut, Win (Staff) TTh 2:15-3:30 or 7:00-8:15 p.m.
   Win, Spr (Weiss) TTh 2:15-3:30

   1 unit, Aut, Win (Weiss) W 11-12:50

65. Modern Dance III — Course material based on a progressive upper intermediate level. Prerequisite: 63 or equivalent.
   1 unit, Win (Cashion) MWF 9
   Spr (Cashion) MWF 10 and M 11

72. Folk Dance I — Selection of dances from many countries with emphasis on traditional and foundation folk dance steps.
   1 unit, Aut, Spr (Lidster) MWF 1:15
   Spr (Lidster) MWF 1:15

73. Folk Dance II — Continued presentation of dances from many countries with definite emphasis on foot and body skills necessary for the styling related to specific countries. Prerequisites: ability to perform basic and traditional folk dance steps; 72 or equivalent.
   1 unit, Aut, Spr (Staff) TTh 1:00-2:05
   plus an additional hour
   Spr (Staff) MWF 2:15

74. Folk Dance III — Dances from selected countries with concentration on foot and body skills necessary for the styling related to those countries. Opportunity for occasional community performances. Prerequisite: 73 or equivalent.
   1 unit, Spr (Staff) TTh 1:00-2:05 plus an additional hour

75. Ethnic Dance: Mexican — Selected regional dances of Mexico to be taught for technical and cultural understanding.
   1 unit, Aut, Spr (Cashion) MWF 1:15

76. Ethnic Dance: Israel — Includes styling, music, and costumes.
   1 unit, Win (Lidster) TTh 11:00-12:30

77. Ethnic Dance: Balkan — Selected dances of the Balkans with a concentration on styles, music and costume.
   1 unit, Spr (Staff) TTh 11:00-12:30

78. Ethnic Dance: Styles and Technique; Hungarian — A concentration on the dance, music and dance lore of Hungary.
   1 unit, Win (Staff) TTh 11-12:50

160. Modern Dance Technique: Advanced — Development of versatile dance techniques and disciplines for strong control and expressive use of movement. Prerequisite: consent of instructor.
   1 to 3 units, Aut (Weiss) MF 4:15-6:00

161. Contemporary Dance Forms I — Sequences for manipulation of movement and advanced techniques. Prerequisite: consent of instructor.
   1 to 3 units, Win (Weiss) MW 4:15-6:00

162. Contemporary Dance Forms II — This class is an extension of 161, for more advanced performance.
   1 to 3 units, Spr (Weiss) MW 4:15-6:00

163. Improvisation and Composition.
   3 units, Aut (Cashion) Th 8:15-9:45 p.m.
   Spr (Cashion) WF 11:00-12:50

164. Choreography Workshop — Compositional problems in Modern Dance based on traditional approaches in handling form and design, time and rhythm, energy flow and force as they relate to dance as an art form. Prerequisite: 163 or consent of instructor.
   3 units, Win (Cashion) Th 7:00-9:45 p.m.

165. Contemporary Dance Workshop — Emphasis on new approaches in design and improvisation, involving exploration of movement and the study and manipulation of creative concepts for dance composition and choreography. Solo and group forms. Prerequisite: consent of instructor.
   2 to 4 units, Aut (Weiss) 4:15-6:00 and by arrangement

166. Performance Workshop — Preparation of choreographies for performance. Prerequisite: consent of instructor or by audition.
   3 units, Spr (Cashion) Th 7-9:45 p.m. and F 4:15-6

168. Labanotation I — The Laban method of
notating, with symbols, dance and other forms of movement.

3 units, Aut (Cashion) MW 2:15–4:00


4 units, Aut (Lidster) TTh 11:00–12:50

172A,B. Folk Dance: Advanced — This three-quarter series focuses on dances with complex patterns and intricate steps. Emphasis on styling and footwork. Opportunity to work with guest teachers. Prerequisite: 74 or equivalent.

1 to 3 units, Aut, Win, Spr (Lidster) Th 4:30–5:45 and M 7:30–9:45 p.m.

173A,B. Folk Dance Exhibition: International—A two quarter series of advanced and exhibition dances mastered in order to participate in dance concerts, demonstrations, exhibitions, and festivals. Prerequisite: consent of instructor.

3 units, Win (Lidster, Staff) M 7:30–9:45 p.m. and W 7:00–9:45 p.m.

175A,B. Folk Dance Exhibition: Mexican—Further understanding of Mexican dance and its relation to the culture with an emphasis on technique and style for presentation of exhibitions. Prerequisite: 75 and/or consent of instructor.

3 units, Win, Spr (Cashion) T 7:00–9:45 p.m. and by arrangement

179. Survey of the Regional Dance of Mexico—A tracing of the historical roots of Mexican dance found in the Pre-Columbian indigenous contributions and the Spanish heritage; followed by a look at each region of Mexico, its dance forms and an understanding of how those forms were developed in relation to varying cultural influences.

3 units, given 1976–77

260. Contemporary Dance Practicum — Fundamentals of modern dance, movement analysis, techniques and dance accompaniment for all age groups, teaching assignments. Prerequisite: consent of instructor.

2 units, Aut (Weiss) F 11–1

261. Dance Production Practicum—Teaching methods, research, curriculum planning, choreographic methods and evaluation of all aspects for performance and staging of dance in schools and the university theatre. Prerequisite: consent of instructor.

4 units, Spr (Weiss) F 11–1 and by arrangement

262. Dance Etudes and Styles — A workshop-seminar representing dance history’s wide range of styles based on the development of instrumental music and trends in art and architecture. Emphasis in the performance of course work is on finished detail within the concept of a whole structural unit. Prerequisite: 160 or consent of instructor.

2 to 4 units, Win (Weiss) W 4:15–6:00

263. Dance Thesis: Contemporary — Individual development of thematic material for a creative project leading toward completion of the A.M. degree in Dance.

5 units, Aut, Win, Spr (Weiss) TTh 3:30 and by arrangement

266. Dance Repertory — Dance sequences, phrases and contrasting progressions, emphasizing fluency of movement, accuracy of timing, and clarity of form. Study of theme and variations. Prerequisite: consent of instructor.

1 to 3 units, Win (Weiss) F 11:00–12:50

268. Labanotation II — Continued application of Labanotation skills. Prerequisite: 168 or equivalent and consent of instructor.

1 to 3 units, Aut, Win, Spr (Cashion) by arrangement

270. Folk Dance Practicum—Analysis and development of instructional materials for an elementary folk dance class with teaching assignments. Prerequisite: 172 series or equivalent and consent of instructor.

2 units, Aut, Win (Lidster) by arrangement

271. Folk Dance Practicum—Analysis and development of instructional materials for an intermediate or advanced folk dance class and for community recreation with teaching assignments. Prerequisite: 172 series or equivalent and consent of instructor.

2 units, Win, Spr (Lidster) by arrangement

272. Seminar in Folk/Ethnic Dance — A relating of folk-ethnic dance forms to their respective cultures. Selected dances from Europe, Asia, Africa, and Latin America. Prerequisite: 160, 172 or their equivalent.

4 units, Win (Lidster, Cashion) MW 11:00–12:50 and M 7:30–9:45 p.m.
273. Dance Thesis: Folk/Ethnic — Individual development of folk/ethnic material for a creative project leading toward completion of the A.M. degree in Dance.  
5 units, Aut, Win, Spr (Lidster)  
by arrangement

369. Individual Study in Dance Research—  
Prerequisite: consent of instructor.  
3 to 5 units, Aut, Win, Spr (Cashion, Lidster, Weiss) by arrangement

SPORTS AND INDIVIDUAL ACTIVITIES

Except as indicated, all courses are open for enrollment by men and women students.

1. Posture—Figure control and posture improvement with individual conditioning.  
1 unit, Aut, Win, Spr (Diaz, Weeks)  
MWF 10 or 1:15

2. Conditioning—Designed to help students achieve their fitness goals. Includes different approaches to conditioning, individualized exercises and maintenance of fitness. Discussions on physiological aspects derived from different methods of conditioning and their effect on weight control and body appearance.  
1 unit, Aut, Win, Spr (Sackman, Staff)  
TTh 10 or 11 or 2:15 or 3:15 or  
MW 11 or 3:15

3. Weight Training—Special emphasis on development of individually prescribed exercise programs and the achievement of student goals. Appropriate discussion of exercise physiology included. Some individual achievement standards are expected.  
1 unit, Aut, Win, Spr (Ruff) MW or  
TTh 3:15 or 4:15

5. Self Defense for Women—Designed to enable the woman student to protect herself in assault situations by understanding the philosophy of the various martial arts, the importance of self control and self discipline and to attain self confidence.  
1 unit, Aut, Win, Spr (Blankenhorn)  
MW 10 or 11 or 2:15

6. Self Defense: Basic — To provide men and women students with basic escape strategies to avoid common street assaults. Emphasis on physical and psychological principles of Ju-Jutsu, Aikido, Judo and Karate. Prerequisite for women: 5 or equivalent.  
1 unit, Aut, Win, Spr (Blankenhorn)  
MWF 10 or 3:15

15. Gymnastics: Beginning—Fundamental gymnastics movement including various flexibility and strength exercises taught on mats and on the Olympic apparatus for men and for women.  
1 unit, Aut, Win, Spr (Hamada) MWF 1:15 or TTh 2:15

16. Gymnastics: Intermediate — For students with background in gymnastics. Group instruction and individualized work to enable some specialization on the various pieces of apparatus for men and for women.  
1 unit, Aut, Win, Spr (Hamada) TTh 1:15 or MW 2:15

17. Track: Basic—Instruction in track and field events. No vaulting. Field events only during Spring Quarter.  
1 unit, Aut, Win, Spr (Clark) TTh 11 or 2:15

1 unit, Aut, Win, Spr (Clark, Jordan)  
by arrangement

20C. Equitation: Beginning—Introduction to the fundamentals of English (forward seat) riding. Special fee.  
1 unit, Aut, Win, Spr (Melville)  
MTTh 1:15 or 2:15

21C. Equitation: Intermediate—Continued development of skill in English (forward seat) riding. Special fee. Prerequisites: ability to walk, trot and canter securely and knowledge of leads and diagonals.  
1 unit, Aut, Win, Spr (Melville)  
MTTh 3:15 or 4:15

22. Golf: Beginning—Fundamentals of the golf swing, use of various clubs, golf etiquette, and knowledge of the rules to enable a beginner to play a round of golf.  
1 or 2 units, Aut, Win, Spr (Diaz, Staff)  
MTWTh 11 or TTh 10 or 2:15

23. Golf: Intermediate—Improvement and perfection of previously learned fundamentals. Utilization of these skills in the game. Prerequisite: promoted from 22 or the equivalent or ability to score in the 60's for nine holes on a regulation length course.  
1 unit, Aut, Win, Spr (Staff) TTh 11 or 1:15

1 unit, Aut, Win, Spr (Diaz) MW 1:15
   1 unit, Win (Schoof) MW 2:15
   Spr (Schoof) TTh 1:15

30. Fencing: Beginning — Basic movements and practice in coordination and timing.
   1 unit, Aut, Spr (Helliwell) MWF 10 or 2:15
   Win (Helliwell) MWF 10

   1 unit, Aut, Spr (Helliwell) MWF 9
   Win (Helliwell) MWF 9 or TTh 1:15

32. Tennis: Beginning — Covers fundamental strokes (forehand, backhand, service and volley), rules and scoring.
   1 unit, Aut, Win, Spr (Gould, Neal, Staff) MW 10 or 11 or 1:15 or TTh 10 or 2:15

33. Tennis: Intermediate — Review of fundamental strokes, introduction of the lob and overhead strokes, and utilization of strategy and tactics in game playing. Prerequisites: knowledge of rules and scoring, average ability in fundamental strokes.
   1 unit, Aut, Win, Spr (Neal, Staff) MW 10 or 2:15 or TTh 11 or 1:15 or 2:15

34. Wrestling: Basic — Introduction to and review of fundamental wrestling skills.
   1 unit, Aut, Win, Spr (DeMeo) MTWTh 2:15 by arrangement

36. Basketball: Basic — For those with a limited basketball background. Includes extensive use of drills plus discussions of tactics, offense and defense. Game practice.
   1 unit, Aut, Spr (Staff) TTh 11

37. Field Hockey: Basic — Focus on conditioning, stick work, individual tactics, team play, strategy and rules.
   1 unit, Aut, Spr (Schoof) MWF 1:15

41. Volleyball: Basic — For those with limited volleyball background. Extensive use of drills to improve skills and game playing strategy.
   1 unit, Aut, Win, Spr (Staff) TTh 11 or 1:15

101. Adapted Physical Education — Individualized programs or opportunities to accommodate the physically inconvenienced student.
   1 unit, Aut, Win, Spr (Ruff) by arrangement

102. Conditioning: Individual Program — Prerequisites: experience in conditioning programs and consent of instructor.
   1 unit, Aut, Win, Spr (Sackman, Staff) by arrangement

103. Weight Training: Individual Program — Prerequisites: experience in weight training and consent of instructor.
   1 unit, Aut, Win, Spr (Ruff) by arrangement

106. Self Defense: Intermediate — Emphasis on practicing self-defense techniques, understanding offensive tactics, throwing techniques, defense strategems to avoid oncoming attacks. Development of speed and control.
   1 unit, Win, Spr (Blankenhorn) by arrangement

120C. Equitation: Jumping — Introduction to and development of jumping skill using low single fences, higher fences, combinations and courses. Special fee. Prerequisite: promoted from 21C or equivalent.
   1 unit, Aut, Win, Spr (Melville) MTWTh 10

122. Golf: Advanced — Focus on understanding of and refining the golf swing as well as increasing power and distance. Prerequisites: ability to hit the ball with relative accuracy and play on a full 18-hole course with an average score of 115 or better.
   1 unit, Aut, Win, Spr (Diaz) TTh 1:15 and by arrangement

128. Badminton: Advanced — Refinement of strokes and utilization of strategy in game playing. Prerequisite: promoted from 29 or extensive experience which has resulted in above average ability.
   1 unit, Aut, Win, Spr (Schoof) TTh 11

130. Fencing: Epee — Prerequisite: consent of instructor.
   1 unit, Aut, Win, Spr (Helliwell) T 7:00–9:45 p.m. and by arrangement

131. Fencing: Advanced — Concentration on practice of attacks. Individual lessons and some competitive experience. Prerequisite: promoted from 31 or equivalent.
   1 unit, Aut, Win, Spr (Helliwell) TTh 10 and T 7:00–9:45 p.m.
132. Tennis: Advanced—Extensive use of drills to refine all strokes and utilize strategy in the game situation. Prerequisite: promoted from 33 or extensive experience which has resulted in above average ability in all strokes.

1 unit, Aut, Win, Spr (Gould, Neal, Staff) TTh 10 or 1:15 or 3:15 or MW 11 or 3:15

136. Basketball: Advanced—Extensive use of drills to refine fundamental skills and utilize offense and defense tactics.

1 unit, Spr (Staff) MTWTh 2:15

by arrangement

137. Field Hockey: Advanced — Emphasis on developing high level of ability in the fundamental and advanced skills and strategies for offense and defense. Prerequisite: promoted from 37 or extensive experience which has resulted in above-average ability.

1 unit, Spr (Schoof) MTWTh 2:15

by arrangement

141. Volleyball: Advanced—Extensive use of drills to refine fundamental and advanced skills and develop advanced level tactics for offense and defense. Prerequisite: above-average ability with extensive experience.

1 unit, Aut, Win, Spr (Lambert) MW 11

PHYSICAL EDUCATION AND SPORTS THEORY COURSES

All courses are coeducational and open to all students who meet indicated prerequisites. See “School of Education” section for additional course offerings.

100. Individual Study—Students may pursue in-depth study in a number of topics related to the discipline of physical education and of recreation leadership. Prerequisite: consent of instructor.

2 to 5 units, Aut, Win, Spr (Staff) by arrangement

104. Analysis of Human Movement — Review of skeletal anatomy and study of the mechanical principles of stability, motion and leverage as they relate to efficient performance in aquatics, dance and sports.

3 units, Aut, Spr (Weeks) TTh 9-11

181. Athletic Training — For students intending to teach and/or coach at the high school or college level. Scope includes the spectrum of prevention, care and rehabilitation of injuries associated with dance and sports activities. Prerequisite: consent of instructor.

2 units, Spr (Blanchard) by arrangement

182. Athletic Team Management—For student managers of intercollegiate teams. Prerequisite: consent of respective varsity team coaches.

2 units, Aut, Win, Spr (Davis) by arrangement

183. Intramural Sports Management — For student managers of IM sports and competitive organizations. Experience in coping with problems of administration, communication, organization of events and budgets as well as practical experience with logistics and rules of intramural tournaments.

1 to 3 units, Aut, Win, Spr (Fehring, Strathairn) by arrangement

200. Individual Study — Opportunity for continued in-depth study of specific topics related to the discipline of physical education. Prerequisite: consent of instructor.

3 to 5 units, Aut, Win, Spr (Ruff, Strathairn) by arrangement

201. Seminar on Motor Learning—Graduate seminar on recent research in motor learning with special application to principles of teaching physical education activities and coaching competitive sports.

3 units, Spr (Nixon) MWF 10

205. History and Philosophy of Japan’s Martial Arts.

3 units, Win (Blankenhorn) TTh 7:00-9:45 p.m.

206. History and Philosophy of the Asian Fighting Arts—Indian, Chinese, and Japanese philosophies as these have been adopted by the various martial arts.

3 units, Spr (Blankenhorn) TTh 7:00-9:45 p.m.

248. Seminar on Swimming Pool Management—Prerequisites: current WSI certificate and consent of instructor.

3 units, Win (Strathairn) by arrangement

290. Seminar on Sports Sociology — The study of sport as a social institution, its value orientations, major social concerns, modes of interaction and structural relationships with other social institutions.

4 units, Sum (Ruff, Nixon) MTWThF 9

SPORTS OFFICIATING

Each of these coeducational courses is concerned with the rules, scoring, records, responsibilities and limitations of officials
for the respective sports. Course work includes practical experience in organizing meets and tournaments as well as development of officiating skill and technique in the game situation. Students have opportunity to receive official's rating as a means for securing employment as an official. See current Time Schedule for times that courses are offered.

123W. Golf (Diaz)
131W. Fencing (Helliwell)
133W. Tennis (Neal)
136W. Basketball (Staff)
137W. Field Hockey (Schoof)
149W. Swimming (Staff)

SPORTS THEORY AND TECHNIQUE

Each of these educational courses is designed to develop an understanding of the skills and strategies of the respective sports as well as to increase teaching/coaching competency. Lecture-discussions of relevant theory in support of teaching methods and performance techniques, psychological-interpersonal relationship phenomena, training dimensions (i.e., pre-season, season and post-season) and conduct on quality interschool competition. Analysis of Human Movement and/or Foundations of Physical Education are highly recommended as prerequisites; therefore, prospective enrollees should confer with the respective instructors regarding interest in the following 2-unit, by-arrangement courses:

101T. Adapted Physical Education (Ruff)
105T. Self Defense (Blankenhorn)
116T. Gymnastics (Hamada)
117T. Track and Field (Clark, Jordan)
123T. Golf (Diaz)
129T. Badminton (Schoof)
131T. Fencing (Helliwell)
133T. Tennis (Gould, Neal)
135T. Baseball (DiBiaso)
136T. Basketball (DiBiaso)
137T. Field Hockey (Schoof)
138T. Football (Christiansen)
141T. Volleyball (Lambert)
149T. Competitive Swimming (Gaughran)
151T. Water Polo (Lambert)

SPORTS PRACTICUM — For the highly skilled student in a given sport who anticipates becoming a teacher/coach of that activity. Teaching opportunities under close, experienced supervision of specified teacher/coaches. Prerequisites: the respective theory and technique course or equivalent and consent of instructor.

2 units, Aut, Win, Spr (Ruff) by arrangement

INTERCOLLEGIATE ATHLETICS

Varsity and junior varsity men's and women's teams in Pac-8 and NCIAC competitive schedules for the highly talented and motivated undergraduate student. Most squads are limited in size and have prerequisite performance standards. Unless specified, team tryouts are open to men and women students.

116I. Gymnastics: Varsity—Eligible women gymnasts have opportunity to develop to team status.

1 to 2 units, Aut, Win, Spr (Hamada)
MTWThF 3:15-5:00

117I. Track and Field: Varsity.

1 to 2 units, Aut, Win, Spr (Jordan)
MTWThF 3:15

118I. Cross Country: Varsity.

1 to 2 units, Aut (Clark) MTWThF 3:15

123I. Golf: Varsity — Men's and women's teams.

1 to 2 units, Aut, Win, Spr (Diaz, Finger)
MTWThF 3:15 by arrangement

131I. Fencing: Varsity — Men's foil, epee and saber teams and women's foil team.

1 to 2 units, Aut, Win, Spr (Helliwell)
TTh 9 and T 7:00-9:45 and by arrangement

133I. Tennis: Varsity—Men's and women's teams.

1 to 2 units, Aut, Win, Spr (Gould)
MTWThF 3:15 by arrangement

134I. Wrestling: Varsity.

1 to 2 units, Aut, Win, Spr (DeMeo)
MTWThF 3:15-5:00

135I. Baseball: Varsity.

1 to 2 units, Aut, Win, Spr (Young)
MTWThF 2:15

136I. Basketball: Varsity—Men's team begins October 15 and women's team begins November 1.

1 to 2 units, Aut, Win (DiBiaso)
MTWThF 1:30 by arrangement
136J. Basketball: Junior Varsity—Women's team.
   1 unit, Aut, Win (Staff) MTWThF

137I. Field Hockey: Varsity — Women's team.
   1 to 2 units, Aut (School) MTWThF 3:15

137J. Field Hockey: Junior Varsity—Women's team.
   1 unit, Aut (School) MTWThF 2:15

138I. Football: Varsity.
   1 to 2 units, Aut, Spr (Christiansen) MTWThF 3:15

138J. Football: Junior Varsity.
   1 unit, Aut (Single) MTWThF 2:15

149I. Swimming: Varsity—Men's and women's teams.
   1 to 2 units, Aut, Win (Gaughran)
   MTWThF 3:15-5:00

150I. Diving: Varsity.
   1 to 2 units, Aut, Win, Spr (Devine)
   MTWThF 3:15 by arrangement

151I. Water Polo: Varsity.
   1 to 2 units, Aut (Lambert) MTWThF
   2:15-5:00
   Spr (Lambert) MTWThF 4:15

CLUB PROGRAM

Student initiated, organized, and conducted physical-activity groups have been affiliated with the Department for many years in several of the oriental martial arts and sports activities. Most of the clubs assess dues for their current members. Clubs, which meet the criteria for academic credit, are scheduled for regular instruction times as published each quarter in the Time Schedule. Other affiliated clubs are assisted in locating appropriate facilities for their recreational activities. For additional information, contact the Department.

ORIENTAL MARTIAL ARTS CLUBS

Each club in this program is unique in its physical skills and philosophical basis. The clubs encourage the uninitiated to observe a variety of class work prior to commitment to any of the following martial arts which have current affiliation:

Aikido—Japan's modern non-violent martial art. A way of life that unifies life energy (ki). Partnered practice includes specific blending movements, centering, ki extension, and techniques of flowing spherical motion which teaches one to be in harmony with others and with oneself.

Japan Karate—Stresses the basics of Karate-do and the development of human character through physical and mental discipline. Instruction and coaching in team and individual competition for advanced students.

Judo—Beginning and advanced instruction. Competitive workouts for advanced students.

Kenpo Karate—Instruction at beginning, intermediate and advanced levels in a Chinese martial arts system emphasizing speed and flexibility. Exploration of philosophical as well as physical principles. Group classes and individual instruction.

Tae Kwan Do—The Stanford TKD Club is involved in exploring the physical and mental discipline of Korean Karate. Students are also introduced to techniques in yoga, meditation and related readings.

Tai Chi Chuan—A highly sophisticated system of exercise composed of a series of self-defense postures specially designed to promote physical and mental fitness. Tai Chi Chuan has often been considered by many people to be one of the most priceless treasures of the Chinese civilization.

Sports Clubs—These student organized and conducted sports groups enable recreation, instruction and competitive opportunities supplementary to the Department's total program of athletics, physical education and recreation. The clubs, which have been or are currently affiliated with the Department, include:

- Backpacking
- Badminton
- Bowling
- Cricket
- Cycling
- Fencing
- Ice Hockey
- Lacrosse
- Skiing (conditioning and racing)
- Table Tennis

Additional clubs, which have been designated as Varsity Clubs, may receive some financial assistance from the Department for intercollegiate competition. Although others may be added, current varsity clubs are:

- Crew—156C
- Rugby—139C
- Sailing—55C and 155C
- Skiing—124C
- Soccer—140C
- Volleyball—141C for men's and women's teams
BLACK PERFORMING ARTS, COMMITTEE ON

Chairman: John H. Cochran (Drama)
Committee: James Shields (Music), Les Williams (Athletics, Physical Education, and Recreation)

The Committee on Black Performing Arts is an interdepartmental, interschool program designed for students interested in the performing arts. The Committee serves two main functions: to produce its own shows and to act as a liaison with established departments in hiring faculty and devising courses and programs of particular interest to the Black Community. Through the cooperation of the departments and the Committee, students are able to take relevant courses in dance, drama, music, cinema and still photography.


Consult Time Schedule for courses offered through the following departments: Drama, Music, Athletics, Physical Education and Recreation, and Art.

ACADEMIC COMPUTING SERVICES

Academic Computing Services is located in Pine and Polya Halls on the Jordan Quad-rangle. The computer currently operated, an IBM 360/67, will be upgraded to an IBM 370/168 during academic year 1975–76. In addition to standard peripheral devices, there are a large number of terminals located remotely on campus, which allow use of the computer without frequent trips to Pine Hall.

Services available include a text editor and file handler (WYLBUR), a remote job entry facility, and a time-sharing system (ORVYL), as well as the usual batch processing capabilities. Under ORVYL many interactive subsystems are available, including BASIC, WATORV, PLC, ALGOLW and SPIRES, a generalized information retrieval system. In addition, BALLOTS, the library automation and management information system, has been in operation since 1972.

A comprehensive library of analysis programs and statistical routines is maintained to assist users in solving their data processing problems. Programming languages available include ALGOL, BASIC, COBOL, FORTRAN, APL, PL/360, LISP, PL/1, SNOBOL, and 360 Assembler. Many other software packages that run under the IBM OS and VS operating systems are also available.

The staff of Academic Computing Services will provide advice on program development and problem solving to present and potential users of the computer. Nevertheless, it is expected that users will do their own programming and will make any necessary adaptations of available programs for their particular application.

At various times throughout the year Academic Computing Services offers short courses in the use of the data processing and timesharing equipment at Pine Hall as well as in the use of the major programming languages available. Registration is required for these courses and begins on University registration day in Pine Hall. The schedule of courses is announced each quarter in the Academic Computing Services Bulletin. In addition, with at least one quarter advance notice, special sections or courses can be arranged through the User Services Office (ext. 7-4400).

1. Introduction to Academic Computing
Services—This one-session course is designed for faculty, staff and students who will be using Academic Computing Services' IBM 360/67 for the first time. Topics covered include languages and programs available, computer charges, keyword protection, use of keypunches and use of the Pine Hall lobby terminal. A tour of Pine and Polya Halls is given. This course meets several times during the first week of the quarter. Each session lasts approximately one and one-half hours.

0 units, Aut, Win, Spr, Sum

5. BASIC—This course is designed to introduce the student to timesharing concepts and to the timesharing language, BASIC. For the researcher who is not a sophisticated programmer, this language is valuable in solving small day-to-day problems. In addition, BASIC's immediate and informative responses to programming errors make it an ideal language for beginning programmers. Through the extensive use of examples, the student gains not only a comprehensive introduction to the language but also a knowledge of the types of problems for which BASIC is particularly well suited. Knowledge of elementary algebra and experience with the text editor WYLBUR are essential.

0 units, Aut, Win, Spr, Sum

10. WYLBUR—This course is intended to familiarize students with the use of the terminal and with the text editing capabilities of WYLBUR on the IBM 360/67. Both programming and non-programming applications of WYLBUR are covered. Students learn how to use WYLBUR for creating and manipulating all kinds of text, such as computer programs, data and manuscripts. Students who plan to use WYLBUR for preparing manuscripts need no prior programming experience; those who plan to use WYLBUR for preparing programs should know a programming language. Some typing experience will be helpful.

0 units, Aut, Win, Spr, Sum

15. FORTRAN IV—This course is designed to provide a thorough introduction to the FORTRAN language. No previous computer experience is needed. An introduction to computer systems, including a description of software services and a typical hardware configuration, is given. The WATFIV compiler is used extensively in this course. A brief comparison of other FORTRAN compilers available on the IBM 360/67 is also presented. The student learns how to input and output data under format control, to use the available program library facilities, and to create SUBROUTINE and FUNCTION subprograms. Some attention is given to the numerical problems encountered when using a digital computer, and good programming practices are emphasized. Throughout the course, the student gains experience in designing, coding, and debugging FORTRAN programs. The student learns enough Job Control Language to use the IBM 360/67 system.

0 units, Aut, Win, Spr, Sum

18. PL/I—This course is intended to provide the student with an introduction to PL/I, a language designed for a wide range of applications. PL/C, a subset of PL/I developed at Cornell University, is used in the course. Previous programming experience is not required; however, knowledge of elementary algebra is essential. Students primarily interested in interactive PL/C are encouraged to take the WYLBUR course before attending this course.

0 units, Aut, Win, Spr, Sum

19. LISP—This course is designed to teach the student the language LISP, and does not emphasize techniques in the theory of list processing. The student solves programming problems using the timeshared LISP facility for initial debugging. The problems relate to the list processing areas of information retrieval, symbol manipulation, etc.; however, no previous knowledge of these areas is required. Experience in the use of the text editor WYLBUR is desirable.

0 units, by arrangement

20. Assembler Language—This course introduces experienced FORTRAN programmers to the 360 Assembler Language. In addition to receiving a complete introduction to the language, the student should gain a knowledge of the various applications of the language through the extensive use of examples. Particular attention is given to the linkage of Assembler Language routines with FORTRAN programs. Assembler macros and data management are not covered in this course. A thorough knowledge of FORTRAN and a high degree of programming sophistication are absolute necessities.

0 units, by arrangement
21. **SNOBOL**—SNOBOL is a general purpose programming language which was originally developed by Bell Telephone Laboratories for string-processing applications. It is a powerful tool for non-numeric computation, and is especially suited to computer applications in the humanities and to symbolic processing in other fields. This course covers both interactive and batch versions of the language.

0 units, Aut, by arrangement

22. **GPSS**—GPSS (General Purpose Simulation System) is an IBM-supplied language designed to assist the user in modeling transaction oriented systems. GPSS will create and simulate entities (transactions) and move them through the system along the path specified by the programmer. It is especially applicable to problems that deal with queuing. The course acquaints the student with the necessary tools to design models. Some familiarity with simple statistics and some previous programming experience are desirable.

0 units, Aut, Spr by arrangement

23. **MPS**—MPS (Mathematical Programming System) is a language designed by IBM for solving linear and separable programming problems. It also allows the user to do sensitivity analysis and parametric programming. The purpose of the course is to acquaint the student with the MPS procedures necessary for linear programming, separable programming, and ranging and parametric analysis. Students are expected to have some familiarity with linear programming techniques; however, no computer experience is required.

0 units, Win, Spr by arrangement

26. **SPSS**—This course is intended to introduce the social science student to SPSS, a Statistical Package for the Social Sciences. SPSS is an integrated system of computer programs for the analysis of data. In addition to the usual descriptive statistics, simple frequency distributions, scattergrams, and crosstabulations, SPSS contains statistical programs for simple correlation, partial correlation, multiple regression, factor analysis, Guttman scaling, canonical correlation, and t test comparison of sample means. This course covers the general format and conventions of SPSS control statements, the procedures and options available, and the Job Control Language for various input and output situations. No previous computer experience is required, but a knowledge of elementary statistics will prove helpful since teaching statistics is not a focus of the SPSS course.

0 units, Aut, Win, Spr, Sum

27. **Plotting**—This course is designed to introduce the student to the Overall Plotting System (OPS). Emphasis is on line graph plotting; bar graph and free-form design plotting are discussed briefly. Students learn to use OPS with all the available plotting hardware. Since the Overall Plotting System is a system of FORTRAN callable subroutines, it is essential that students have knowledge of FORTRAN.

0 units, Aut, Spr

28. **PL360**—This course introduces the PL360 programming language as an alternative to Assembler Language. PL360 enables the programmer to write efficient assembly level programs in a high level language style similar to that of ALGOL. The course is designed to provide a thorough introduction to PL360 programming with emphasis on the effective use of the language. Knowledge of the System/360 architecture is advised.

0 units, Aut, Spr by arrangement

30. **Introduction to SPIRES**—This course introduces students to the Stanford Public Information Retrieval System. Primary emphasis is placed on the search capabilities of SPIRES, using examples from typical bibliography, personnel directory and numerical data files. File updating using the online SPIRES processor is also discussed. Students need no prior programming experience, but are expected to be familiar with common WYLBUR commands.

0 units, Aut, Win, Spr, Sum

31. **SPIRES File Definition**—This course covers the file definition capabilities of the Stanford Public Information Retrieval System. Students learn how to describe file structures in SPIRES, to create SPIRES sub-files, to specify access or update restrictions for groups of file users, and to use SPIRES processing rules to describe input and file searching. SPIRES is not a programming language; programming experience is not required for this course. Familiarity with WYLBUR is expected, and the Introduction to SPIRES course is a prerequisite.

0 units, Aut, Win, Spr, Sum
32. SPIRES Output Formats—This course may be considered a continuation of SPIRES File Definition or may be taken by students already familiar with file building in SPIRES. The course covers development of output formats, including report generation, for data contained in SPIRES subfiles.

0 units, Aut, Win, Spr, Sum

33. JCL and Data Management — This course introduces the experienced programmer to the Job Control Language for Operating System/360, and explains the job, execute and data definition statements in detail. The FORTRAN H cataloged procedures are used as a source of examples of these statements. Program optimization and data management techniques applicable to FORTRAN programming are covered. Programmers who plan to use tape or disk devices should find this course valuable. Extensive knowledge of a programming language and experience in using it are essential for students taking this course.

0 units, Aut, Win, Spr, Sum

34. Using the Linkage Editor and Loader—This course covers Job Control Language for Operating System/360 as it applies to the creation and editing of load modules using the linkage editor and loader. The comparative use of these programs is discussed using FORTRAN examples. Extensive knowledge of, and experience with, a programming language is essential for students attending this course. The JCL and Data Management course, or knowledge of the job, execute and data definition statements, is strongly recommended.

0 units, Aut, Win, Spr, Sum

FOOD RESEARCH INSTITUTE


Director: Walter P. Falcon

Professors: Walter P. Falcon, Roger W. Gray, Bruce F. Johnston, Dudley Kirk, Clark W. Reynolds, Pan A. Yotopoulos

Associate Professors: Scott R. Pearson

Assistant Professors: Dennis L. Chinn, Omar L. Davies (Geography), Tetteh A. Kofi.

Acting: Barry J. Edmonston (Demography)

Librarian: Charles C. Milford

Affiliated Faculty:

Professors: Donald Kennedy (Biological Sciences)

OFFERINGS AND FACILITIES

The Food Research Institute was founded in 1921 to study problems of food supply, distribution, and consumption in their economic, social, and political aspects on a world-wide scale. The range of its investigation comprises the world food and agricultural economy, domestic and international trade in primary products, agriculture and economic development, and world population problems.

The Institute’s specialized library contains some 60,000 items, including up-to-date series of periodicals from over 50 countries, and is open for reference to students and others.

Food Research Institute Studies in Agricultural Economics, Trade, and Development, published three times a year, reflects the research interests in the Institute.

THE INSTRUCTIONAL PROGRAM

Graduate teaching leading either to the Master of Arts or Doctor of Philosophy degree has become an integral part of the Institute’s program. The program is designed for graduate students with solid undergraduate training in economics or agricultural economics, who possess a special interest in problems lying within the Institute’s areas of research.

The Institute does not undertake supervision of studies leading to a Bachelor’s degree, though certain of its courses may be counted toward a major in economics and in some other undergraduate programs.

The University requirements for advanced degrees, as set forth under “Degrees” elsewhere in this bulletin, should be consulted by all prospective students. The following are Departmental requirements.

MASTER OF ARTS

A student who completes at least 25 units of work in the Food Research Institute with an average grade of B or better; and who has completed at least 45 units of approved work in courses numbered 100 or above in the first
four quarters at Stanford, with an average grade of B or better, may be awarded the Master of Arts degree. (See also under "Doctor of Philosophy.") Qualified graduate students from other Schools and Departments may apply for an A.M. degree within the Food Research Institute. For such candidates, the same regulations prevail as for the regular A.M., except that the four-quarter rule may be waived. Applications should be made to the Chairman, Graduate Instruction Committee.

DOCTOR OF PHILOSOPHY

1. The first-year program for pre-doctoral students consists of a series of required and elective courses totaling 45 units. Economics 202, 203 (Price and Allocation Theory I and II), Economics 170, 171 (Introduction to Econometrics I and II) and Food Research 200 (Economics of Income, Employment and Structural Change in Disequilibrium Systems) are required. It is expected that the four other courses taken during the first year will be in the fields of the Institute.

2. During the second year of the Ph.D. program the student prepares through lectures, seminars, and directed reading and research in three fields for written examinations that are administered at the end of the second or early in the third year. Normally these are chosen from the following Institute fields: Economics of Agriculture; Economics of Consumption; Economics of Production; Commodity Prices and Markets; Applications of Economics to Development; International Trade Problems and Policies; Economic Geography; and Demography. A student wishing to offer a field outside this list or outside the Institute must secure approval.

3. Each student is required to prepare a detailed prospectus of his or her doctoral dissertation, which is subject to committee approval, and to defend this in a University-administered oral examination. The completed dissertation is subject to faculty approval, but no further formal defense is required.

4. To meet the foreign language requirement, a candidate must demonstrate a reading knowledge of one language other than English. The requirement may be satisfied in either of two ways: (a) by completion with passing grade of an approved reading course for the language concerned or, (b) by passing a special reading examination, to be given by a qualified member of the Food Research Institute or in the relevant language department.

5. At least two years (6 quarters) of graduate registration in the Institute program satisfactorily completed is required for each candidate.

Minor

Qualified doctoral candidates in other Schools and Departments may apply for a minor in Food Research. Requirements for this option include successful completion of two Institute fields, plus approval by the Chairman of the Graduate Instruction Committee of the overall program of work.

FELLOWSHIPS AND SCHOLARSHIPS

The Food Research Institute has available a limited number of University fellowships and scholarships for qualified students, ranging in amount of support to approximately $2,100 a year plus tuition. All students receiving University support are expected to accept a Research Assistantship or Teaching Assistantship in exchange for fellowship aid during at least one quarter of residence. Applications for all fellowships and scholarships should be made to the Graduate Admissions Office, Stanford University, Stanford, California 94305.

COURSES

100. Human Geography—The course presents an introduction to modern geographical perspective. Among the topics considered are: the interaction between cities (migration, information flows, diffusion of information); perception of space; locational decision-making; and the spatial organization of cities (with special emphasis given to the development and spread of ghettos).

5 units, Aut (Davies) given 1976–77

102. The Geography of Latin America—(May be taken as 202 by graduate students.) The course will consider the economic geography of Latin America concentrating on the role of agriculture in the area's development. Geographical theories of spatial organization will be presented and then ana-
lyzed for empirical validity within the Latin American context. The effect of U.S. influence on the area, due to geographical proximity, will also be examined.

5 units, Win (Davies) given 1976–77

103. The World Food Economy—(Same as Economics 106 and Human Biology 121.) This course will examine the individual components essential to a macro-perspective of the world food economy. The biological and economic principles of food production will be used to explain the potential for food supplies. Next attention will be devoted to nutritional, social, and economic factors that influence the consumption of major food groups. Techniques for measuring and evaluating nutritional well-being will be discussed briefly. The last part of the course will examine the world food economy in global perspective.

3 units, Spr (Johnston) MWF 10

105. Commodity Futures Markets and Prices —(Same as Economics 107A.) (May be taken as 205 by graduate students.) Description of the uses and functioning of commodity futures markets, with emphasis upon business uses of the markets. The meaning of hedging and the evolution of hedging practice. Determinants of the level of market use, and the relationship between level of use and market usefulness. Consideration from the evidence of price behavior, trading composition, and external influences, of the performance of futures markets in price determination and other functions. The extent, influence, and importance of speculation in commodity futures.

3 units, Aut (Gray) MW 4:15–6:05

106. Workshop in Commodity Price Analysis—(Same as Economics 107B.) (May be taken as 206 by graduate students.) Applications of various approaches to commodity price analysis and forecasting. Student papers to report on analyses of particular commodities and markets. Prerequisite: 105 or 205 and consent of instructor.

3 units, Win (Gray) W 7:30–10:00 p.m.

120. Marketing, Consumption, and Price Analysis—(Same as Economics 128.) Applications of micro-economic theory to problems of commodity price determination, with major emphasis on methods of analyzing consumption and marketing channels. Agricultural examples are stressed and the marketing analysis has an economic development focus.

3 units, Aut (Staff) MW 1:15–3:05

129. Analytical Techniques for Development Planning—(Same as Economics 129.) (May be taken as 229 by graduate students.) This course will emphasize linear programming and benefit/cost analysis as methods of evaluating projects and sectoral programs. The focus will be on applications rather than on theory, and on technique rather than on mathematically sophisticated methodology. Examples will be drawn primarily from the agricultural sector of less developed countries, but the techniques that are examined will be applicable to a much wider set of problems and issues.

3 units, Aut (Chinn) MWF 11

133, 134. Economic Development Problems of Third World Economies with Colonial Heritage I and II—(Same as Economics 127A,B.) (May be taken as 233 or 234 by graduate students.) An analysis of development theories, problems and policies common to third world economies, the evolution of these economies through the pre-colonial, colonial, and post-colonial eras, categorization of empirical growth models and patterns in terms of basic internal structures and institutions and international influences. Topics include development models of closed and open economies, problems associated with monoeconomies, land tenure systems, agricultural development, foreign investment and multinational businesses, industrialization, balance of payments and debt servicing, terms of trade and remunerative incomes from sales of primary produce, commodity agreements and related problems. Contemporary theories of economic imperialism and dependency models of development will be analyzed.

Research papers initiated in the first or second quarter will emphasize area studies or case studies of individual countries—hypotheses will be formulated and tested qualitatively or quantitatively.

5 units each quarter, Win, Spr (Kofi) TTh 4:15–6:05

135. Population Problems—(Same as Economics 131 and Sociology 170.) (May be taken as 235 by graduate students.) Contemporary problems of U.S. and world population in a social science context. Economic and sociological causes and consequences of
population composition and trends in births, deaths, and migration. Sociological implications of urbanization and of the demography of minority groups. Population growth in relation to food, resources, and modernization in developing countries. Population policies; family planning programs and population control.

5 units, Win (Kirk and Edmonston) MTWTh 9

136. Human Ecology—(Same as Sociology 231.) (May be taken as 236 by graduate students.) Introduction to the complex and varied systems of interaction between human populations and the living and nonliving environment. Principles of human ecology are presented in the context of the relationships of population, organization, and technology within the human environment. Particular attention is paid to the ecological aspects of food and population. Each member of the class will research the human ecology of a specific country or region of individual interest.

3–5 units, Aut (Edmonston) TTh 1:15–3:05

144. Economics of Agriculture: Structure and Policy—(Same as Economics 144.) (May be taken as 244 by graduate students.) The course deals with American agriculture and its historical and contemporary role in the economy. Topics include the structure and characteristics of farming and processing units, the role of agriculture in American economic development, government policy toward commercial agriculture, poverty problems in rural America, and the international dimensions of United States agriculture. Emphasis is on policy alternatives rather than on farm management.

3 to 5 units, Aut (Falcon) MWF 9

145. U.S. Agriculture: Interaction of Biology and Economics—(Same as Human Biology 153.) The development of agriculture in the United States has been profoundly shaped by biological and by economic influences; sound policy determination usually requires an understanding of the roles of both. This course is devoted to the interaction of these influences. It will consider (a) the biological basis of agricultural practice, including the major groups of cultivated plants, soil and water relations, growth physiology, genetics and plant breeding, agroecosystems and pest control; (b) basic agricultural economics, including the micro-economic basis of production, the supply of agricultural products, technological change, the demand for farm products, and the influence of federal farm programs on agricultural incomes, output, and international trade. In the last part of the course, the scientific and institutional components of selected policy issues in agriculture will be considered.

3 units, Spr (Falcon, Kennedy) MWF II

153. Location Theory and Spatial Analysis—(Same as Economics 149.) (May be taken as 253 by graduate students.) This course will be organized on a lecture-seminar basis and students will have the option of preparing research papers. The principal theories and techniques used in the analysis of spatial organization will be examined. In addition to more well-known classical theories, students will be exposed to the work of more recent scholars. Among the topics to be covered are: classical location theory, central place theory, spatial interaction, space in development planning, and certain aspects of spatial statistics.

5 units, Spr (Davies) given 1976–77

160. Trade and Development Problems of Tropical Africa—(Same as Economics 160.) (May be taken as 260 by graduate students.) Analysis of selected international aspects of tropical African economic development. Topics include African-non-African international trade and economic relations (theoretical background, historical perspective, case studies of export-led growth and the impacts of international capital flows) and intra-African trade and economic integration (customs union theory, historical perspective, case studies of African economic integration).

3 to 5 units, Spr (Kofi) MW 2:15–4:05

166. International Trade and Investment Policy—(Same as Economics 166.) (May be taken as 266 by graduate students.) This course is concerned with the formulation, implementation, effects, and possible improvement of selected governmental policies affecting international trade and foreign investment. Topics include policies affecting international trade in energy resources, influences of domestic agricultural policies on international commodity trade, issues underlying the international negotiation of reductions of barriers to trade, governmental responses to competition from
imports, international implications of environmental control, special trade and investment arrangements for developing countries, and domestic and international impacts of multinational corporations. With respect to each topic, initial attention is focused on existing institutions and practices, and policy analysis is then carried out to suggest improvements in current regulations. Prerequisite: Economics 165 or consent of the instructor.

5 units, Win (Pearson) TTh 2:15-4:05

**COURSES PRIMARILY FOR GRADUATE STUDENTS**

200. *Economics of Income, Employment, and Structural Change in Disequilibrium Systems*—A framework is developed for the macroeconomic analysis of market interaction in economic systems subject to structural transformation. Special attention is paid to the process of income distribution, welfare, and growth. The relationship between real and financial markets is examined, with respect to the roles of fiscal and monetary policy in the transformation process. Alternative social accounting techniques are evaluated with respect to their usefulness in analyzing regional and national economic change. Several short papers and final exam.

5 units, Spr (Reynolds) MW 3:15-5:05


205. *Commodity Futures Markets and Prices*—See 105.


218. *Economic Development in Latin America*—(Same as Economics 123, 223.) (Open to advanced undergraduate students, with the consent of the instructor.) An examination of the historical problems of economic growth and structural change in selected Latin American countries. Emphasis is placed on the application of modern analytical methods to problems of savings and investment, income distribution, employment, trade and finance. Given seminar style with individual research papers.

5 units, Aut (Reynolds) TTh 3:15-5:05

220. *Marketing, Consumption, and Price Analysis*—Same lectures as Food Research 120, but will include additional discussions on analytical techniques. An empirical investigation will be begun for presentation in Food Research 320 in Winter Quarter.

5 units, Aut (——) TTh 1:15-3:05

221. *Economics of Production*—The theory of production with special emphasis on agriculture. Production functions, profit functions and input demand functions; supply responsiveness; economic efficiency and technological change in the process of agricultural development. Prerequisite: one course in microeconomic theory and econometrics.

5 units, Win (——)

224. *Problems of Poverty, Income Distribution, and Unemployment in LDC's*—Theoretical arguments and existing empirical evidence on the relationships between income distribution, unemployment, and the process of economic development in LDC's will be critically examined. The course will focus on the possibilities of designing macro- and micro-economic policies consistent with both growth and equity objectives. Specific topics include income distribution and the green revolution; mechanization and employment; land reform; potential effects of redistribution on aggregate growth potential.

5 units, Spr (Chinn) MW 2:15-4:05

225. *Agricultural Development and Economic Growth*—A theoretical-historical approach with emphasis on agriculture's role in the development process. Selected issues to be examined include intersectoral relationships and resource flows, dualism, economic rationality and labor-leisure allocations, technical change, land tenure and taxation, and criteria relevant to the choice of strategies for agricultural development.

5 units, Win (Johnston) MW 10-12

229. *Analytical Techniques for Development Planning*—See 129.


244. *Economics of Agriculture: Structure and Policy*—See 144.
GRADUATE DIVISION SPECIAL PROGRAMS

253. Location Theory and Spatial Analysis—See 153.


266. International Trade and Investment Policy—See 166.

285. Seminar: Demography of the Developing Countries—(Same as Sociology 332.) The demographic situations of each of the major regions—Latin America, tropical Africa, Islam, India, and East Asia—in relation to economic and social development. Population forecasts and prospects. Present and possible policies for restricting population growth. Each student is required to lead a seminar and prepare a paper based on a term project. Prerequisite: 235 or consent of instructor.

5 units, Aut (Kirk) MW given 1976–77

286. Demographic Methods—(Same as Sociology 286.) Methodology of population analysis, including actuarial procedures, fertility measurement, stable population analysis, cohort analysis, population projection, and construction of demographic models.

3 to 5 units, Spr (Edmonston) TTh 10–12


3 units per quarter (Staff) by arrangement

320. Seminar: Empirical Analysis of Consumption—The seminar will discuss in depth several research papers prepared for 220, and a number of readings essential for the field examination in the economics of consumption. Food and agricultural topics are highlighted. Prerequisite: 220.

3 units, Win (——) T 1:15–3:05

321. Seminar: Applications of the Theory of Production—The purpose of this seminar is to prepare students for their dissertation fieldwork in the economics of production.

3 units, Spr (Yotopoulos) given 1976–77

362. Seminar: Empirical Analysis of International Trade and Investment—This seminar deals with selected topics in the analysis of policies governing international trade and investment. Each student must lead a discussion and write a term paper. Prerequisite: 262.

3 to 5 units, Spr (Pearson) W 2:15–4:05

365. Seminar: Economics of Tropical Agriculture—Selected topics in organization of production and marketing of agricultural products for home consumption and for export. Prerequisite: consent of instructor.

5 units, Win (Falcon) by arrangement

371, 372, 373, 374. Directed Reading and Research.

371. 3 units, Aut (Staff) by arrangement

372. 3 units, Win (Staff) by arrangement

373. 3 units, Spr (Staff) by arrangement

374. 3 units, Sum (Staff) by arrangement

401, 402, 403, 404. Advanced Directed Reading and Research.

401. 3 units, Aut (Staff) by arrangement

402. 3 units, Win (Staff) by arrangement

403. 3 units, Spr (Staff) by arrangement

404. 3 units, Sum (Staff) by arrangement

GRADUATE DIVISION SPECIAL PROGRAMS

Dean of Graduate Studies and Vice Provost for Faculty: to be named

Associate Dean of Graduate Studies for Administration: Karlene N. Dickey

Assistant Deans: Ronald D. Arroyo, Lynette N. Hall, Patricia D. Weiss

SPECIAL PH.D. PROGRAM

The Graduate Division Special Programs make provision for students whose plans for study toward the Ph.D. degree do not fall within the province of any one department. Such a program may be individually planned for an unusually able and well-qualified graduate student who has already been admitted to a department or school of the University to study for the Ph.D. and enrolled therein for at least two full quarters.

A student with a well-considered program not now provided for in the existing departments or special programs of the University
may then approach a member of the Academic Council qualified to give him or her guidance. The professor, if he or she believes the program desirable, will gather a sponsoring committee consisting of at least three other members of the Academic Council who represent the student’s various fields of interest. Included in this committee must be professors from at least two departments of the University. Before the student embarks on the program, this committee will address a Declaration of Intention (Form G54) to the University Committee on Graduate Studies:

1. Defining the area of the special program, showing that the University is qualified to offer it, and proposing a title for the degree.
2. Outlining the program of study and research contemplated.
3. Indicating, if possible, the nature of the dissertation contemplated.

If this Declaration is approved by the University Committee on Graduate Studies, an advisory committee, which usually but not necessarily will be the same as the sponsoring committee, will supervise the candidate’s work and sign the forms ordinarily transmitted by major departments. The chairman of the advisory committee will normally direct the dissertation. Students registering for special research under the guidance of their committee or for the Ph.D. dissertation should use the following course numbers:

400. Research.
   By arrangement

   By arrangement

**Courses for Graduate Students**

**337A, 337B, 337C. Seminar in Public Affairs**
—The core seminar in the University’s Public Affairs Fellowship Program, focusing on the contemporary role of democratic government and the responsibilities of its leaders; the nature of democratic government and politics; the dynamics of social, economic, and political change; and critical emerging issues of public policy. Credit will be given only for completion of the entire sequence.

337A. 5 units, Aut (Alvarez-Tostado) by arrangement
337B. 5 units, Win (Alvarez-Tostado) by arrangement
337C. 5 units, Spr (Alvarez-Tostado) by arrangement

**420A, 420B. Interdisciplinary Transportation Analysis**—This lecture/workshop course provides a broad interdisciplinary view of transportation and its importance to the economic and sociological well being of communities and the nation. Methods of forecasting transportation demand and modal choice and analyzing alternative transportation systems capable of satisfying this demand are studied. The technological and economic characteristics of present and future vehicles, terminal and other infrastructure requirements, impacts on surrounding communities, such as pollution, noise, traffic congestion, effects on tax base, population and employment are all considered in constructing methods of comparative evaluation of the competitive systems.

The interdisciplinary class from various engineering departments, economics, the social sciences, and the school of business develops solutions to specific transportation problems of importance to the nation and/or the Bay Area. The format is 2 lectures per week plus a 1 hour meeting of student working groups with the instructor. Guest lecturers from various Stanford departments and off campus participate. Seniors may enroll upon consent of instructor.

420A. 3 units, Win (Shevell) MWF 10
420B. 3 units, Spr (Shevell) MWF 9

The following courses, though given within the departments listed, may be taken by any interested graduate students:

**Computer Science**

105. Introduction to Computing.
106. Introduction to Computing.

**Education**

106. Education as Cultural Colonialism
109A. Cultural Pluralism: Classroom and Curricular Strategies.
109B. Cultural Pluralism: Classroom and Curricular Strategies.
200. History of Education.
201. History of Education in the United States.
212. The Politics of Educational Innovation: Comparative Analysis.
216. Cultural Pluralism and American Educational Policy.
220A. The Social Sciences and Educational Analysis: Introduction to the Economics of Education.
242. Bicultural Processes in Education.
253. Early Education Programs.
302. Colloquium on the History of American Urban Education.
306B. Education and Political Development.
311. Socialization of the Young in Contemporary Society.
411. Seminar in Child Development and Early Education (with instructors' consent).

FOOD RESEARCH INSTITUTE
260. Trade and Development Problems of Tropical Africa.

APPLIED EARTH SCIENCES
130. Environmental Earth Sciences I.
131. Environmental Earth Sciences II.
132. Environmental Earth Sciences III.

GRADUATE SCHOOL OF BUSINESS
For course offerings in the Graduate School of Business, please refer to their current Degree Programs Bulletin.

HOOVER INSTITUTION
Note—The following course taught by staff members of the Hoover Institution is offered for academic credit as indicated.
5 units, any quarter (Gann or Duignan)

INDUSTRIAL ENGINEERING
208. Biotechnology.
229. Engineering Economy.


NONMATRICULATED GRADUATE STUDY

Graduates of colleges and universities of recognized standing are eligible to be considered as applicants for admission to nonmatriculated status in the Graduate Division of the University. Nonmatriculated graduate student status is granted to special students who are not seeking advanced degrees from Stanford University but who would benefit from course work at Stanford for a variety of reasons. This status is granted for one year. The nonmatriculated student will obtain academic credit for the courses satisfactorily completed, is entitled to an official transcript and is eligible to use all University facilities and services which are available to matriculated students. However, in cases of limited class enrollment, students in degree programs have priority over nonmatriculated students. U.S. citizens are required to submit one official transcript from the school from which the Bachelor’s degree was received, except that current or former Stanford students need not submit Stanford transcripts with their applications. No letters of recommendation or Graduate Record Examination scores are required. No financial aid is available.

Foreign applicants for admission as nonmatriculated students are subject to the same requirements as applicants for admission to degree programs with respect to (1) the academic credentials to be submitted, (2) adequacy of financial support, and (3) English proficiency qualifications. Nonmatriculated status is appropriate primarily for those foreign students who are sponsored for a limited period (3 to 12 months) of U.S. study by an international agency or by their home governments or universities. The requested study period at Stanford is intended to contribute to ongoing advanced degree programs in their home universities or to a specific area of professional development under circumstances where time does not permit, or their purposes do not call for, completion of a Stanford degree program.

Further questions should be directed to the Assistant Dean of Graduate Studies, Graduate Division Office, Inner Quad, Building 1.
HOOVER INSTITUTION
ON WAR, REVOLUTION AND PEACE

Director: W. Glenn Campbell
Associate Director: Richard F. Staar
Associate Director: Richard T. Burress
Associate Director: Darrell M. Trent
Consultant to the Director: Witold S. Sworakowski
Information Officer: George Marotta
Finance Officer: Rosemarie Smaltz
Administrative Assistants: Laverne Klebofski, Dennis Spellmire

Research and Publications
Honorary Fellows: Ronald Reagan, Alexander Solzhenitsyn
Consultant: Yuan-li Wu

National, Peace and Public Affairs Fellows Program, Executive Secretary: Dennis L. Bark
Research Fellows: Dennis L. Bark, Paul Cocks, Ross D. Eckert, Brian R. Fry, Robert Hessen, William E. Ratliff, Charles Ridley, P. Craig Roberts, Molly Sturges
Russian Review Editor: Terence Emmons
Information Editor: Thomas Wilfong
Research Assistants: Valerie Bloom, Christopher Hall, Chi-Yi Hsiang, Stephen Scharf, Ludmila Sidoroff, Kathryn Szczepanski

Publications Department
Head: To be named
Distribution and Microfilm Manager: Mickey Hamilton

The Library and Archives
Associate Director for Library Operations: Richard F. Staar
Readers’ Services
Head: Arline Paul
Reference Department
Librarians II: Rena K. Fowler, Hilja Kukk
Circulation Department
Group Supervisor: Dorothy Godsall
Library Services Assistant: Mary Gillmor
Interlibrary Loan: Ann Robison
Photographic Service: Helene Pashin
Serial Records Department
Librarian II: Marie Schutz
Technical Processing Specialist: Ellen Leung
Catalog and Acquisitions Services
Head: Adorjan de Galffy
Librarians III: William Boreysza
Librarians II: James Emdy, Priscilla Wong
Librarian I: Laszlo Horvath
Senior Library Specialist: Barbara Lasarev
Group Supervisor (Acquisitions): Natascha Gass
Technical Processing Specialists: Cornelia Boer, Peter Horton, Marina Izrailov

East Asia Collection
Curator: Ramon H. Myers
Research Fellow: Charles Ridley
Deputy Curator: Emiko Moffitt
Librarians III: Allan Paul, Julia Tung
Librarians II: Jun Nakamura, Michiko Kyohara
Librarians I: Ming Pai, T. Y. Wu
Senior Library Specialist: Linda Tsou
Technical Processing Specialists: Akiko Grubaugh, Chang-ning Hu, Vena Sheng, Aileen Wang

Curatorships
Africa
Curator: Peter Duignan
Deputy Curator: Lewis Gann
Assistant Curator: Karen Fung
The Institution has its own resident research staff of historians, economists, and political scientists and promotes basic research and documentary studies. Notable long-term research topics include African colonialism, post-Mao China, the International Communist movement, and non-Russian nationalities in the Soviet Union.

The Institution is currently expanding its domestic research and fellowship programs, which will become comparable in size and quality to the international studies program. Scholars participating in the program will conduct advanced research on current political, economic, and social issues of domestic policy; in addition, there will be conferences, seminars, and lectures that deal with the issues.

Thomas G. Moore, formerly professor of economics at Michigan State University, has been appointed director of domestic studies. His own current research project is "Regulation and Deregulation of European Trucking: Lessons for the United States." Other projects include Martin Anderson's "The All-Volunteer Armed Force," an analysis of the defense manpower policy in the United States with particular emphasis on the recent elimination of the draft and its results; Rita Ricardo Campbell's "Food Safety Regulation," a critique and analysis of the federal regulations governing food safety in the United States; and Roger Freeman's "The Growth of American Government."

In addition to its own research staff, the Institution has been visited over the years by tens of thousands of American and foreign scholars. Considering the value of the collections, every effort will be made to increase the use of Institution resources by providing more funds for postdoctoral fellowships. Illustrative of this aim is the National Fellows Program, which includes a special category of Peace Fellowships. The program offers by invitation to young scholars time for unrestricted research in modern history, political science, international relations, economics, and sociology.

The Institution also has a publications program, and since 1919 some 300 volumes have been published.

Recent joint appointments between the Institution and the University include: Rita Ricardo Campbell, Senior Fellow, Lecturer in Health Services Administration at the Stanford Medical School; Paul Cocks, Re-

Eastern Europe
Curator: Wayne Vucinich  
Research Fellow: Paul Cocks  
Senior Library Specialist: Cleo Burns  

Latin America
Curator: Joseph Bingaman  
Research Fellow: William Ratliff  

Middle East
Curator: George Rentz  
Assistant Curator: Michel Nabti  

Western Europe
Curator: Agnes Peterson  

British Labour Collection
Honorary Curator: Richard Lyman  

Boris I. Nicolaevsky Collection
Curator: Anna Bourguina  

Imperial Russian Collection
Honorary Curator: Vasili Romanov  

Hoover Institution Archives
Archivist: Milorad M. Drachkovitch  
International Associate: Weldon B. Gibson  
Special Representative: Franz G. Lassner  
Deputy Archivist: Charles Palm  
Assistant Archivist: Crone Kernke  
Librarian: Dale Reed  
Senior Library Specialist: Ronald Bultoff  
Subject Specialist: V. Nicholas Vucinich  
Research Assistant: Ludmila Sidoroff  

Since its founding by Herbert Hoover in 1919 as a special collection dealing with the causes and consequences of World War I, the Hoover Institution on War, Revolution and Peace has become an international center for documentation, research, and publications on problems of political, economic, and social change in the twentieth century.

The library includes the largest private archive in the United States and outstanding area collections on Africa, East Asia, Eastern Europe, Latin America, the Middle East, and Western Europe.

Holdings include government documents, files of newspapers and serials, manuscript memoirs, diaries and personal papers of men and women important in world affairs, publications of ephemeral societies and of resistance and underground movements, and the publications and records of national and international bodies, both official and unofficial, as well as books and pamphlets, many of them rare and irreplaceable. The materials are open to all Stanford students, faculty, and staff, and to scholars from outside the University.
search Fellow, Lecturer in the Political Science Department; Paul Cootner, Senior Research Fellow, Miller Professor of Finance; Alexander Dallin, Senior Research Fellow, Professor of History and Political Science; Robert Hessen, Research Fellow, Lecturer in the Graduate School of Business; Thomas Moore, Senior Fellow, Lecturer in the Graduate School of Business; George Rentz, Middle East Curator, Lecturer in the History Department; Kenneth Scott, Senior Research Fellow, Professor of Law. In addition, Peter Duignan, who is the Institution’s curator on Africa, also serves as curator for the African program of the University as a whole. George Rentz performs curatorial functions on a University-wide basis for materials in Arabic, Turkish and Persian. And the Institution’s East Asian library collects research materials in the Chinese and Japanese languages for all of Stanford.

COMMITTEE ON HYDROLOGY

Committee in Charge: Irwin Remson (Chairman), William E. Brigham, Joseph B. Franzini, Paul Kruger, Perry McCarty

PROGRAMS OF STUDY

The Committee on Hydrology, which includes faculty from the Departments of Applied Earth Sciences, Civil Engineering, Geology, and Petroleum Engineering, administers a program of graduate studies leading to degrees of M.S. in Hydrology and Ph.D. in Hydrology.

The program is interdisciplinary and covers a wide range of the Hydrologic Sciences, emphasizing surface hydrology and groundwater hydrology together with those parts of meteorology and oceanography that are related to the hydrologic cycle. Studies involving the impact of the nuclear age on hydrology are also available.

MASTER OF SCIENCE

This program is available to students having the Bachelor’s degree in Civil Engineering, Chemical Engineering, Chemistry, Geology, Geophysics, Agronomy, Forestry, Meteorology, Nuclear Science or Engineering, and related fields. In order to earn the M.S. degree in one year, the student should have completed basic courses in physics, chemistry, mathematics through an introduction to differential equations, geology, and elementary fluid mechanics.

The M.S. program will include 45 or more units of which at least 35 will normally come from the following list of courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES 192, 292</td>
<td>Geomathematics I, IV</td>
<td>8</td>
</tr>
<tr>
<td>AES 284</td>
<td>Engineering Geology</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 203</td>
<td>Statistical Models in Civil Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 206</td>
<td>Stochastic Processes and Decision Statistics for Civil Engineers</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 222</td>
<td>Water Resources Planning</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 261</td>
<td>Environmental Fluid Mechanics I</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 262</td>
<td>Environmental Fluid Mechanics II</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 263</td>
<td>Fluid Mechanics of Closed Conduits</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 264</td>
<td>Open Channel Hydraulics and Sedimentation Problems</td>
<td>4</td>
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<tr>
<td>Civil Engr. 265</td>
<td>Engineering Hydrology</td>
<td>4</td>
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<tr>
<td>Civil Engr. 267</td>
<td>Advanced Hydrology</td>
<td>4</td>
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<tr>
<td>Civil Engr. 268</td>
<td>Water Resources Development</td>
<td>4</td>
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<tr>
<td>Civil Engr. 269</td>
<td>Water Resources Seminar</td>
<td>1</td>
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<tr>
<td>Civil Engr. 270</td>
<td>Water Quality in Water Resources Development</td>
<td>3</td>
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<tr>
<td>Civil Engr. 273</td>
<td>Water Chemistry</td>
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<tr>
<td>Civil Engr. 273A</td>
<td>Water Chemistry Laboratory</td>
<td>1</td>
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<tr>
<td>Civil Engr. 274</td>
<td>Water Microbiology</td>
<td>2</td>
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<tr>
<td>Civil Engr. 276A</td>
<td>Nuclear Methods in Environmental Sciences</td>
<td>3</td>
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<tr>
<td>Civil Engr. 276B</td>
<td>Environmental Impact of Power Generation</td>
<td>3</td>
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<tr>
<td>Civil Engr. 276C</td>
<td>Environmental Radioactivity</td>
<td>3</td>
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<tr>
<td>Civil Engr. 277</td>
<td>Explosion Construction Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Elec. Engr. 292A</td>
<td>Environmental Systems Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 171</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
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<tr>
<td>Geol. 190</td>
<td>Introduction to Probability and Statistics in Geology</td>
<td>3</td>
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<tr>
<td>Geol. 221</td>
<td>Photogeology</td>
<td>3</td>
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<tr>
<td>Geol. 222</td>
<td>Geomorphology</td>
<td>4</td>
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<tr>
<td>Geol. 230</td>
<td>Hydrogeology</td>
<td>5</td>
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<tr>
<td>Geol. 231</td>
<td>Groundwater Resources</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 232</td>
<td>Numerical Methods in Hydrogeology</td>
<td>2</td>
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<tr>
<td>Geol. 250</td>
<td>Introduction to Marine Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 290</td>
<td>Applications of Probability and Statistics in Geology</td>
<td>3</td>
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<tr>
<td>Pet.E. 150A,B</td>
<td>Formation Evaluation</td>
<td>6</td>
</tr>
<tr>
<td>Pet.E. 151A,B</td>
<td>Reservoir Fluids</td>
<td>6</td>
</tr>
<tr>
<td>Pet.E. 151E</td>
<td>Core Analysis Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 170</td>
<td>Elements of Petroleum Reservoir Engineering</td>
<td>3</td>
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<tr>
<td>Pet.E. 172</td>
<td>Gas Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 275</td>
<td>Fundamentals of Well Test Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 281</td>
<td>Applied Mathematics in Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Comp.Sci. 106</td>
<td>Introduction to Computing</td>
<td>3</td>
</tr>
<tr>
<td>Indus. Engr. 141</td>
<td>Computer Applications and Techniques</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 110</td>
<td>Statistical Methods in Engineering and the Physical Sciences</td>
<td>4</td>
</tr>
<tr>
<td>Stat. 116</td>
<td>Theory of Probability</td>
<td>4</td>
</tr>
</tbody>
</table>
The program is subject to approval by the Committee and must represent a strong, coherent course of study in the student's area of professional interest. Inclusion of more than 10 units not listed above may be approved if this aids in assembling a coherent program. The average of grades in graduate work must be at least a B. Sample curricula may be obtained on request from the Committee.

**Doctor of Philosophy**

Ph.D. programs will be determined by discussion with the Committee on Hydrology but will normally include the substantial equivalent of the M.S. program plus an additional minimum of 45 units of course work, totaling at least 90 units. To become a Ph.D. candidate the student must demonstrate proficiency in one foreign language, pass a qualifying examination specified by the Committee and have a grade point average in graduate work of at least a B. Minimum residence requirements for the Ph.D. are nine quarters (six semesters) of graduate study; at least six quarters must be at Stanford. Completion of all requirements including the dissertation is rarely accomplished within the minimum time requirement, and students should expect to spend as much as one year beyond the minimum. A minor in Hydrology is not offered for Ph.D. programs in other departments of the University.

**Financial Assistance**

In addition to the usual University aid, a limited number of research assistantships are available. Assistants customarily work under supervision of a faculty member on one of the current research projects with which Committee members are involved. Where possible, students are assigned to projects that are in line with their professional interests. Research results are often used by doctoral candidates as a basis for a dissertation.

**International Studies**

*(Center for Research in)*

The Center for Research in International Studies (CRIS) was established in 1967 as a means of coordinating Stanford's numerous activities in the fields of international, comparative, and regional studies. Until 1974 it worked variously with the Presidential Committee and later the Commission on International Studies, but in that year the Commission was replaced by an Advisory Committee to the Director of CRIS.

CRIS provides the University with a means of planning, financing, stimulating, and coordinating a variety of activities and programs that relate to teaching and research in the international field. It is specifically concerned with the nature and quality of Stanford's curriculum in the sphere of international, comparative, and foreign area studies and has played a leading role in the development of the new undergraduate curriculum in International Relations. It is continuously and closely involved in the planning, support, and coordination of Stanford's foreign area and language programs and a variety of major research programs as well. CRIS also raises and administers funds from governmental, foundation, and private sources to support the University's activities in the international field and uses these funds in part to finance related faculty research, student fellowships, library development, and new faculty appointments.

The operations of CRIS are university-wide and extend to research and teaching activities in the Schools of Humanities and Sciences, Law, Business, Education, and the Food Research Institute. Relations with the various departments in the social sciences and humanities are especially close, as are those with the Hoover Institution on War, Revolution and Peace which is very heavily involved in international studies and research.

CRIS also administers on behalf of two consortia of major universities the Inter-University Center for Japanese Language Studies in Tokyo and the Inter-University Program for Chinese Language Studies in Taipei. Between them these provide the United States' most outstanding facilities for advanced professional training in the Japanese and Chinese languages.

CRIS is administered by a Director and Associate Director who work with a small administrative and secretarial staff. The Director has the advice and assistance of a Committee composed of faculty members and students representing many sectors of the International Studies community at Stanford. The offices are located in Building 460, Suite 465 (Telephone: 415 497-3347).

CRIS neither offers courses nor confers degrees. These academic functions are per-
formed by the schools, departments, and programs with which CRIS is associated.

**Area Studies Programs**

Stanford has four interdisciplinary language and area programs: East Asian Studies, Latin American Studies, Russian and East European Studies, and African Studies. These are separately organized as Centers responsible for coordinating the University’s resources in all schools and departments for teaching and research relating to each of these areas. The relevant faculty members from these schools and departments constitute the staff of the four Centers. The great majority of area-related courses and seminars are offered by the school or department concerned, not directly by the Centers. Undergraduate degree programs are coordinated by staff associated with each of the area programs. Special graduate programs leading to the A.M. in Latin American Studies, East Asian Studies and Russian and East European Studies are available and are described separately in this bulletin. The area studies programs do not offer the Ph.D. but a qualified doctoral candidate may design a cross-disciplinary specialization which emphasizes the area interest within the student’s interdisciplinary preparation for the degree.

**Undergraduate Program**

A special interdisciplinary program in International Relations, including an undergraduate major, has been developed in response to initiatives to review this aspect of the international studies curriculum. The relevant course offerings are described under the rubric “International Relations: Special Offerings for Undergraduates” in the School of Humanities and Sciences section of this bulletin.

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**INTER-UNIVERSITY CENTER FOR JAPANESE STUDIES IN TOKYO**

**ADMINISTERED BY STANFORD UNIVERSITY**

The Inter-University Center for Japanese Language Studies in Tokyo, Japan, is a cooperative enterprise of 11 major academic institutions in the United States and Canada with Stanford University as the administrative agency. The purpose of the Center is to provide qualified graduate and undergraduate students with intensive audio-lingual Japanese language instruction, as well as to further the students’ familiarity with Japanese texts and materials preparatory or leading to research in given disciplinary or professional fields. The location of the Center in Tokyo provides maximum opportunities for students to gain fluency in both the written and spoken language in a Japanese-speaking and Japanese cultural environment. Language study is carried on in small classes or in individual tutorial sessions by Japanese instructors. Advanced and Post-doctoral students may be given opportunities for specialized work in the language, as well as other individual study, dependent upon their linguistic qualifications and their degree programs as established by their home institutions.

The academic year at the Center is equivalent to four full quarters, beginning in early September. Any student may apply for admission provided that he or she (a) is a student in good standing, and is a degree candidate at an accredited university or college; (b) will have successfully completed prior to attendance a minimum of two years of Japanese or its equivalent at the college level; and (c) takes a written screening examination in the Japanese language.

For further information please write to:
Center for Research in International Studies
Room 465, Building 460
Stanford University
Stanford, California 94305

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**INTER-UNIVERSITY PROGRAM FOR CHINESE LANGUAGE STUDIES IN TAIPEI**

**ADMINISTERED BY STANFORD UNIVERSITY**

The Inter-University Program for Chinese Language Studies in Taipei, Taiwan, was established in September 1963. It is spon-
sored by ten American universities, with Stanford University as the administrative agency. The Program is a cooperative effort drawing upon the accumulated experience of the profession in providing advanced language training in a Chinese cultural area and is not intended to be a substitute for strong language offerings at American institutions.

The purpose of the Program is to provide graduate and undergraduate students with intensive audio-lingual language instruction, as well as to further the students' familiarity with Chinese texts and materials preparatory or leading to research in given disciplinary or professional fields.

Undergraduate, graduate, or postdoctoral candidates are eligible to apply to the Program if they have successfully completed a minimum of two academic years, or its equivalent, of Chinese language study at the college level. Applicants must also pass a short written screening examination in the Chinese language.

For further information please address your inquiries to:

Center for Research in International Studies
Room 465, Building 460
Stanford University
Stanford, California 94305

Assistant Director for Public Services: Dale B. Canelas
Building Projects Manager: Philip D. Leighton
Financial and Planning Officer: John Heyeck
Department Chiefs: Ralph W. Hansen (Acquisition); A. H. Epstein (Automation); Philip D. Leighton (Building Services); Lawrence E. Leonard (Catalog); Gloria Stockton (Central Circulation); Sandra K. Korn (Government Documents); Tina Kass (Personnel); B. Jack Pooler (Science); Florian J. Shasky (Special Collections)

University Archivist: Ralph W. Hansen
Curators — Resources Development Program: James Breedlove (Latin American Materials); Paul J. Kann (Romance Languages); Wojciech Zalewski (Russian and East European Materials)

Curators — Honorary: George T. Keating (Music Bibliography); Irving Whittemore Bobbins, Jr. (Rare Books and Manuscripts); Elmer E. Robinson (Americana); Albert Sperisen (Typography)

Food Research Institute Library
Librarian: Charles C. Milford

Hoover Institution—See listing elsewhere in this catalog.

J. Hugh Jackson Library of Business
Director: Marion M. Smith
Reference Librarian and Head, Reader Service: Martha A. Ashmon

Lane Medical Library
Director: Peter Stangl
Coordinator for Library Operations and Services and Head, Acquisitions Section: Ruth Pressman; Head, Cataloging Section: Gloria Linder; Head, Reference Section: Paul S. Hanson; Head, Circulation Section: Betty Vadeboncoeur; Head, Gifts and Finishing Section: Herman Pai

Law Library
Law Librarian: J. Myron Jacobstein
Special Projects: Rosalee Long; Head, Acquisitions: Howard W. Sugarman; Head, Cataloging, Judy Ting; Head, Circulation and Reference: George Torzsay-Biber
Lineq Accelerator Center Library

Technical Information Officer: George E. Owens
Head Librarian: Robert Gex
Associate Head Librarian: Louise Addis

The Libraries of Stanford University sponsor a variety of instructional activities in order to promote awareness of the library resources and services that are available to the campus community and to expedite their effective use.

The reference librarians in all major library units provide professional advice and consultation on locating and utilizing published information. Curators and branch librarians offer similar bibliographic help within their subject specialties. Other types of instructional aid include tours, audio-visual presentations, and lectures to classes at the instructor's request.

Numerous library publications are prepared to inform and instruct library users, the most general and basic of these being the Guide to Stanford University Libraries, which is frequently revised and available free at all major libraries. A general description of the libraries, their collections and services, is also included in the Information Bulletin.

The formal courses listed below are intended to serve those students for whom a more extended study of bibliographic organization is useful.

Courses

Library 1. Library Resources and Research Methods—Designed for students at all levels who wish to improve their ability to use libraries in general and the Libraries of Stanford University in particular. Emphasizes major types of material and the use of catalogs, bibliographies, indexes, abstracts, and other aids to study. Directed to the individual student's subject interests as far as possible.

3 units, Aut, Win, Spr (Staff)

Freshman Seminar 37A,B. The World of Rare Books and Their Collectors Through the Ages—This two-quarter course is designed to teach the student how to describe, compare, investigate, and attribute rare books, both hand-written and printed. The history of parchment and papermaking, illumination and woodcuts, and various techniques of book production will be investigated. Other activities will include printing on the antique hand-press of the Bender Room, and the planning and arranging of a small exhibit.

6 units, Win, Spr (Lenkey)

Slavic 184. Introduction to Slavic Bibliography—Analysis of basic Slavic research tools and bibliographic research media with emphasis on Russian and Soviet materials. The approach will be historical and evaluative. The aim of the course is to acquaint students with reference sources, bibliographic search techniques, library use, and materials available in Stanford University Libraries. Students will examine, evaluate and employ reference material. Knowledge of Russian and/or another Slavic language helpful. Open to graduate and undergraduate students. No final examination.

2 units, Aut (Zaletoski)

Music 200. Music Bibliography—Survey of reference and research materials in the field of music. Discussion of scope and organization of the Music Library holdings and access by means of the card catalog and other bibliographic and discographic guides. Practice in the use of reference materials, with emphasis on identification and location of primary resources. Introduction to methods of research through model problems and term projects involving sources, scholarly editions of music and performance materials, and writings found in encyclopedias, monographs, and serial publications.

3 units, Aut (Zalewski)

Art 236. Colloquium: Art Historical Bibliography and Library Methods—An introduction to and survey of standard works and reference materials in art and architectural history. Subjects covered will include acquisition and research techniques, cataloging and library procedures, indexing and abstracting, the history of the book, papermaking, conservation as it relates to art history and museum practices, and career possibilities in the field of art. Competence in art historical research will be gained through bibliographical problems and the compilation of an annotated bibliography.

4 units, Win, Spr (Ross)

Latin American Studies 260. Colloquium on Latin American Bibliography—This course
is directed to the needs of beginning graduate students. Its purpose is two-fold: to acquaint the student with the principal resources for Latin American studies in the humanities and social sciences; and to teach the mechanics of utilizing the bibliographic data available for the study of Latin America in the Stanford University libraries.

2 units, Aut (Breedlove)

PHYSICAL SCIENCES
(GENERAL PROGRAM)

Professor: Claudio Alvarez-Tostado  
Lecturer: William A. Perkins

The general program in Physical Sciences is designed to give students an acquaintance with all the principal fields of physical science without requiring specialization in any one. It provides training suitable especially for students who are preparing to teach science courses in secondary schools.

PROGRAMS OF STUDY
BACHELOR OF SCIENCE

The following requirements are in addition to the University's basic requirements for the Bachelor's degree:

Chemistry 31, 33, 35, 36, Mathematics 41, 42, 43, Geology 1, 2, Physics 21, 23, 29, or equivalents.

Forty-five additional units of work in chemistry, physics, mathematics, geology, or related fields.

Programs of study must be approved by an adviser appointed by the chairman of the Physical Sciences Subcommittee. The average grade for the science and mathematics courses specified above must be at least C.

MASTER OF SCIENCE

Candidates for the degree of Master of Science in Physical Sciences (General Program) are expected to complete, in addition to the general residence and other requirements of the University for that degree, a program of study approved by an adviser assigned by the chairman of the Physical Sciences Subcommittee. The program of study will include (1) an acceptable thesis; (2) the satisfactory completion of at least 30 units of advanced work in physics, chemistry, mathematics, geology, or related fields; and (3) such other advanced work in the University, making a total of at least 45 units, as may be approved by the adviser.

COURSES

5, 6, 7. Physical Science—A study of the development of physical sciences and their interaction with other activities of society. The sequence considers the development of scientific thought from Greek times to the present, using selected topics that seem to illustrate best the nature of scientific activity. Lectures emphasize history and philosophy of science.

5. 3 units, Aut (Alvarez-Tostado)  
TTh 11:00-12:15

6. 3 units, Win (Alvarez-Tostado)  
TTh 11:00-12:15

7. 3 units, Spr (Alvarez-Tostado)  
TTh 11:00-12:15

10. Introduction to Meteorology—A review of current knowledge about weather, with special attention to problems of air pollution. Lectures and problem sessions.

3 units, Aut (Alvarez-Tostado)  
Lecture TTh 9 and problem session by arrangement

15. Modern Astronomy — A review of current concepts and ideas regarding the nature of the solar system, galaxy, and extragalactic systems; essentially nonmathematical discussion of the basis for these concepts. Telescopic observations if possible.

3 units, Spr (Perkins) MWF 11

99. Directed Reading.
Any quarter (Staff)

Any quarter (Staff)

STANFORD OVERSEAS STUDIES

Stanford Overseas Studies Programs offer a variety of overseas study opportunities to Stanford undergraduates and graduates. General studies programs in Austria, Britain, France, Germany, and Italy provide courses
for undergraduates in the history, politics, literature, art, and economics of each country. Programs in Germany, France, and Spain afford advanced undergraduates a chance to study in foreign universities. Graduate students can use the centers as a base for advanced research.

Students in Berlin, Beutelsbach, Tours, and Vienna live in student dorms and apartments and generally take courses specifically organized for Stanford students. Students with a strong language background can take courses at local universities in Berlin, Vienna, and Tours. In Florence and at Cliveden, near London, students live in a residential center and take courses designed for Stanford students. In Bonn, Paris, and Salamanca, advanced students are regularly enrolled in local universities and live in dorms and apartments.

All regularly enrolled Stanford students are eligible to attend an Overseas Studies Center. Language and preparatory course requirements vary for each center, however. Students can study overseas for one, two, or three quarters. Tuition overseas is the same each quarter as on the home campus and the overseas fee closely approximates the quarterly room and board fees on the home campus. All courses taken overseas receive regular University credit. For more information about offerings, requirements, and fees, see the publication Stanford Overseas Studies 1975-76 or the appropriate program folder, both available in the Overseas Studies Office, room 112, Old Union.

More detailed information about courses described below can be found in the Stanford Overseas Studies Course Abstracts. Courses are not listed for Bonn, Paris, or Salamanca since students will choose from among the courses offered at the University in which they are enrolled.

ITALIAN STUDIES CENTER, FLORENCE

Academic and administrative personnel:
Giuseppe Mammarella, Director
Carla Lekai, Assistant Director
Joan M. Mammarella, Language Program Coordinator
Sidney Alexander
Roberto D'Alimonte
Lucia Benini
Franca Celli
Guido Fink
Guelfo Frulla
Umberto Giovine
Matthew S. Kahn
Anna Kaiser
Yoram Milo
C. Peter Rosenbaum
David Rosenhan
Lawrence V. Ryan
Giovanni Scichilone
Bernard Siegel
Maria Todorow

Italian History, I: Medieval Italy—An introduction to medieval Italian history from the fall of the Roman Empire to the age of Dante. Themes such as the development of regionalism, the birth of the Italian city-states, and the conflict between the Empire and the Papacy will be studied.

Aut (Frulla)

Italian History, II: Renaissance Italy—An introduction to Italian history from the age of Dante to the age of Galileo. Main themes to be studied include the crisis of medieval representative institutions and the growth of Absolutism; the dominance of the citystates (Florence, Venice, Milan, Rome, and Naples); Spanish domination; the historical and political writing of Machiavelli, Guicciardini, and Sarpi.

Win (Frulla)

Italian History, III: Modern Italy from the Enlightenment to Fascism—A survey of modern Italian history, emphasizing the influence of other European nations on the formation of modern Italy and the influence of various political ideologies on the developing Italian political system.

Spr (G. Mammarella)

Etruscan and Roman Culture and Art—A study of the origins and development of Etruscan culture and of Etruscan interactions with other Mediterranean cultures.

Win (Scichilone)

The Italian Communist Party: Its History and Politics—A survey of the Italian Communist Party's (PCI) development, and a comparative analysis of the PCI's and of other Communist movements' ideologies and policies.

Aut (G. Mammarella)

The U.S. and Western Europe After World War II—A study from the European point
of view of the economic, political, military, and cultural relations between the U.S. and Western Europe between 1945 and the present.

**Win (G. Mammarella)**

**Mediterranean Problems**—A study of the major ethnic, religious, cultural, economic, and political problems of the Mediterranean area from 1917 to 1947, with emphasis on the major political settlements which shaped the area shortly before World War II.

**Win, Sum (Giovine)**

**European Integration**—A study of the major events leading toward European integration after World War II and of the economic, political, ideological, and cultural problems of integration.

**Spr (Giovine)**

**Comparative Mediterranean Political Systems: Between Authoritarian and Democratic Regimes**—A study of the alternation between authoritarian and democratic regimes common to the Mediterranean area in the past century.

**Win (D'Alimonte)**

**Tuscan Art from Giotto to Leonardo**—A chronological analysis of the stylistic development of Tuscan art for the 13th to 15th centuries, including study of such masters as Giotto, Donatello, Botticelli, and Leonardo.

**Aut (Todorow)**

**The High Renaissance in the Visual Arts**—A study of the stylistic trends, iconography, and social history of Italian Renaissance art, concentrating on Michelangelo and Rafaello but including study of such artists as Bronzino, Vasari, Titian, Tintoretto, and Caravaggio.

**Win, Sum (Staff)**

**Architecture in Florence**—A study of the stylistic development of Florentine architecture, as well as a limited study of urban development.

**Spr (Staff)**

**Image and Insight**—A study of the fundamentals of visual perception using Italian art—recent and historic, environmental and fine—as a background, with emphasis on the aesthetic content of works in different media.

**Sum (Kahn)**

**Studio Seminar**—Students will translate their experience of Italian culture into a creative work in one of three ways: a photographic essay on an aspect of the Tuscan environment; a series of drawings responsive to Florentine art, life, or character; or written research into contemporary Italian design, architecture, or fine art.

**Sum (Kahn)**

**Art and Culture of Greece and Magna Graecia**—A study of the origins, development, and major achievements of Greek art between 1050 and 50 B.C. in its historical context.

**Aut, Spr (Scichilone)**

**Masterpieces of Italian Literature**—A survey of major works of Italian literature from the 13th century to the present. The works will be read in translation.

**Masterpieces of Italian Literature, I: 1200–1400**

**Aut (J. Mammarella)**

**Masterpieces of Italian Literature, II: 1400–1500**

**Win (J. Mammarella)**

**Masterpieces of Italian Literature, III: 1800–1900**

**Spr (J. Mammarella)**

**Dante's Inferno**—A stylistic analysis of some key Cantos in the first part of the Divine Comedy, with discussion of their historical background.

**Win (Fink)**

**The Evolution of Medieval Naturalism**—A study of the ways in which Medieval literary works reflect the social, economic, and religious development of Western Europe.

**Spr (Milo)**

**Dante, Petrarch, and Boccaccio**—A study of major writings by three founders of Florentine literature—Dante's Commedia, Petrarch's Rime, and Boccaccio's Decameron. The works will be read extensively in translation, while selected portions of each will be read in Italian.

**Sum (Ryan)**

**Renaissance Society and Culture**—A study of the interrelations of literature, art, and history in Quattrocento and Cinquecento Italy. Authors read will include Bruni, Alberti, Pico, Ficino, Castiglione, Machiavelli, Ariosto, and Michelangelo. Visits will be
made to locales with which the topics and writers studied are connected.

*Sum (Ryan)*

**Cinema and Italian Society**—An analysis of Italian history and society from the second half of the 19th century to the present through contemporary Italian film. Study of stylistic and technical developments will be included.

*Aut (Fink)*

**Fellini**—A study of Fellini’s films, their stylistic development, and the views they express about Italian society.

*Spr (Fink)*

**Focus Program: Cross Cultural Social Structure and Personality**

The following courses are part of the Cross Cultural Social Structure and Personality focus program offered Autumn, Winter, and Spring Quarters. Students will concentrate their studies on two related areas: Italian social structure, and personality development in Italy and the United States. In addition, students will examine the ways in which medical, psychosocial, emotional, and personality disorders are recognized and treated in the prevailing Italian medical and mental health institutions.

**Abnormal Psychology and Psychiatry, I: Twentieth Century European and American Views of Madness**—A survey of various concepts of madness, including madness as a biological defect, as a defect in family relations, as a socially defined problem, as a class defined problem, and as sanity in an insane world. In anticipation of field work, there will be some discussion of how these concepts affect treatment programs.

*Aut (Rosenbaum)*

**Abnormal Psychology and Psychiatry, II: Contemporary Italian Treatment Concepts for Severe Mental Illness**—A comparative study of how psychoses are defined and treated in the prevailing mental health facilities in Italy and the United States.

*Win (Rosenbaum)*

**Abnormal Psychology and Psychiatry, III: The Treatment of Relatively Minor Disturbances**—This seminar focuses on the origins and treatment of “neuroses,” with special concern for the differential problems that arise in Italy and the United States.

*Spr (Rosenhan)*

**Italian and American Individual Personality Development in the Context of the Family: A Transcultural View**—An examination of individual psychosocial personality development, with emphasis on the transmission of social and moral values, and on attitudes toward the family and other social institutions.

*Aut (Rosenbaum)*

**The Ethnography of Italy and the Mediterranean**—A survey comparing the cultural, socio-economic, and political forces prevalent in Italy to those in other Mediterranean countries, with special emphasis on the effects of migration.

*Aut (Siegel)*

**Field Work Colloquium**—Students will be instructed in the theory and practice of anthropological and sociological field work. Field work will be done in two communities—Grassina and Sesto Fiorentino.

*Win (Siegel)*

**Italian Health Delivery Services**—A study of the ways in which socioeconomic, political, and institutional (academic and insurance institutions, for example) factors influence various modes of health care delivery.

*Win (Rosenbaum)*

**Seminar on Comparative Mental Health Law**—A comparative study of the rights and treatment of psychiatric patients, the mentally retarded, and the criminally insane in the United States and Italy.

*Spr (Rosenhan)*

**The Italian Language Program**

**Intensive Italian**—Students will study grammar, conversation, and composition three hours a day, five days a week for the first four weeks of each quarter, and eight hours per week for the remainder of the quarter. 8 units, *Aut, Win, Spr, Sum*  
(J. Mammarella, Benini, Celli, Staff)

**Italian Language Continuation Courses**—Students will study grammar, conversation, composition, and literary works for eight hours each week during the second and third quarters of their stays. 4 units, *Aut, Win, Spr, Sum*  
(J. Mammarella, Benini, Celli, Staff)

**British Studies Center, Cliveden**

*Academic and administrative personnel:*
George A. B. Docker, *Director*
Felix Aprahamian
Barry Axford
Julian Blaustein
John Burnett
Jacqueline Cannon
Judith Dobbs
Larry Friedlander
Christopher Game
David Halliburton
Annette Morgan
David Robinson
Lucio P. Ruotolo
Rodney Shewan
Anthony Smith
Geoffrey Tyack
V.C.D. Vowles
Basil Wright
Graham Zellick

The Foundations of Modern Britain—First course of three in the British history series, concentrating on the more important constitutional, political, and economic developments between the 16th and 18th centuries.

Aut (Burnett)

British Society and Politics, 1750-1870—A study of the evolution of modern British society and politics under the impact of the Industrial Revolution.

Win (Tyack)

British Society and Politics, 1870-1945—A course in social history showing how the British social structure and modern British attitudes evolved as Britain's economic and political roles in the world were rapidly changing.

Spr (Tyack)

An Introduction to Modern British Culture—An introduction to the important historical, literary, theatrical, musical, and artistic events which have shaped modern British culture since 1900.

Sum (Dobbs)

Rural England—A study of the historical evolution of English rural society, and of the English landscape, based on a detailed examination of the area around Cliveden House, and stressing the roles played by economic and demographic change.

Aut (Tyack)

The English Country House—The architectural and social history of the country house from the Middle Ages to the First World War, emphasizing changes in design and planning, as well as changes in the fortunes and social composition of the English landed aristocracy.

Aut (Tyack)

The English Town—A study of urbanization in Britain, concentrating on the physical growth of towns, the evolution of their social structure, and their place in the national economy. Particular emphasis will be placed on the development of London.

Spr (Tyack)

Modern British Government and Politics—An introduction to the major political and administrative institutions of British government and the way they work. This introduction will include an analysis of the ways in which these institutions have adapted to recent governmental and administrative reforms.

Aut (Game)

An Introduction to Political Sociology—A survey of some of the key fields of interest in behavioral political science (e.g., political culture, socialization, the social psychology of politics, electoral behavior) and a critical evaluation of representative research in these fields.

Aut (Game)

Policy Making in Britain—An analysis of the role played by the main institutions of British government—political parties, interest groups, Parliament—in making particular governmental decisions and in defining governmental policies.

Win (Game)

Social Structure of Modern Britain—An introduction to the social structure and institutions of modern Britain. The basic themes and concepts of sociology will be employed to examine some of the key institutions of British society, such as the family, the political system, and religion.

Win (Game)

20th Century Political Thought in Britain—An introduction to the main currents of political thought and action in 20th century Britain, and an examination of the basic theoretical concepts and principles which underlie them.

Spr (Game)

Modern British Political Leaders—An introduction to British government and political history since World War I through an ex-
amination of the biographies and memoirs of leading politicians, such as Lloyd George, Neville Chamberlain, Churchill, and Macmillan.

_Spr (Game)_

**The English Legal System**—A comparative analysis of English common law and American civil law.

_Aut (Zellick)_

**Education in England and Wales**—An outline of the organization, institutions, and curriculum of the educational systems in England and Wales. Changing factors which influence British education will also be examined.

_Win (Vowles)_

**Britain in Search of a Role**—A study of Britain's economic and political role in Europe since World War II. The impact of Britain's domestic and foreign economic and political policies on Britain and on other European nations will be examined.

_Win (Cannon, Morgan)_

**A Study of Major Economic Policies in Britain, Germany, and Sweden**—A study of major economic policy areas—social market economy, the welfare state, demand management policy—and their historical development since World War II in selected European countries.

_Sum (Cannon)_

**Socialization in Britain**—An examination of the conflicting theories about the state's role in a capitalist economy, and a study of the actual problems of socialized industry in Britain.

_Sum (Axford)_

**English Attitudes to Emotion, I: 1660–1960 (Comedy of Manners)**—A study of the comedy of wit and the comedy of manners in England. Plays of various character and personality have been chosen to illustrate the changing nature of the genre and the relationship of social convention to the developing dramatic form.

_Aut (Shewan)_

**English Attitudes to Emotion, II: The Romantic Novel**—An introduction to Romantic attitudes in Britain, as expressed primarily through the novel, between 1760 and 1840.

_Win (Shewan)_

**English Attitudes to Emotion, III: Victorian Poetry and Painting**—A course exploring the many links between poetry and painting during the 19th century, beginning with a retrospective glance at the 18th century, then examining some Romantic poets, the Pre-Raphaelite movement and its successors, and major figures later in the century.

_Sum (Shewan)_

**English Painting, 1700–1840**—An introduction to English art in the 18th and early 19th centuries, based on close study in London galleries when possible, of the most representative works by leading painters, such as Hogarth, Reynolds, Gainsborough, Blake, Constable, and Turner.

_Win (Tyack)_

**English Music from Elgar to Britten**—An introduction to the basic elements of music and to the principal English composers in the first half of the 20th century, including Elgar, Delius, Vaughan Williams, Holst, Walton, and Britten.

_Sum (Aprahamian)_

**Poetic Form and Language**—An introduction to the traditional poetic forms in English literature (for example, the sonnet, ballad, elegy, and epistle), to the fundamental techniques of composition, and to the varieties of poetic diction.

_Aut (Shewan)_

**Contemporary British Drama**—A study of contemporary British plays being produced in London, including West End, workshop, experimental, theatre club, and pub theatre productions.

_Win (Shewan)_

**The Contemporary British Novel**—An introduction to the major developments in the British novel over the past twenty years, including novels by Fowles, Murdoch, Renault, and Wilson.

_Spr (Shewan)_

**The Image of Woman in Literature, 1850–1910**—An advanced colloquium, offered in conjunction with English Society and Politics, 1870–1945—they need not be taken concurrently, however—which investigates the changing image of women in literature, principally in the novel but also in poetry, journals, diaries, and polemical writings.

_Spr (Shewan)_
Oscar Wilde and the Fin de Siècle—A study of Wilde's use of irony, paradox, and wit to reshape conventional forms and ideas. Wilde's prose, poetry, and letters will be related to the works of his contemporaries and to the thought of the period.

*Sum (Shewan)*

**Focus Program: British Film and Broadcasting**

The following courses are part of the focus program *British Film and Broadcasting* offered Autumn and Winter Quarters. The program has been designed to study the different practices and theories of the communication industries in Britain and the United States, and to take advantage of the numerous and excellent communication institutions in the London area. The program will also explore the historical conditions which gave rise to a public broadcasting industry in Britain and a private broadcasting industry in the United States. The effects a society has on the content and style of the mass media will also be studied.

*The British Documentary*—A study of the development of the British documentary film from the experimental films of the Thirties to the recent revolution in documentary film making caused by television.

*Aut (Wright)*

*British Broadcasting*—A study of the social and cultural origins, the modes of operation, the styles of entertainment, and the current problems of British broadcasting institutions.

*Aut (Smith)*

*The British Film Industry*—This course will observe the development of the British film industry from the 1920's to the present in its social and economic context.

*Win (Blaustein)*

*Popular Culture and the Mass Media*—A study of the ways in which the mass media has shaped and reflects British attitudes toward youth, family roles, politics, sex, and violence.

*Win (Robinson)*

**Focus Program: Perspectives on Modern British Culture**

The following courses are part of the focus program *Perspectives on Modern British Culture* offered Spring and Summer Quarters. This program is an interdisciplinary study of the main currents of modern British culture. Students will study not only writers whose specialties were in particular fields such as literature, philosophy, politics, and economics, but also those writers who ventured beyond their own fields and who tried to broaden their cultural perspective. In addition to gaining an interdisciplinary perspective, students will find an historical overview of modern culture helpful. This overview will concentrate on the period just after the turn of the century but, as importantly, will cover the preceding decades, often referred to as the Late Victorian Epoch. Moreover, a synchronic and comparative approach designed to highlight the uniqueness of modern British culture will be employed.

*Modern British and European Thought*—A comparative analysis of 20th century British and continental European thought. The conceptualization, logic, and argumentation of British thinkers will be compared to Continental thinkers in such fields as philosophy, psychology, social thought, cultural criticism, and anthropology.

*Spr (Halliburton)*

*Colloquium on National and International Identity*—Intensive study of the national and international dimensions of literature, drama, and thought, with emphasis on modern problems of identity in Anglo-American and European cultures.

*Spr (Halliburton)*

*The Bloomsbury Group*—A study of the artistic, philosophical, and social assumptions that brought together this diverse and controversial group of people between 1906 and World War II.

*Spr (Ruotolo)*

*Virginia Woolf and Her Circle*—An exploration of Virginia Woolf's unique contributions to modern British literature and thought. Of particular interest will be the importance of London in her life and work; her preoccupation with space and time; her concern for feminine consciousness; and her close relationship to the Bloomsbury Group.

*Spr (Ruotolo)*

*The British Cinema*—A study of the British film and, through it, the ways in which the British perceive themselves. If possible, films screened will include The Ruling Class,
If, Sunday Bloody Sunday, and Hard Day’s Night.
Sum (Ruotolo)

The Twentieth Century British Novel—A study of the ways in which the British novel communicates and penetrates “social reality.” Specific themes to be discussed include: the meaning of art and its relationship to social action; the breakdown of class identity; and women’s new consciousness of self and world.
Sum (Ruotolo)

20th Century British Drama
Sum (Friedlander)

Contemporary British Performing Arts
Sum (Friedlander)

FRENCH STUDIES CENTER, TOURS

Academic and administrative personnel:
Paul LeMoal, Director
Claude Doubinsky, Assistant Director
Anne Durand, Assistant Director
Joëlle Blot
Rene Borius
Alain Corbin
Odile de Croizant
Pierre Gault
Michelle Jomaron
Patrick Menget
Francoise Perdoux
Jacques Roger
Jean Michel Vaccaro
Austryn Wainhouse

French History, I: From Medieval France to the Revolution—An historical survey of the political and social changes in Medieval and Renaissance France which ultimately lead to the Revolution.
Aut (Borius)

French History, II: From the Revolution to World War I—An historical survey of the political and social changes in France from the Revolution to the beginning of the 20th century.
Win (Borius)

French History, III: From World War I to the Present—An historical survey of the political causes of the two world wars, of the political and social problems the wars caused, and of the political and social problems of the Fifth Republic.
Spr (Borius)

The Development of French Socialism—A study of the ideological and political development of French socialism since the turn of the century.
Win (Corbin)

The Passing of the Peasant World—An enquiry into the French rural past, the recent changes in rural France, and the social implications of those changes.
Win (Wainhouse)

The Left in Modern French Politics—An analysis of the ideological and political positions of the left in contemporary French politics.
Spr (Corbin)

Spr (Staff)

The History of the Resistance—A study of the activities and politics of the Resistance in France during World War II.
Spr (Borius)

Etude Socio-Politique et Intellectuelle de la Science Française au XIIIe Siècle—A study of the external (economic, social, and political) and internal (synthesis of new data, theoretical advances) factors which influenced the development of French science during the 18th century, and of the intellectual problems created by science.
Win (Roger)

Introduction au Structuralisme en Ethnologie—A theoretical and empirical evaluation of the structuralist method in social anthropology.
Spr (Menget)

French Literature, I, II, and III—A three-quarter survey of major works in French literature from Medieval times to the present.
Aut, Win, Spr (Staff)

The Contemporary French Literary Scene—A study of works by French authors during the 60’s and 70’s that represent the main trends in contemporary French literature.
Aut (Doubinsky)

La Condition Humaine: André Malraux—An in-depth study of the historical, political,

*Win (Doubinsky)*

**La Musique Classique Française**—A presentation of the principal French musical currents (vocal and instrumental) during the 17th and 18th centuries.

*Aut (Vaccaro)*

**French Architecture and Town Planning from Gallo-Roman Times to the Middle Ages**—A study of French painting, sculpture, architecture, and town planning from prehistoric cave drawings to paleochristian art in the 5th century.

*Aut (Borius)*

**French Architecture from the Middle Ages to the 18th Century**—A study of the development of two specific examples of French architecture during the Middle Ages: the church and the castle.

*Win (Borius)*

**Impressionist Painting in France**—A survey of the major representatives of the impressionist movement in France, including Manet, Monet, Pissaro, Sisley, Degas, Renoir, and Cézanne.

*Spr (de Croizant)*

**The French Cinema**—A survey of the major works of contemporary French cinema.

*Aut (Bourdìn)*

**Critical Analysis**—A joint course for Stanford and University of Tours students in which they will study works by an English or American author intensively. Prerequisite: English major or the instructor's approval.

*Aut and Win (LeMoal)*

**The French Language Program**

**Intensive French**—Students will study grammar, conversation, and composition three hours a day, five days a week for the first four weeks of each quarter, and eight hours a week for the remainder of the quarter.

8 units, *Aut, Win, Spr, Sum* (Jomaron, Perdoux, Blot, Staff)

**French Language Continuation Courses**—Students will study grammar, conversation, and composition four hours each week during the second and third quarters of their stay.

4 units, *Aut, Win, Spr, Sum* (Jomaron, Perdoux, Staff)

**GERMAN STUDIES CENTER, WEINSTADT/BEUTELSBACK**

**Academic and administrative personnel:**

Alfred Schmidt, Director

H. Rüdiger Hipp, Language Program Coordinator

Javene Black

Carl Davis

Idis Bridgit Hartmann

Christel Köhle-Hezinger

Michael von Poser

Hartmut Wasser

**The Remstal**—An anthropological study of the historical, political, economic, religious, and cultural complexity of the Remstal region (location of Beutelsbach).

*Aut, Win, Spr (Köhle-Hezinger)*

**German History, I: 1789–1918**—A survey of German history from the late 18th through the 19th and early 20th centuries, with particular emphasis on the consequences of industrialization and nationalism in Germany.

*Aut (Wasser)*

**German History, II: 1918–1945**—An analysis of some of the basic problems in 20th Century German history through World War II: the decline and failure of the Weimar Republic; the rise of National Socialism; and the origins of the Federal Republic.

*Win (Wasser)*

**German History, III: 1945 to the Present**—A study of contemporary German problems and their development from the division of Germany after the war to the Cold War and, later, detente.

*Spr (Wasser)*

**East-West Relations: Cold War to Detente**—A study of the fluctuating political relations of East and West from 1941 to the present, attempting to analyze the causes and consequences of the Cold War period and to define the roles of the two Germanies in shaping the era of detente since 1962.

*Aut (Black)*

**The German Economy in Europe**—A study of the German economy's collapse and re-
generation after World War II and the subsequent role it has played in the structures and institutions of the European economy.

Win (Staff)

Contemporary German Politics—A critical analysis of the various political institutions of the Federal Republic of Germany and the ways in which they function.

Spr (Staff)

German Art History—A chronological survey of the style, iconography, and history of German architecture, sculpture, and painting from medieval times to the present.

Aut, Spr (Hartmann)

Modern German Literature in Translation—An examination of the literary quality, significance, and socio-political meaning of selected works by modern German authors such as Döblin, Seghers, Mann, Böll, and Wolf.

Aut (Staff)

Major German Composers—An introductory survey of the music of the great German composers from Bach to Schoenberg, with special emphasis on the interrelationship of the composer’s life, his milieu, and his music.

Win (Davis)

The German Language Program

Intensive German—Intensive language instruction will be offered for students at the elementary and intermediate levels. Classes will meet two hours a day, five days a week, throughout the quarter. Conversation component will meet three hours per week for the first four weeks of the quarter.

5–8 units, Aut, Win, Spr (Hipp, von Poser)

German Conversation—Two sections of German conversation, studying useful conversational skills, will be offered each quarter. Classes will meet three hours each week.

3 units, Aut, Win, Spr (Hipp, von Poser)

German Newspapers—Students will study grammar, idiomatic expressions, and composition through current German periodicals. Prerequisite: German 51.

3 units, Aut, Spr (Hipp, von Poser)

German Short Stories—A study of German grammar, conversation, and composition through German short stories. Prerequisite: German 51.

4 units, Aut, Spr (Hipp, von Poser)

German Television and Movies—A study of German grammar, conversation, and composition through the use of television and selected films. Prerequisite: German 51.

3 units, Win (Hipp, von Poser)

German Drama—A study of German grammar, conversation, and composition through selected plays by German authors. Prerequisite: German 51.

4 units, Win (Hipp, von Poser)

AUSTRIAN STUDIES CENTER, VIENNA

Academic and administrative personnel:

Siegfried Korninger, Director of Studies
Hedwig Thimig, Associate Director
Margret Mehrl, Language Program Coordinator
Roswitha Benesch
Ingeborg Bernhart
Herbert Hausmaninger
Grete Klingenstein
Wendelin Schmidt-Dengler
Gottfried Scholz

Austrian History, I: The Habsburg Empire, 1848–1914—An historical survey of the economic, political, and social problems of Austria between 1848 and 1918.

Aut (Klingenstein)

Austrian History, II: 1918–1945—A study of Austrian history from the fall of the monarchy through reconstruction after the war, the emergence of fascism, the Nazi Anschluss, and World War II.

Win (Klingenstein)

Austrian History, III: 1945 to the Present—A study of Austrian political, economic, and social reconstruction after World War II and of Austria’s changing role in international affairs.

Spr (Klingenstein)

Political Movements in Austria Between the Wars—A study of important political movements in Germany, Italy, Spain, and the Soviet Union between the Wars and of the ways in which they affected Austrian political movements.

Win (Hausmaninger)
Art and Museums in Vienna—A survey of 19th century Austrian art, with some comparative studies of other major European art schools of the same period.

Aut, Win (Benesch)

Classical Music in Modern Vienna—A music appreciation course relying on frequent concert and opera performances in Vienna. Concert pieces will be discussed and analyzed before the performance and the performance itself will be evaluated later.

Aut, Spr (Scholz)

Drama in Austria—A survey of typical Austrian dramatic forms which reflect the social and political conditions of their times during the 19th and 20th centuries. Students will attend productions in Vienna when possible.

Aut, Spr (Thimig)

European and Austrian Theatre History—A course concentrating on theatre history—the emergence of national theatres, and theatre “revolutions,” like Goethe’s in Weimar, Stanislavski’s in Moscow, and Reinhard’s in Berlin—and on technical aspects of the theatre, such as set designs, acting styles, and administration.

Win (Thimig)

The Intellectual and Literary Scene in Vienna Since the Turn of the Century—An introduction to the cultural and political contributions of Austrian intellectuals, such as Freud, Wittgenstein, Schnitzler, Hofmannsthal, and Kafka at the beginning of the 20th century.

Spr (Schmidt-Dengler)

**The German Language Program**

Intensive German—Two sections of intensive language instruction will be offered each quarter which will study German grammar, conversation, composition, and literary texts. Classes will meet four hours a day, five days a week during the first four weeks of the quarter, and thirteen hours per week the rest of the quarter.

10 units, Aut, Win, Spr (Mehrl, Bernhart)

**German Studies Center, Berlin**

Academic and administrative personnel:
Gordon Craig, Director (Winter and Spring)

Walter Lohnes, Director (Summer)
Pat McConegh, Language Program Coordinator
Edith Badstübner
Josef Hutschneider
Ingrid Isensee

German History to 1919—A survey of German history in the late 18th, 19th, and early 20th centuries, with particular emphasis on the problems of national unification and nationalism.

Win (Staff)

German History, 1919 to the Present—A study of the basic problems in 20th century German history: the failure of the Weimar Republic; the rise of National Socialism and the Nazi regime; the origins and development of the Federal Republic and of the Democratic Republic; the tensions of the Cold War; and the road to détente.

Spr (Craig)

Berlin: Its History, Politics, and Culture.

Win (Craig)

Capitalist and Marxist Economic Theory, I and II—A comparison of capitalist and Marxist economic theories using East and West Germany as examples.

Win, Spr (Staff)

German International Relations—A study of contemporary Germany’s role in East-West relations and of its leading economic role primarily in Europe, but also throughout the world.

Spr (Staff)

East-West Relations in Berlin—In general, a study of Germany’s role in East-West relations since World War II and, in particular, a study of Berlin’s role in East-West relations.

Sum (Staff)

The West German Economy—A study of economic reconstruction after World War II and an analysis of current fiscal, trade, finance, and investment policies.

Sum (Staff)

The Performing Arts in Berlin—A study of drama, opera, cinema, and ballet productions in Berlin and their historical, literary, and socio-political context. Attending performances will be an integral part of the course.

Win (Hutschneider)
Literature and Politics—A socio-economic and political study of selected works by a noted contemporary German author. 
Spr (Staff)

German Art History—A survey of the major trends in German art from the Romantic movement to the present and utilizing Berlin’s museums extensively. 
Sum (Staff)

Sum (Staff)

The German Language Program

Intensive German—Intensive language instruction will be offered for students at the elementary and intermediate levels. Classes will meet two hours a day, five days a week, throughout each quarter. The conversation component will meet three hours per week for the first four weeks. 
5-8 units, Win, Spr, Sum (McConelly and Staff)

German Conversation — Two sections of German conversation, studying useful conversational skills, will be offered each quarter. Classes will meet three hours each week. 
3 units, Win, Spr, Sum (McConelly and Staff)

German Newspapers—Students will study grammar, idiomatic constructions, and composition through current German periodicals. Prerequisite: German 51. 
3 units, Win, Sum (McConelly and Staff)

German Short Stories—A study of German grammar, conversation, and composition through German short stories. Prerequisite: German 51. 
4 units, Win, Spr (McConelly and Staff)

German Television and Movies—A study of German grammar, conversation, and composition through the use of television and selected films. Prerequisite: German 51. 
3 units, Spr (McConelly and Staff)

German Drama—A study of German grammar, conversation, and composition through selected plays by German authors. Prerequisite: German 51. 
4 units, Spr (McConelly and Staff)

French Studies Center, Paris
Marc Bertrand, Director

German Studies Center, Bonn
Josef Hutschneider, Director

Spanish Studies Center, Salamanca
Isabel Criado, Director
SPECIAL OPPORTUNITIES IN GRADUATE STUDY

INSTITUTE FOR PLASMA RESEARCH


The Institute is an interdepartmental organization coordinating teaching and research in plasma physics at Stanford and incorporates seven specialized research groups.

The Aerophysics Group (Baganoff, Bershader, Chang) conducts experimental and theoretical research on plasma and plasma flow at high density and moderate temperature, using shock tubes and advanced interferometric and spectroscopic equipment.

The Gas Kinetics Group (Koutsoyannis) is engaged in theoretical studies (kinetic theory, spectroscopy, discharge theory) and experimental studies related to the interaction of plasma and radiation.

The High-Temperature Gasdynamics Group (Eustis, Kruger, Mitchner, Self) concentrates on experimental and theoretical research on flowing, high temperature gases related to such applications as magneto-hydrodynamic energy conversion, air pollution, combustion, chemical kinetics, and lasers, and includes studies of diagnostic techniques and calculations of non-equilibrium properties.

The Experimental Plasma Physics Group (Crawford, Self) carries out experimental research, with supporting theoretical studies, on waves and instabilities, beam-plasma interactions, and nonlinear processes such as wave-wave and wave-particle interactions.

The Solar-Terrestrial Physics Group (Wilcox) operates the Stanford Solar Observatory, and is engaged in observational and theoretical studies of the solar magnetic field and its interactions with solar activity, the solar wind, and geomagnetic responses.

The Space Science and Astrophysics Group (Petrosian, Sturrock, Walker) is engaged in both theoretical and experimental studies: the experimental work is concerned primarily with x-ray spectroscopic observations of the solar corona, supernova remnants, x-ray stars and the interstellar medium; the theoretical program is concerned with solar structure and solar activity, pulsars, radio galaxies, quasars and cosmology.

The Theoretical Plasma Physics Group (Buneman) concentrates on computer simulation and stability calculations as related to plasma containment for fusion, and to extraterrestrial plasmas.

The facilities of the Institute are available to any interested and qualified student, who must be admitted by and registered in a department. The Departments of Aeronautics and Astronautics, Electrical Engineering, Mechanical Engineering, and Applied Physics provide opportunities leading to an M.S. or Ph.D. degree for work in plasma physics. A number of plasma courses are listed by these departments and by the School of Engineering.

Further information is available from members of each group and from the Chairman of the Executive Committee.

SPACE SCIENCE AND RELATED PROGRAMS


Space science, which is the study of natural phenomena by observations from space vehicles, is actively pursued by many groups at Stanford. Experimental research in progress includes development of experimental packages to be carried by rockets, satellites, and space probes for studies including: wave propagation and wave-particle interactions in the magnetosphere; radio measurements of the interplanetary medium and of planetary atmospheres; plasma waves in space; infrared and radar sensing of planetary sur-
faces; X-ray emission from the sun and other astronomical objects; and gravitation.

Related observations by means of ground-based equipment are made at the Radio-science Laboratory (ionospheric and magnetospheric structure and radio properties); the Radio Astronomy Institute (the sun and other radio sources); the Center for Radar Astronomy (planetary surfaces and atmospheres, interplanetary media and solar corona), operated jointly with Stanford Research Institute; and the Institute for Plasma Research.

The experimental work is supported by theoretical studies and by a program of laboratory simulation of space plasma wave and instability phenomena.

A program in theoretical astrophysics provides for study and research over a wide range of topics including solar physics, solar-terrestrial relations, and nonthermal phenomena related to pulsars, radio galaxies, quasars and cosmic rays.

Stanford is a member of the Universities Space Research Association, a consortium of universities which operates the Lunar Science Institute in Houston, Texas. Opportunities and financial support for graduate students interested in advanced lunar research are available.

Courses related to many of the above topics are listed below. The descriptions of these courses will be found listed under Aeronautics and Astronautics, Applied Physics, Electrical Engineering, Geophysics, and Mechanical Engineering, and also under the Astronomy Course Program.

The Space Science and Related Programs are available to any interested and qualified graduate student, who must be admitted by and registered in a department. The Departments of Aeronautics and Astronautics, Applied Physics, Electrical Engineering, Geophysics, and Mechanical Engineering provide opportunities leading to a Ph.D. degree for work in space science, astronomy, or astrophysics.

In case a study program is not appropriate to any one department, a student has the privilege, under the general provisions of the Graduate Division Special Programs, of proposing a special program leading to a Ph.D. degree on a topic such as space science, astronomy, or astrophysics.

Further information is available from the Chairman of the Committee in Charge.

15. The Nature of the Universe—(Enroll in Applied Physics 15.)
   3 units, Aut (Petrosian) MWF 10

25A. Extraterrestrial Civilization—(Enroll in Astronomy 25.)
   3 units, Aut (Sturrock) TTh 2:15–3:30

   3 units, Win (Bracewell) MW 2:15–3:30

   3 units, Aut (Eshleman) TTh 2:15–3:30

102A,B,C. Astronomy Laboratory and Observational Astronomy—(Enroll in Astronomy 102A,B,C)
   102A. 1 or 2 units, Aut (Walker) lecture M 4:15, laboratory by arrangement
   102B. 1 or 2 units, Win (Walker) lecture M 4:15, laboratory by arrangement
   102C. 1 or 2 units, Spr (Walker) lecture M 4:15, laboratory by arrangement

103. Stellar and Galactic Astronomy—(Enroll in Applied Physics 103.)
   3 units, Win (Sturrock) TTh 2:15–3:30

105. High-Energy Astronomy — (Enroll in Applied Physics 105.)
   3 units, Spr (Petrosian) TTh 2:15–3:30

132. Optical Methods in Engineering Science—(Enroll in Aeronautics and Astronautics 132.)
   3 units, Aut (Bershader), alternate years, given 1976–77

150A,B,C. Advanced Astronomy Laboratory—(Enroll in Astronomy 150A,B,C,D.)
   150A. 3 units, Aut (Walker) by arrangement
   150B. 3 units, Win (Walker) by arrangement
   150C. 3 units, Spr (Johnson) by arrangement
   150D. 3 units, Sum (Walker) by arrangement

193B. Senior Seminar, X-Ray Astronomy—(Enroll in Astronomy 193B.)
   3 units, Win (Walker) TTh 2:15–3:30, alternate years, given 1976–77
193C. Senior Seminar, Peculiar Stars and Close Binary Systems—(Enroll in Astronomy 193C.)

3 units, Spr (Walker) W 2:15–4:05, discussion F 2:15, alternate years, given 1975–76

211B. Physical Gas Dynamics—(Enroll in Aeronautics and Astronautics 211B.)

3 units, Spr (Bershader), alternate years, given 1976–77

227. Atmospheric and Space Physics—(Enroll in Aeronautics and Astronautics 227.)

3 units, Spr (Spreiter) TTh 2:45–4:00

260. Geophysical Fluid Dynamics—(Enroll in Mechanical Engineering 260.)

3 units, Spr (Spreiter) TTh 2:45–4:00, alternate years, given 1976–77

295. Physics of Planetary Interiors—(Enroll in Geophysics 295.)

3 units, Aut (Kovach), alternate years, given 1976–77

348. Ionospheric Processes—(Enroll in Electrical Engineering 348.)

3 units, Spr (Staff) alternate years, given 1975–76

350. Radioscience Seminar—(Enroll in Electrical Engineering 350.)

1 unit, Aut, Win, Spr (Staff) by arrangement

351. Plasma Wave Theory—(Enroll in Electrical Engineering 351.)

3 units, Spr (Crawford) alternate years, given 1975–76

352. Wave Propagation in the Ionosphere and Magnetosphere—(Enroll in Electrical Engineering 352.)

3 units, Spr (Helliwell) alternate years, given 1976–77

354. Theory and Application of Radio Wave Scattering—(Enroll in Electrical Engineering 354.)

3 units, Aut (Tyler) by arrangement, alternate years, given 1975–76

360. Solar Terrestrial Relations—(Enroll in Applied Physics 360.)

3 units, Aut (Staff) alternate years, given 1976–77

361. The Sun and Solar Activity—(Enroll in Applied Physics 361.)

3 units, Win (Staff) alternate years, given 1976–77


3 units, Win (Petrosian) alternate years, given 1976–77

364. Radiation from Plasmas—(Enroll in Applied Physics 364.)

3 units (Staff) alternate years, given 1976–77

367. Physical Processes in the Galaxy—(Enroll in Applied Physics 367.)

3 units, Spr (Sturrock) TTh 2:15–3:30

STANFORD LINEAR ACCELERATOR CENTER

Director: Wolfgang K. H. Panofsky
Deputy Director: Sidney D. Drell
Associate Directors: Joseph Ballam (Research Division); Robert H. Moulton, Jr. (Administrative Services Division); Richard B. Neal (Technical Division); Frederick V. L. Pindar (Business Services Division)


Associate Professors: Elliot Bloom, Michel Davier

Assistant Professors: Robert K. Carnegie, Harvey L. Lynch, Roy Schwitters

Adjunct Professors: Karl L. Brown, Herbert DeStaebler, Jean V. Lebaqz, Gregory A. Loew, Joseph J. Murray, Richard B. Neal, John R. Rees, Perry B. Wilson

The Stanford Linear Accelerator Center (SLAC) is devoted to experimental and theoretical research in elementary particle physics and to the development of new techniques in high energy accelerators and elementary particle detectors. The Center is located on 480 acres of Stanford property.
west of the main campus, parallel to and south of Sand Hill Road and is operated under a contract with the United States Atomic Energy Commission. The major experimental facility of the Center is a two-mile-long linear electron accelerator.

The accelerator, which began operations for physics research during 1966, can provide an electron beam at energies up to 22 BeV and at beam intensities up to 30 microamperes average current. Positrons can also be accelerated to a maximum energy of about 14 BeV, at average beam currents up to about one microampere. A "switchyard" of magnetic elements at the end of the accelerator can direct the beams to any of several experimental areas. A large number of secondary beams of special character, including pion, kaon, muon, and photon beams, are available. A complement of large research instruments available for use with the accelerator includes three magnetic spectrometers capable of analyzing momenta up to 1.6, 8, and 20 BeV/c; two bubble chambers, a 40-inch diameter, cylindrical chamber built at SLAC and a 14-inch rapid-cycling bubble chamber that operates in a hybrid mode with triggering counters; two large-volume magnets, with pole diameters of 54 inches and 80 inches, used in spark-chamber and streamer-chamber experiments. A variety of general purpose apparatus is also available. An electron-positron storage ring facility (SPEAR) has recently been constructed and is now engaged in a full research program with colliding beams each of 2.5 BeV energy. During the coming year its energy will be increased to about 4.2 BeV for each beam. A large-aperture superconducting solenoid (LASS) system is nearing the end of construction and will begin a study of multi-hadron events this year.

The Center is operated by Stanford as a national facility so that qualified scientists from universities and research centers throughout the country and world, as well as those at Stanford, may participate in the high energy physics research program of the Center. As of January 1974, physicists from 50 other institutions have had research programs accepted for execution at the Center. The faculty of the Center leads a group of some 80 physicists in research programs on theoretical and experimental particle physics. In addition, the faculty offers lecture series on various aspects of high energy physics, and conducts seminars on topics of current interest.

The experimental research program at SLAC deals with almost all areas of elementary particle physics at high energies. To name but a few, experiments are in progress on high energy elastic and inelastic electron scattering, the study of high energy photon and hadron interactions both with bubble chamber and electronic techniques, studies of decay properties of weakly interacting particles, and the study of electron-positron annihilation to form hadrons, leptons, and photons. The work in theoretical physics deals with all phases of elementary particle theory.

Stanford graduate students may, with the approval of their departments, carry out research for the Ph.D. degree with members of the SLAC faculty. (Graduate students from other universities also participate in the research programs of visiting groups.)

Research assistantships are available for qualified students by arrangement with individual faculty members. There are also opportunities for summer employment in the research groups at the Center. Interested students should apply to the Office of the Director.

**STANFORD SYNCHROTRON RADIATION PROJECT**

*Director:* S. Doniach  
*Consulting Director:* W. Spicer  
*Deputy Director:* H. Winick  
*Associate Director:* M. O'Neill  
*Participating Faculty:* A. Bienenstock, P. Eisenberger, S. Doniach, P. Hodgson, I. Lindenau, W. Spicer, M. Weissbluth, H. Winick

The Stanford Synchrotron Radiation Project (SSRP) is a new national facility for research in a variety of disciplines utilizing the intense ultraviolet and X-radiation from the Storage Ring SPEAR at the Stanford Linear Accelerator Center (SLAC).
main SSRP laboratory facilities are located at SLAC which is on Sand Hill Road, two miles west of the main campus. The project is funded by the National Science Foundation and is administered by the W. W. Hansen Laboratories of Physics.

Synchrotron radiation is electromagnetic radiation emitted by charged particles curving in magnetic fields. During the operation of SPEAR for studies of the high energy reactions of electrons and positrons, the emitted synchrotron radiation extends from the infrared to X-rays of 40 or 50 KeV, with intensity 1000 or more times that which is available from conventional sources. This high intensity, broad bandwidth and other properties of the radiation (natural collimation, high polarization, pulsed time structure) offer unique research opportunities in physics, chemistry, materials science, biology, metallurgy, and medicine. The following are examples of research programs underway or being planned:

- Studies of electron core levels and valence bands by ultraviolet and X-ray photoemissions.
- Structural studies of solids, liquids and gases (including biological materials such as metallo-proteins) by measurement of Extended X-ray Absorption Fine Structure (EXAFS).
- Studies of the structure of cellular organelles such as muscle filaments and photo receptor membranes by X-ray diffraction.
- Surface physics studies by measurement of ultraviolet reflection, absorption, and scattering.
- Solution of the structure of protein crystals by X-ray diffraction.

One beam run is split so that five experiments, each with a monochromator, can operate simultaneously. The laboratory has two custom built high-vacuum grating monochromators and three crystal monochromators. Some data acquisition and analysis equipment and general experimental support equipment is on hand. Additional facilities are now being planned (a second beam run with additional monochromators and instrumentation).

SSRP facilities are available to graduate students from Stanford (and other universities) for thesis research for the Ph.D. degree, with the approval of their departments.

UNDERGRADUATE PROGRAMS

Engineering and Society

Relations between society, engineering, and technology are studied in various courses and programs:

SCHOOL OF ENGINEERING PROGRAM

A program entitled "Engineering and Society" is available to undergraduate students in the School of Engineering. (See the "School of Engineering" section of this Bulletin.) It gives the interested student the opportunity to explore the interfaces between engineering, technology, and society in some depth. Adequate technical courses are included so that understanding of technology can be acquired. Flexibility exists in the program so that the student may tailor the coursework to his or her own career goals and interests.

TECHNOLOGY AND SOCIETY COURSES

A list of courses specifically dealing with the interaction of Technology and Society is available in the Office of the Dean of Engineering. This list was assembled for the use of engineering students in fulfilling the Technology and Society requirement in the undergraduate engineering curriculum, but it contains many courses open to all students, regardless of major.

ENGINEERING COURSES OF GENERAL INTEREST

The following courses are of general interest to both engineering and non-engineering students. They are taken by students from diverse departments and have no prerequisites:

- Engr. 1. The Engineer in Modern Society
- Engr. 3,4,5. Applied Mechanics I, II, III
- Engr. 7. Energy, From Nature to Man
- Engr. 10. Aeronautics and Astronautics
- Engr. 44. Basic Electronics
- Engr. 50. Introductory Science of Materials
Engr. 161. Engineering Economy
Chem.E. 20. Introduction to Chemical Engineering
C.E. 40. Elementary Surveying
C.E. 130. Transportation
C.E. 133. Introduction to Urban Planning
C.E. 170. Man and His Environment
C.E. 171. Environmental Planning
E.E. 181. Introduction to Computer Organization, Machine and Assembly Languages
I.E. 10. The Practice of Industrial Engineering
I.E. 50. Human Values in a Technological Society
I.E. 100. Organizations: Theory and Management
I.E. 133. Industrial Accounting
M.E. 30. Social Aspects of Nuclear Power
M.E. 101. Visual Thinking
M.E. 102a,b. Design Communication Workshop
M.E. 103. Manufacturing Technology
M.E. 137. Air Pollution
M.E. 139. Noise Pollution
M.E. 139. Environmental Measurements
M.E. 180. Energy and Society
Arch. 42. Introduction to Architecture

Students interested in the broader relations between human values, technology, and society should also consult the Values, Technology, and Society (VTS) section of this bulletin.

Human Biology
(Program in)

Committee in Charge: Donald Kennedy (Crocker Professor of Human Biology and Biology), Chairman: Sanford M. Dornbusch (Sociology); Paul R. Ehrlich (Biological Sciences); David A. Hamburg (Reed-Hodgson Professor of Human Biology and Psychiatry); Albert Hastorf (Psychology); Joshua Lederberg (Genetics); Colin S. Pittendrigh (Bing Professor of Human Biology and Biology—on leave 1975-76); James L. Gibbs, ex officio (Dean of Undergraduate Studies)

Faculty: Albert J. Ammerman (Genetics); Jack D. Barchas (Psychiatry); Philip A. Berger (Psychiatry); Merton R. Bernfield (Pediatrics); J. Martin Brown (Radiology); Luigi L. Cavalli-Sforza (Genetics); Jane F. Collier (Anthropology); Garth Collier (Civil Engineering); Thomas Connolly (Mechanical Engineering); Peter Corning (Political Science); Julian M. Davidson (Physiology); Carl Djerassi (Chemistry); Burr S. Elchelman, Jr. (Psychiatry); Walter P. Falcon (Food Research); Shirley Feldman (Psychology); Jane Goodall (Psychiatry); John G. Gurley (Economics); George M. Hahn (Radiology); Bruce F. Johnston (Food Research); Henry S. Kaplan (Radiology); Harant Katchadourian (Psychiatry); Sidney Liebes, Jr. (Genetics); Donald T. Lunde (Psychiatry); Eleanor E. Maccoby (Psychology); Alberta A. Siegel (Psychiatry); Keith B. Taylor (Medicine).

Student Members: Margaret A. Corrigan, Stephen T. Hecht, Ellis M. Knight, Emily A. Polis, Pamela K. Pickett, Patricia C. Tobin, Wendy L. Wornham

Program Coordinator: Sophia G. Alway

STATEMENT OF PURPOSE

This Program is an undergraduate major designed to encourage the convergence of natural and social science in the study of man. The Program is an interschool, interdepartmental major, utilizing not only those faculty and courses particularly created for the major, but also pertinent areas of instruction available throughout the University. It also is concerned with man as an organism, his adaptation to other men and to nature, his ability to control and to live with the environment, and the mechanism by which these factors relate to his biological and behavioral evolution.

This Program is a response to the need for knowledge of the complex relationship of man with nature, exemplified by the dilemmas of social policy in health and education, population problems, pollution of the environment, and conservation and development of resources. The Program is designed for the general education of policy makers and citizens. It is also a route to advanced study in the established natural and social sciences and related professions.

OFFERINGS AND FACILITIES

The Program leads to an A.B. in Human Biology. The curriculum is designed for those students who desire a knowledge of biology, particularly of man, linked with knowledge of the behavioral sciences. The Program predominantly involves faculty from the School of Humanities and Sciences and the Medical School. Representatives from other Schools will also participate in the Program.

The core of the Program for majors in
Human Biology is the Fundamental Program. It consists of eight one-quarter courses required of all majors. The objective of these courses is to present a broad but rigorous overview of the biology and behavior of man in society. The core is the necessary academic basis for the more specialized and advanced offerings of the Program.

There is no graduate program in Human Biology, but students will be prepared for advanced training in either biology, the behavioral and social sciences, medicine, law, or education, depending on their choice of advanced courses following the Fundamental Program.

The Office of the Program in Human Biology is located in Building 80 of the Inner Quad.

PROGRAM OF STUDY

BACHELOR OF ARTS

The degree of Bachelor of Arts in Human Biology will require approximately 60 to 65 units in the major. The Fundamental Program will consist of 33 units and will satisfy the University Distribution Requirements in the social sciences and the natural sciences. Upper division work comprises two distinct components: (1) an integrated program of study within either the biological or social-behavioral sciences (20 units); (2) three courses or seminars on interdisciplinary and/or policy issues, selected from an approved list. Detailed guidance should be sought at the office of the Program in Human Biology so that the program for the individual student can be designed to fit his or her particular needs and career goals.

The Honors Program provides qualified majors with an opportunity to do research and write a thesis on a subject of individual interest, for which up to 15 units of credit can be given in the honors candidate's senior year. These units (see Human Biology 198 under "Courses") will be in addition to the 30 upper division units ordinarily required for an A.B. in Human Biology.

Application for admission to the Honors Program should be made by the third quarter of the junior year. Applicants must have completed the Human Biology "core" requirements including the Workshop. The submission of the Honors thesis is expected by the beginning of the spring quarter of the year of graduation.

COURSES

Note: Students who have elected a major in Human Biology will be expected to take courses 1 through 6 in the Fundamental or "Core" Program. These courses must be taken for a grade by majors with the exception of the workshop. It is advised that the sequence be initiated in Spring Quarter of the Freshman year. Courses 1 through 4 are open to non-majors; however, the A and B Series must be taken concurrently and in sequence by all students.

FUNDAMENTAL PROGRAM

1. Evolution of Life and Emergence of Man — The question "what is life?" leads to a discussion of the nature of organisms, of organization in general, its dependence on information, and the central position of genetic and evolutionary theory in all biological sciences. A beginning is made in developing an understanding of the role of natural selection in molding the character of organisms and societies as self-reproducing entities adapted to the conditions in which they exist.

A major section of this course is a substantial treatment of Mendelian and population genetics. The nature/nurture problem is introduced as one of the most important contributions which the biologists as such can make to an understanding of man and political issues that beset him.

The metabolism of organisms is discussed with principal emphasis on energetics and the flow of material constituents between organisms and environment. The cell is studied as the simplest unit of living organization. The structure of its organelles is considered in terms of the functions that they serve, especially in terms of the energy relations.

This introductory course is primarily concerned with broad outlines of the origin and history of life, with special emphasis on the evolution of the vertebrates and the primates. The quarter will close with a discussion of the biological uniqueness of man and his origins from the Australopithecines.

5 units, Spr (Staff) MTWThF 9

2A. Cells, Organisms, and Societies — The structural and functional prerequisites for life at various levels of organization are treated in this quarter in greater depth, i.e.,
cellular structure, molecular architecture, and the energetics of living systems. The character of intercellular communication in multicellular organisms, leading to the neural and endocrine mechanisms underlying behavior; will provide the major theme for the course. Prerequisite: 1 or Biological Sciences 1; must be taken concurrently with 2B.

4 units, Aut (Kennedy, Barchas, Bernfield) MWF 9

2B. Evolution of Human Behavior — This course views man as an organism with a long evolutionary history that has significance for understanding the behavior of contemporary man. Over millions of years, behavior patterns have evolved in relation to meeting survival requirements: food, shelter, defense, reproduction, preparation of offspring to cope with environmental conditions. Such adaptive patterns will be examined as they existed in different eras of human evolution: in nonhuman primates; in hunting-and-gathering societies; and in agricultural societies. Attention will be given to subsistence patterns; to interpersonal and intergroup relations; and to sources of conflict and modes of conflict resolution.

4 units, Aut (Hamburg, Goodall) MWF 10

3A. The Human Organism — This course will build on the material in 2A, emphasizing issues in physiological control and development. Particular emphasis will be placed upon (1) adaptation and homeostatic capacity; (2) coordinating mechanisms that underlie these abilities and (3) human performance under environmental extremes. Prerequisites: Human Biology 2A and 2B; must be taken concurrently with 3B.

4 units, Win (Kennedy, Barchas, Bernfield) MWF 9

3B. The Person in the Social Structure—This course will explore the development and functioning of the person in a social and institutional context. We shall look at individual development within the setting of family, school and work. Those social-psychological processes will be emphasized which are relevant to the understanding of social interaction and human organization. Stress will be placed upon the influence of both the person and the institutional setting in determining belief systems and behavior.

Prerequisites: Human Biology 2A and 2B; must be taken concurrently with 3A.

4 units, Win (Siegel, Hastorf, Dornbusch) MWF 10

4A. Biology of Populations—The course will present an overview of populations as biological units, emphasizing their genetics, dynamics, and the interactions of populations in ecosystems. Illustrative material will be drawn largely from human populations and those of organisms which interact closely with man. Subjects discussed will include race, human population growth, resource depletion, and man's impact on the environment. Prerequisites: Human Biology 3A and 3B; must be taken concurrently with 4B. Some background in statistics and calculus is desirable.

4 units, Spr (Ehrlich, Staff) MWF 9

4B. Human Institutions—This course will present selected economic and political principles relevant to contemporary problems of human biology. Certain data and concepts of the social sciences will be considered, and their significance explored in relation to some aspects of health, disease, and other areas where biology and the social sciences interact.

4 units, Spr (Gurley, Corning) MWF 10

6. Workshop in Human Biology — This workshop, required of all Program majors, offers the student the opportunity to augment his formal course work with a supervised field, community, or laboratory project of his own choosing. To be arranged in advance and to be initiated at least three quarters prior to graduation. Limited to majors in Human Biology. Course graded pass/no credit exclusively.

4 units (Liebes) by arrangement

10. Human Sexuality—Human sexual function and behavior will be reviewed from biological, psychological, and cultural perspectives. In the first part, the anatomy, physiology, and endocrinology of sexual and reproductive functions are examined. The second part deals with psycho-sexual development and patterns of sexual behavior. In the final portion of the course, erotic themes in literature and art are reviewed, and legal and moral aspects of human sexuality ex-
amined. The emphasis in the course is on information, not advice.

4 units, Win (Katchadourian, Lunde, Staff) MWF 11

ADVANCED COURSES

Note: A major in Human Biology is expected to take 30 units of upper division credits in fields related to the natural or physical and the social or behavioral aspects of Human Biology. The courses may be selected from the upper division offerings of the Program, or any appropriate department on the campus. The student must balance the advanced courses so that 20 units are in either the natural or the social sciences, while one-third are in interdisciplinary and/or policy aspects. The upper division courses should reflect a unity directed toward the ultimate goal of the student. The student's individual design of an advanced program must have approval from a Program adviser and the Committee on the Major. At the student's discretion one half of the upper division courses (15 units) may be taken for pass/no credit.

Students who plan to pursue graduate work in the sciences or social sciences should be aware of admissions requirements for graduate programs and the necessity for early planning of their programs, in order to satisfy the requirements of both the Program and graduate schools.

Advanced courses presented by the Program in Human Biology are open to non-majors with the proper prerequisites. Human Biology majors will have preference where the number of students must be restricted.

102. Health as Human Ecology — This course is concerned with the interplay of environmental, biologic and social factors that influence health outcomes, and how these relate to social policy. This year the purposes of the course will be met by a combined lecture-seminar format. Introductory discussions by the lecturer will focus on 3 case studies: cholera, Down's syndrome, occupational cancer. Student-initiated seminars will then follow on selected themes. (Students interested in the sociology and economics of medical services should see FCPM 200). Prerequisites: Human Biology core or 20 units of Biological Sciences.

4 units, Win (Lederberg) MWF 11

103. The Natural History of the San Francisco Bay Area — This course is designed to provide a basic understanding of all aspects of the natural history of the San Francisco Bay Area and to investigate the effects of human use and development on the natural history of the region. Lectures will include discussions of the geography and geological history of the Bay Area; the climate and weather; the basic taxonomy and biogeography of the flora and vertebrate fauna of the area; ecology of the major biotic communities, from the offshore waters to the floor of the central valley; the history and impact of the human use and development of the Bay Area. Field trips will permit students to experience all of the major biotic communities found in the Bay Area, and to acquaint the student, as fully as possible, with the entire natural history of each community. Evening guest lecturer/film sessions will allow students to be subjected to outside views about problems in the natural history of the Bay Area.

5 units, Win (Staff) TTh 11

106. Man-Made Environment — A course consisting of lectures, discussions, and readings reviewing man's role in shaping his environment. Emphasis will be placed upon the planning factors and processes which act to determine the nature of our cities and communities. The class is limited to 40 students with preference given to Human Biology majors.

3 units, Spr (Collier) Th 2:15-4:05

120. Human Nutrition — An introduction to human nutrition including the metabolic basis of nutritional requirements, dietary requirements, biogeographic aspects, socio-economic determinants of dietary problems, specific deficiency diseases, and global aspects of malnutrition. Prerequisite: Human Biology core or consent of instructor.

4 units, Win (Taylor, Anthony) MWF 4:15

121. The World Food Economy — (Same as Food Research 103 and Economics 106.) This course will examine the individual components essential to a macro-perspective of the world food economy. The biological and economic principles of food production will be used to explain the potential for food supplies. Next, attention will be devoted to nutritional, social and economic factors that in-
fluence the consumption of major food groups. Techniques for measuring and evaluating nutritional wellbeing will be discussed briefly. The last part of the course will examine the world food economy in global perspective.

3 units, Spr (B. F. Johnston) MWF 10

130. Human Genetics—This course will include the following: molecular aspects of human variation, genetics of disease and of continuous traits including behavioral attributes; population aspects; dynamics of change and equilibria under mutation, selection, drift, migration and population structure models; social aspects of human genetics. Prerequisite: Human Biology core or consent of instructor.

4 units, Aut (Cavalli-Sforza) MWF 2:15

131. Human Evolution—Early and recent human evolution and differentiation in the light of modern evolutionary theories as revealed by a multidisciplinary approach (archeology, paleoanthropology, paleoecology, geology, population biology and genetics). Attention will be paid to both cultural and biological adaptations and the nature of their interplay over the course of human evolution. Special topics will be developed in greater depth in the seminar in Human Evolution (Human Biology 132) which is run concurrently.

3 units, Win (Ammerman, Cavalli-Sforza) TTh 4:15

132. Seminar in Human Evolution—Discussion of selected topics to be chosen among those presented in the course on Human Evolution. Examples of areas that may be examined would include: adaptations to changing environments during the Pleistocene, anatomical changes in the genus Homo, patterns of cultural change and regional differentiation at various points during the course of human evolution, origins of agriculture and related cultural and biological implications. The selection of topics will be based in part on the background and interests of those taking the course. Prerequisite: to be taken concurrently with Human Biology 131 or consent of the instructor.

3 units, Win (Ammerman) by arrangement

136. Topics in Intelligence—(Same as Biology 136.) The major perspectives on intelligence will come from population biology and psychology. Topics will include the nature and development of intelligence from a psychometric viewpoint, the essentials of psychological testing, the meaning and usefulness of heritability, the impact of environmental influences (including nutrition and compensatory education), group differences in intelligence, and a critical evaluation of social policy concerning IQ testing. Prerequisite: Human Biology core, Math 5, 6, 7 or Psychology 60 recommended.

3 units, Spr (M. Feldman, S. Feldman) W 1:15–3:05 alternate years, given 1976–77

137. Seminar in International Aspects of Environmental Disruption—(Same as Political Science 147C.) Many environmental problems transcend national borders. Others are at least partially the result of international politics and economic activities. In this seminar, students will explore the environmental crisis as a subset of international relations, with particular emphasis on ocean and waterway problems.

5 units, Spr (Corning) T 2:15–4:05

140. Energy and Society—(Same as Mechanical Engineering 180.) A unified analysis of the effects on man's environment of the production, distribution, and consumption of energy. Treatment will include: the kinds and magnitude of energy resources; the various technologies for conversion to electric energy and other consumer forms; priorities and strategies for future development; the social conflicts between growing demands and environmental degradation; technological assessment; the legal and economic framework of the energy industry. Presentation of technical information will be in terms understandable to the non-engineering student. Prerequisites: high school physics and junior standing or consent of instructor.

3 units, Spr (Connolly, Liebes) TTh 1:15–2:30

150A,B. Biosocial Aspects of Birth Control—(Same as Chemistry 130A,B.) The problems of introducing a new, practical birth control agent or procedure involve legal, political, cultural and economic factors in addition to purely biological ones. The subject matter therefore represents a perfect case of illustrating how many components ought to enter into major policy decisions. The course will deal with a critical evalua-
tion of the logistic aspects of human fertility control and will include lectures on "hardware" as well as "software" aspects of birth control. Groups of five to eight students of diverse backgrounds will develop a series of position papers dealing with new birth control procedures suitable for populations of different cultural and socioeconomic backgrounds. The first quarter will consist predominantly of lectures, of selecting the population groups and task forces and of individual discussions with each task force. The second quarter will be dedicated to library and field work, the completion of written task force reports and oral presentations to the class. The selection of students admitted to this class will be based on the desire to create a multi-disciplinary student group (approximately equally divided between males and females) so that each position paper will be prepared by task forces consisting of participants with different undergraduate backgrounds (e.g., Pre-Medicine, Pre-Law, Biological Sciences, Anthropology, Chemistry, Economics, Political Science, Psychology, etc.) who will focus on specific logistic aspects of a common topic in the birth control field. Limited to 40 students.

Preregistration prior to the Fall quarter is essential, using preregistration questionnaire available from the Human Biology office.

Prerequisites: At least junior standing, registration for both quarters.

5 units, Aut, Win (Djerassi) MW 2:15-4:05; alternate years, given 1975-76

152. Biosocial Aspects of Pest Control—This course will focus on policy issues in the management of pests in agriculture and public health. Among the topics considered will be the following: biological basis of contemporary control techniques and the major alternatives; the properties of agroecosystems and the biology of pest organisms; economic and political factors that motivate pest-control practices; measuring the costs and benefits of chemical control; impact of regulation on the development of new technology in private and public sectors. The first part of the course will consist of lectures on these and other biological and institutional features of the problem. In the second part, teams of 6–8 students will investigate a particular application, in most cases a local one that may be examined at first hand, and formulate a set of policy recommendations. Limited to 40 students, who must preregister for course during the winter quarter.

5 units, Aut (Kennedy) TTh 2:15-4:05

153. U.S. Agriculture: Interaction of Biology and Economics—(Same as Food Research 145.) The development of agriculture in the United States has been profoundly shaped by biological and by economic influences; sound policy determination usually requires an understanding of the roles of both. This course is devoted to the interaction of these influences. It will consider (a) the biological basis of agricultural practice, including the major groups of cultivated plants, soil and water relations, growth physiology, genetics and plant breeding, agroecosystems and pest control; (b) basic agricultural economics, including the microeconomic basis of production, the supply of agricultural products, technological change, the demand for farm products, and the influence of federal farm programs on agricultural incomes, output, and international trade. In the last part of the course, the scientific and institutional components of selected policy issues in agriculture will be considered.

3 units, Spr (Falcon, Kennedy) MWF 11

154. The Biosocial Aspects of Cancer—This course is concerned with the various problems of cancer: the diagnosis and treatment of human neoplasms, the psycho-social and economic impact, the organization of cancer care and research. There will be detailed consideration of the specific control mechanisms operative in vitro and/or in vivo and delineation of their influence in an attempt to characterize the differences between normal and malignant growth.

3 units, Spr (Kaplan, Brown, Hahn) W 7:30-9:30 p.m.

160. Primate Behavior—This course will study in detail the research literature on behavior of higher primates in natural habitats. Special attention will be given to chimpanzee behavior, but material on other species of great apes and Old World monkeys will be considered. Some evidence will be included on experimental analysis of questions arising from observation in natural habitats.

Prerequisites: Human Biology 2A and 2B.

3 units, Spr (Hamburg, McGinnis) by arrangement

161. Primate Behavior Workshop—An Afri-
can elective; minimum 2 quarters. Prerequisite: Human Biology 160; limited to 8 Human Biology majors per year.

15 units, Aut, Win, Spr, Sum (Goodall) by arrangement

163. Topics in Psychobiology—This course will focus on recent developments in psychopharmacology, as they relate to the study of human mood disorders and schizophrenia. Current theories regarding the etiology of mental illness will be discussed. The relationship between hormones and human behavior will be examined. Emphasis in the course will be on student participation, using a seminar format. Limited to 24 students. Prerequisite: Human Biology core.

3 units, Aut (Berger) T 3:15-5:05

164. Human Aggressiveness — This course, taught in seminar format, will review data and theory concerning biological, psychological and social aspects of human aggressive behavior. Biological aspects will include instinct theories, genetic variables, hormonal contributions, evidence from the study of nonhuman primates, and brain mechanisms. From a psychological viewpoint, links between frustration and aggression, as well as social learning of aggressive behavior will be reviewed. Social factors will include effects of crowding, stranger contact, status conflicts, and inter-group competition. An effort will be made to integrate information and ideas from biological and psychosocial perspectives. Limited to 20 students. Prerequisite: completion of Human Biology core program.

3 units, Win (Eichelman) W 1:15-4:05

171. Adolescence—This age period will be considered as a major transitional stage in development. Different perspectives will be examined, including those from endocrinology, physiology, anthropology, psychology, sociology and psychiatry.

4 units, Win (S. Feldman) TTh 10:00-12:30

175. The Nature and Origins of Sex Differences—(Same as Anthropology 187.) This course will combine biological, psychological and cultural perspectives on the development of sex differences. Included will be a review and discussion of: (a) the course of biological differentiation, (b) the nature and possible origins of sex differences in psychological functioning, (c) how sex differences develop in various cultural settings.

5 units, Spr (J. Collier, Davidson, E. Maccoby) by arrangement

178. Problems of Aging—Aging will be discussed from various points of view: biological and intellectual changes, social adaptation, and society’s treatment of the aged.

4 units, Spr (Staff) by arrangement

198. Honors Program—This establishes an opportunity for in-depth research on an appropriate issue or problem by the student. It is necessary to choose a faculty sponsor who will be the adviser to the project and a faculty consultant who will act as second reader of the thesis; at least one of these two must be a member of the Human Biology faculty.

Minimum requirement for the Honors program work and the resultant thesis is the equivalent of 10 units of work; a maximum of 15 units may be awarded. Limited to majors in the Program in Human Biology who have completed the “core” courses including the workshop. Interested candidates should consult with advisers in the Program in Human Biology for explicit requirements for the Honors Program.

(Staff) by arrangement

199. Directed Reading/Special Projects — Independent study undertaken with faculty in the Program in Human Biology. Course graded pass/no credit exclusively.

Any quarter (Staff) by arrangement

Individually Designed Majors

This program is intended for students who are interested in pursuing in depth an area of scholarly inquiry which falls outside the purview of a single, established, academic department or program of the university. What is envisioned are intellectually coherent majors designed by the students themselves with the assistance of faculty members of their choice. The Interdepartmental Major Program is not an honors program, and an honors grade point average is not a requisite. Any student in good academic standing is invited to participate.

In designing a major, the student will con-
suit with at least three faculty members from at least two separate departments or programs of the University; one of the faculty members will be selected as the student's "primary" adviser. In helping the student design the major and in signing the proposal requesting approval from the Dean's Advisory Committee on Individually Designed Majors, the faculty members are committing themselves to act as a regular academic advisory group for the student until graduation. The Committee will not consider proposals (or changes in previously approved proposals) unless the student has the approval of the faculty advisory group.

THE "COMMITTEE IN CHARGE"

The Program for Individually Designed Majors is administered by the (Undergraduate Studies) Dean's Advisory Committee on Individually Designed Majors. The Committee is composed of both faculty and student members, with representatives from the Office of the Dean of Undergraduate Studies serving in ex officio positions.

The Committee acts in lieu of a regular department of the University. This role involves certifying the scholarly merit of the program and includes the obligation to consider, approve, and recommend changes in each proposed major. Because the Committee works closely with the Office of the Dean of Undergraduate Studies, and especially the Academic Information Center, it can facilitate access to the full range of resources available to the student.

In carrying out its role, the Committee reserves the right to reject proposals which in its opinion lack scholarly merit or which are not clearly interdisciplinary. Occasionally, the Committee must reject a proposal which, though of considerable academic merit, requires resources which are not available at Stanford. The Committee also reserves the right to recommend additions to each student's faculty advisory group.

THE PROPOSAL

The proposal should begin with a statement which describes the major, articulates the motivation for, and the justification and ultimate goal of, the major, and shows how the courses listed relate to and fulfill the major's goal. This statement should be followed by a list of the proposed core courses to be counted toward the major and, as far as possible, the sequence in which they are to be taken. The total proposal must be signed by at least three faculty members; their signatures certify that they approve of the major as described in the proposal and agree to serve as the student's permanent advisory group. The proposal must also be accompanied by a statement from the primary adviser, giving his or her frank appraisal of the academic viability of the proposed major.

All members of the student's advisory group must be members of the Academic Council at Stanford; this requirement will help ensure that they will be available throughout the student's program.

THE GUIDELINES

To defend the program for Individually Designed Majors as fully equivalent to a Stanford Bachelor of Arts or Bachelor of Science degree in an established department or program, the Senate of the Academic Council originally established these requirements.

1) Each major shall consist of at least sixty (60) units, all in courses at or above the 100 level (or equivalent).
2) A maximum of fifteen (15) of these sixty (60) may be taken on a pass/no-credit basis.
3) A maximum of five (5) units of these sixty (60) may be taken in individual study or directed reading.
4) Students proposing an individually designed major must have at least two quarters' undergraduate work remaining at Stanford after the date on which the proposal is to be discussed by the Committee. Since each proposal is considered individually, the student and the faculty advisory group may request exception to these guidelines. Such a request must be included in the statement which justifies the major.

Further information on the program may be obtained at the Academic Information Center.

LEARNING ASSISTANCE CENTER

Director: Michael McHargue

The Learning Assistance Center (LAC) is designed to improve the learning environ-
ment at Stanford. It has helped several departments develop expanded tutoring programs and has worked to improve the teaching, advising and counseling services available to students.

The LAC provides five direct services to students:

A. Course Tutoring — Students who need extra help in their courses (that cannot be provided by professors, TA's or departmental tutoring programs) may come to the LAC and obtain the names of tutors from our files.

B. Study Skills Improvement — The LAC offers individual counseling and tutoring, workshops, and courses in effective learning and study skills. A broad range of topics are covered, including: (1) self-management skills; (2) study and time management; (3) major course-related skills (including study-reading, exam techniques, and responsive listening and note-taking); (4) auxiliary course skills (like research and communication skills); (5) attitudes and interests that affect learning.

C. Reading Improvement—Counseling, the LAC Learning Lab, and an academic course are all designed to help students become more efficient, flexible, sophisticated readers.

D. Tutor Training—Courses and workshops train students to become effective academic tutors.

E. Peer Counseling Training—A new course sequence (100–102) teaches students the skills they need to become proficient peer counselors.

All LAC courses are pass/no credit and they can all be taken for fewer than the listed number of units by consent of the instructor. All LAC services are free. You are invited to visit the Center at Meyer Library 123, or call us at ext. 7-2207. We are open Monday through Friday, 9–5 and some evenings.

**Courses**

1. Effective Learning Skills—Teaches self-management and study skills. Lectures, discussions, assignments, and individual counseling are designed to encourage students to practice new techniques on other coursework.

2 units, Aut, Win, Spr, Sum (McHargue, Stevenson and Staff)

10. Effective Reading Skills—Small sections designed to improve reading skills including vocabulary building, critical and analytical reading of college-level materials, study reading, and rate improvement.

3 units, Aut, Win, Spr, Sum (Walker and Staff)

100. Peer Counseling Techniques — New course sequence designed to teach students the skills they need to become effective peer counselors. Course suffix will indicate focus on study skills, academic tutoring, or other types of peer counseling. Some prerequisites or concurrent registration may be required. Consent of instructor is required.

2 to 4 units, Aut, Win, Spr, Sum (McHargue, Adams, Cannom and Staff)

101. Peer Counseling Practicum — Supervised peer counseling in the specialty you have prepared. Consent of instructor required. Prerequisite: LAC–100 or enroll concurrently. May be repeated for credit up to total of 6 units.

1–3 units per quarter. Aut, Win, Spr, Sum (McHargue, Adams, Cannom, and Staff)

102. Training Peer Counselors — Highly qualified and experienced peer counselors will participate in the selection, training, and supervision of new peer counselors. Consent of instructor required. Prerequisite: LAC–101.

1–3 units, Aut, Win, Spr, Sum (McHargue, Adams, Cannom and Staff)

**Mathematical Sciences (Program in)**

Committee in Charge: John G. Herriot (Computer Science), Chairman; Paul W. Berg (Mathematics), Arthur F. Veinott, Jr. (Operations Research), M. Vernon Johns (Statistics).

**Statement of Purpose**

This interdepartmental, interschool undergraduate program is designed as a ma-
Seminars for Entering Students

Dean's Advisory Committee in Charge: George A. Collier (Director of the Program), Thomas A. Bowers, Marvin Chodorow, Karel de Leeuw, John Goheen, Sonia Jarvis, Sheryl Kerner (ex officio), Ronald Rebholz, Mason Yearin (ex officio), Lynn Yip.

The seminars for entering students, with course topics covering a great variety of fields, are especially designed to provide small group learning experiences. The seminars allow you to explore a subject of particular interest, working closely with a professor, lecturer, or advanced graduate student.

There are anywhere from six to twelve students in a seminar. Since approximately 1,800 entering students are eligible for some 96 seminars, everyone cannot be placed in his or her first choice, and some students who apply may not be placed in a seminar at all.

The seminars are for three, four, or five units of credit per quarter. The two-quarter seminars are continuing courses, and students are expected to complete both quarters. Some seminars fulfill part or all of the Writing Requirement and others can count toward the University's distribution requirement.

Application and Admission Procedures

All students who accept admission to Stanford University receive in June a copy of Approaching Stanford which includes descriptions of the seminar offerings for the following academic year. Applications for the seminars are received and processed in late summer and students are notified of their acceptance into the particular seminars upon arrival at Stanford.

Correspondence regarding the program for students interested in the mathematical sciences or in the use of mathematical ideas and analysis in problems in the social or management sciences. It provides a core of mathematics basic to all of the mathematical sciences, and an introduction to the concepts and techniques of automatic computation, optimal decision making, probabilistic modeling, and statistical inference; it also provides an opportunity to undertake elective work in any of the mathematical science disciplines at Stanford.

The program utilizes the faculty and courses of the Departments of Computer Science, Mathematics, Operations Research, and Statistics. It is intended to prepare students for graduate study or employment in the mathematical sciences or in those areas of applied mathematics which center around the use of high-speed computers and are concerned with the problems of the social and management sciences.

Program of Study

Bachelor of Science

The requirement for the Bachelor's degree, beyond the University's basic requirement, is an approved course program of 71 to 75 units, distributed as follows:

1. Mathematics (33 units): Calculus and Analytic Geometry through Mathematics 43 or 23, or equivalent; Advanced Calculus (44, 45); Linear Algebra (113); Fundamental Concepts of Analysis (115); Modern Algebra (120); Differential Equations (130). Mathematics 54, 55 (8 units) may be substituted for Mathematics 44, 45, and 115.

2. Computer Science (9 units): Introduction to Computing (105 or 106); Numerical Analysis (137A,B).

3. Operations Research (6-9 units): Introduction to Operations Research (151, 153) or Linear Programming (240) and Models in Operations Research (250, 251).


5. Electives (12 units): Twelve units of courses in the Mathematical Sciences of which six (6) must be chosen from Mathematics 114, Mathematics 116 (or Mathematics 56), Computer Science 111, Computer Science 155 (or Computer Science 150 or Operations Research 245), Statistics 217 (or Mathematics 124). The choice of electives will be determined by the student's interest. In particular, students planning doctoral study in Operations Research are advised to take Mathematics 114 and 116.
should be addressed to the Office of the Dean of Undergraduate Studies, Building 1, Room 1-C, Stanford University, Stanford, California 94305.

Stanford Workshops on Political and Social Issues (SWOPSI)

Stanford Workshops on Political and Social Issues (SWOPSI) is a student-initiated program organized in an effort to provide within Stanford's curriculum more practical and direct involvement in the search for solutions to urgent social and political problems. It is based on the assumption that one of the major responsibilities of the university in such times of concern and urgency is to help cultivate a community in which concern with respect to social problems is founded in knowledge and understanding of the facts, and in which the translation of a sense of urgency into action is thoughtfully directed.

SWOPSI was organized during the summer of 1969, and began the following autumn quarter with an offering of 10 workshops on such topics as: air pollution in the Bay Area, California logging policy, the delivery of health services, University research policy, and disarmament negotiations. The program has expanded since then and has now involved over 5,000 students in over 250 workshops. In the future SWOPSI will offer for credit an average of 20 to 25 workshops per quarter.

The basic objective of all SWOPSI workshops is to develop new insights into contemporary issues of political and social consequence; and, ultimately, to affect more people than are actually members of the workshop. This might be done through informing the community of their conclusions in publications or public forums, or by using the results to form the basis of concrete legal, political or community action.

Workshops are generally concerned with issues which are of interest to Stanford students and faculty, but workshops may also be initiated by concerned members of the outside community. Since each problem may require a different approach, the specific structure of a workshop is determined by the instructors and students who are involved in it.

Workshops are open to both undergraduates and graduates, as well as other interested members of the Stanford community. There are occasionally prerequisites for a workshop, but past experience has indicated that a diversity of backgrounds enhances the possibility of a more perceptive analysis and more imaginative solutions. In general, the workshops meet weekly, but the largest part of the work is done through individual research, interviews, and other kinds of field work. Credit is available for the workshops, primarily on a pass/no credit basis.

Each workshop is provided with a small amount of financial support for operating expenses.

Further information and the specific workshop offerings for any quarter may be found in the SWOPSI catalogue distributed each registration day. There is no pre-registration for workshops, and enrollment limits are determined by the instructor.

Any person interested in organizing, running, or participating in a workshop on a particular issue should contact the SWOPSI office at Ext. 7-4305.

The Student Center for Innovation in Research and Education (SCIRE)

The Student Center for Innovation in Research and Education (SCIRE) is a student-initiated, extradepartmental program. The program's overall objective is to support the educational needs of undergraduate students. This is accomplished through assistance to individual students and by work done to improve the general state of undergraduate education.

Best known among SCIRE's activities is its support of individual or small group student-initiated projects. SCIRE facilitates these projects in several ways. The staff works with interested students, developing and refining project ideas. Members of the academic community and other qualified individuals with interests similar to the students' are sought out by the staff and students jointly. Academic credit is then granted to those project proposals which receive the approval of the
SCIRE Policy Board which consists of four students and three faculty members.

SCIRE projects allow undergraduates to directly affect their education by giving them the opportunity to experiment with new subject matter, creative research and learning approaches, and unique field experiences. The number of units granted for a project may range from 1 to 15 per quarter. This flexibility enables students to test initial interest in a new field through small introductory projects or to engage in intensive study in an area to which the student is already committed.

In addition to encouraging increased student responsibility for their academic programs, SCIRE is currently working in some new areas relevant to undergraduate education. Policy Board members have identified a number of educational problem areas and task forces are being organized to work on ways to resolve these.

SCIRE will use the support of students and other University community members in this endeavor, both in identifying problems and working toward their resolution.

Another area of emphasis at SCIRE is the stimulation of opportunities for students to work and learn off campus. SCIRE is in the process of developing a file of experiential learning resources. Plans are also under way to increasingly serve as a clearing house for off-campus learning opportunities by stimulating better coordination among the various agencies and groups in this field. Eventually SCIRE would like to serve as a catalyst for the development of a coherent approach to educational opportunities in the local community.

In past years, SCIRE has provided sponsorship and support for a number of exciting projects which have improved undergraduate education at Stanford. Projects such as the Urban Studies Program, the Undergraduate Program in the School of Education (UPSE) and the Optical Observatory were all inaugurated with SCIRE sponsorship. Current SCIRE activities continue to support such projects. The program has developed an innovation fund which will be used to make grants of "seed money" to support exciting educational projects developed by students. The stress of the fund will be upon ideas which are likely to have a positive impact upon undergraduate education.

Students with academic project ideas, an interest in task forces, a desire to work and learn off campus, and with innovation fund proposals should come by the SCIRE office, 590-A Old Union, or call extension 74504. The office is open Monday through Friday from 8 to 5.

**Undergraduate Special Courses**

Undergraduate Special Courses are sponsored by the Office of the Dean of Undergraduate Studies. They widen the range of options open to undergraduate students by drawing upon the educational resources of the entire university community, including some parts which customarily have not participated in undergraduate work. Members of the faculties of the graduate professional schools may offer such courses. These are not intended to introduce the technical content of the professional schools into the undergraduate curriculum, but rather are to be general in character. Undergraduate Special Courses may be taught, under suitable arrangements, by persons who are not members of the Academic Council, under the sponsorship of a Council member. The administrative structure of this program of courses is intended to encourage innovation, the introduction of experimental and interdisciplinary courses, and other types of offerings which for various reasons might not appear under the auspices of a particular department or school.

The maximum number of students who may enroll for credit in any Undergraduate Special Course in one quarter is 40. In some of these courses, the enrollment is limited to fewer students.

Grades in these courses are given in the normal manner, with the pass/no credit option available upon the instructor's approval. A student may take 12 Undergraduate Special courses, or 36 units of Undergraduate Specials, whichever is lower. Up to 27 of these units may be SCIRE (Student Center for Innovation in Research and Education), SWOPSI (Stanford Workshops on Political and Social Issues), and/or Urban Studies.

The list of all Undergraduate Special courses to be offered in any given quarter is available to students in advance of registration in the separately published program catalog. Enrollment of individual students in
all courses is determined by the Registrar’s class lists, with sign-ups handled in accord with the regular University system of alphabetical rotation, on regular advance registration or registration days, at the location established by the Registrar. Courses which are approved as part of a residence’s program of residential education may reserve no more than 75 percent of the total places available in the course for students who live in that residence. In such cases, the Registrar will maintain separate class lists for residents and for non-residents according to established procedures.

Prerequisites and other enrollment restrictions for Undergraduate Special courses must be approved by the Committee in Charge at the time the course proposal is reviewed. No restriction will be approved based on race, creed, sex, or national origin.

A proposal for an Undergraduate Special course may be initiated by a student, staff member, faculty member, or other member of the academic community. The proposed instructor—the person doing the actual teaching or presentation of course materials—should file with the Committee a form obtained from the Program Office, 590-A Old Union, indicating:

1. A statement of course objectives.
2. The planned approach and an outline of general requirements and/or prerequisites.
3. Specific requirements, definition of special projects, method of evaluation and intended grading system.
4. A reading list identifying required and suggested readings.
5. A week-by-week syllabus which is as detailed as possible and which links readings, lectures, discussions and projects.
6. The name of the instructor(s) and any others who will assist in teaching the course, and a statement of the qualifications of these individuals.

In addition, instructors who are not members of the Academic Council must obtain a sponsor’s statement from a Council member indicating support for the course and the qualifications of the proposed instructor(s). The sponsor will be responsible to the Committee on Undergraduate Special Courses through the Office of the Dean of Undergraduate Studies for the quality of the course, the performance of the instructor, and the evaluation of individual student performance, in accord with the course description as approved by the Committee.

Academic credit is granted only if the course proposal receives a favorable evaluation from the standing committee, composed of faculty members and students. Undergraduate Special courses are administered through the Office of the Dean of Undergraduate Studies. Proposals are due by the fifth week of the quarter preceding the one in which the proposed course is to be offered.

Undergraduate Specials satisfy neither the Writing nor the Distribution requirements. Listings of courses available each quarter will be printed in the program catalog and at the Academic Information Center.

UNDERGRADUATE WRITING PROGRAM

Director: Ellen W. Nold

Most of the Writing Program’s teaching duties have been absorbed by the English Department. For information about free tutoring and writing courses for those students who have already fulfilled the Writing Requirement, check with Ms. Betty Brereton in 51-L.

Ellen Nold, staff member of the Office of the Dean of Undergraduate Studies, can be reached for counseling about the Writing Requirement in Meyer Library 123.

THE PROGRAM ON URBAN STUDIES

The Committee on Urban Studies: John Mollenkopf, Assistant Professor of Urban Management and by courtesy of Political Science; Clayborne Carson, Acting Assistant Professor of History; Lydia Kennard, student member; Michael Kirst, Associate Professor of Education and by courtesy of Business; Michael Levinthal, student member; Robert Mittlestadt, Associate Professor of Mechanical Engineering; Richard Muth, Professor of Economics;
Nancy Tuma, Assistant Professor of Sociology; Paul Turner, Assistant Professor of Art; Julie Williamson, student member. Ex Officio members: Steve Burrows, student member; David Mason, Associate Dean of Undergraduate Studies; Frederic Stout, Urban Studies Program Coordinator; Carole Martin, Urban Studies Program Secretary.

GENERAL INFORMATION

The Program on Urban Studies is an undergraduate extradepartmental program concerned with cities and urban life in the local, regional, national and world contexts. The focus of the Program is broadly interdisciplinary and emphasizes the complex interaction of social, political, economic and cultural forces in the urban setting. The Program takes as an area of special concern the problems of urbanization as they affect the San Francisco Bay Region.

The Program is empowered by the Faculty Senate to coordinate offerings of regular Stanford departments and to offer fieldwork internships and adjunct courses taught both by Stanford faculty members and outside community experts. A supplemental catalog updating and outlining the adjunct courses is available prior to the beginning of each academic quarter at the Program offices, B-16 Old Union, Ext. 73452.

Urban Studies courses and internships are open to all Stanford students. A student wishing to major in Urban Studies may do so by designing his or her own Interdepartmental Major through the offices of the Academic Information Center, Room 306, Old Union, Ext. 2426. The staff of the Program on Urban Studies will gladly assist any student in the design of an Interdepartmental Major in Urban Studies. Members of the Committee on Urban Studies, including its student subcommittee on peer counseling, are also available for counseling.

THE CORE CURRICULUM

The Committee on Urban Studies is currently designing a core curriculum which, when completed and approved, will constitute an Interdisciplinary Urban Studies major. That major will provide a strong central discipline, both in terms of content and methodology, by requiring a thorough grounding in the skills and concepts of a variety of urban-related fields. It will also encourage flexibility by allowing the student to pursue a specific area of concentration relating to his or her individual interests. The Junior Seminar in Urban Studies (which demonstrates the interconnected nature of the major urban-oriented disciplines) is a requirement for majors.

History 254S. Seminar in American Urban History.
Political Science 204. Seminar in Planning for Metropolitan Areas.
Sociology 251. The City.
Architecture 160. Introduction to Urban Design.
Civil Engineering 133. Introduction to Urban Planning.

OR

Civil Engineering 171. Environmental Planning.
URBN 100A,B. Urban Studies Junior Seminar: The City as Human Experience.

VALUES, TECHNOLOGY, AND SOCIETY

(Program in)

Emeriti: Evan Just (Professor, Applied Earth Sciences), Philip H. Rhinelander (Professor, Philosophy and Humanities)

Chairman: Edwin M. Good
Coordinator: Robert E. McGinn

Professors: Clifford R. Barnett (Anthropology), Thomas J. Connolly (Mechanical Engineering), Edwin M. Good (Religious Studies), Eric Hutchinson (Chemistry), Stephen J. Kline (Mechanical Engineering), William C. Reynolds (Mechanical Engineering), Nathan Rosenberg (Economics), David F. Tuttle (Electrical Engineering), Walter G. Vincenti (Aeronautics and Astronautics)

Assistant Professors: Winston B. Davis (Religious Studies), Robert E. McGinn (Values, Technology, and Society)
Adjunct Professor: William R. Kincheloe  
(Electrical Engineering)

Lecturer: Robert A. Kreiss

STATEMENT OF PURPOSE

Values, Technology, and Society (VTS) studies the ways in which technology affects and is affected by human values and social institutions in the contemporary world. The Program is rooted in the assumption that technology is a pivotal force in modern society, intimately bound up with the evolving character, problems, and potentials of the world in which we live. Thus VTS believes that it is vitally important to obtain a broad understanding of technology and of its human and social implications. To this end, various VTS courses approach the study of technology from a variety of humanistic and social scientific perspectives.

OFFERINGS AND FACILITIES

Several VTS courses are designed as an integrated sequence to provide a comprehensive framework fostering a better understanding of modern society.

Integrated sequences of VTS courses may be used in a variety of ways:
(a) as coherent ways of satisfying the University Distribution Requirement;
(b) as part of student-designed concentrations to the major in Humanities (Humanities Honors Program);
(c) to fulfill the Technology and Society requirement in the School of Engineering;
(d) as minors to regular departmental majors.

Many VTS courses may be applied toward the fulfillment of the Distribution Requirement in any one of the two or three areas a particular VTS course satisfies. Here are three sample sequences of VTS courses that might be used in relation to one or another of these options:

1. to fulfill distribution requirements in Social Science and Math./Science/Tech.: VTS 107, 153, 154 (SS); 106, 115, 121 (M/S/T).
2. to fulfill distribution requirements in Humanities and M/S/T: VTS 101, 105, 154 (H); 106, 121, 141 or 142 or 143 (M/S/T).
3. to fulfill School of Engineering requirements in Technology and Society: VTS 101, 121; or 105, 142; or 107, 143.

For further information on which distribution areas a given VTS course satisfies, inquire at the VTS office, Building 370, Room 372, ext. 7-2565.

At present there is no conventional major in VTS. However, a student may elect to design her or his own interdepartmental major in VTS, or in a VTS-related area, in consultation with Program faculty and the Academic Information Center. Samples of such student-designed majors are on file at the VTS office.

VTS courses will be particularly valuable for undergraduates planning further study in graduate professional schools (e.g., business, education, engineering, law, or medicine) as well as for students wishing to relate the more specialized knowledge of their major fields to broad, technology-related aspects of life in modern society.

ADMISSION TO PROGRAM OFFERINGS

VTS courses are designed primarily for undergraduates. Several have enrollments that are limited either in number and/or with respect to the distribution of student majors. Students are urged to consult course abstracts in the Academic Information Center or the VTS office for details on individual courses.

FUNDAMENTAL COURSES

101. Contemporary Technological Society
—The nature, significance, problems, and potentials of contemporary technological society, with special reference to America in the 1970's. A variety of approaches to the subject will be employed: anthropological, philosophical, legal, literary, religious studies, historical, and politico-economic. Technology and the transformation of cultures; evaluative frameworks for assessing social changes arising out of technological innovations; legal status and ethical implications of biomedical and behavioral technologies; the impact of technology and science on human consciousness; historical perspective on technology and the fabric of experience in American life; and American communications technologies.

4 or 5 units, Spr (McGinn) TTh 2:15-4:05 or 4:15-6:05

105. Human Values and Technological So-
ciety—Analysis and assessment of the status of human values in contemporary Western society, factors affecting this status, and the fabric of human life today. Values include moral and aesthetic, individual and social, spiritual and material. Alternative value systems in relation to contemporary social structure; human costs and benefits of economic growth; philosophical principles and values informing social institutions and developments. Readings from Nietzsche, Marx, Rilke, Kafka, Seneca, Thoreau, Zolla, Mishan, Grant, Rieff, and Hardin.

4 units, Aut (McGinn) MW 10 Section W 2:15–4:05 or Th 7:15–9:05

106. Technology, Humanity, and Nature—Technology as a form of human activity shaping society. Broad concepts necessary to comprehend the interaction of technology with other elements of society; technology's relations to human functions and capacities, natural resources, and cultural constraints; technology in historical and cross-cultural perspective; modern psychosocial theories and ecological concepts as the basis of decision-making in technological society; the dynamics of change and development in modern technology; technology and current social problems and potentials.

4 units, Spr (Kline) TTh 10 Section W 2:15–4:05

107. Technology and Modern Industrial Society—The interrelationships between technology and the nature and form of industrial societies over the past 200 years. Technological change as a socio-economic process illuminating the history of industrial societies. Factors in the rate and direction of technological change and diffusion. Implications for economic structure and the growth of large-scale organizations. The impact of these changes on modern industrial man as producer and consumer.

4 units, Win (Rosenberg) TTh 2:15–4:05

ADDITIONAL COURSES

115. Models and Modeling: Representations of Reality—Appropriate models of reality vary in nature, validity, and utility from one discipline to another. The course examines this thesis by scrutinizing a wide variety of models from humanities, social sciences, physical sciences and technology. For example: creation myths, metaphors, theoretical and practical scientific models, two-species interaction models (competition, commensalism, predation), and a model from the Forrester school (e.g., World Dynamics). The use of mathematics will be kept consonant with the class background.

3 units, Spr (Tuttle) MW 2:15–4:05

121. Social History of Technology—Origins of contemporary industrialized civilization, interplay of technological change and societal development from ancient times until the beginning of the twentieth century. Among the topics are: Egyptian pyramids; Chinese and Islamic technology; technosocial influences of medieval Christianity; clocks and the concept of time; cannon, ships, and European expansion; origins and impact of the Industrial Revolution. The course can be taken either with a final examination (4 units) or with a research paper (5 units).

4 to 5 units, Aut (Vincenti) MW 3:15, Section Th 9:00–10:50 or 2:15–4:05

125. Case Studies in Socio-Technological History—In-depth studies of historical cases in the interaction of technology and society. Students will do research papers on different aspects of a common general area covered by initial common readings; papers will be discussed as they develop. Topic area for 1975–76: technological invention and innovation and their social context in 18th- and 19th-century Britain. VTS 121 is recommended but not required as background. Enrollment limited to 12.

5 units, Win (Vincenti) TTh 2:15–4:05

141. Energy: From Nature to Man—(Same as Engineering 7.) Nature provides an abundant supply of energy, mostly in forms not directly usable by man. The engineer has the problem of designing systems to convert this energy to usable forms, to transmit energy, and to use the energy in a socially responsible way. This course provides an introduction to the science of energy and to the technical aspects of energy supply. Open to all students who have taken some mathematics and science in high school. (Sophomore engineering students should take Engineering 32 instead.)

4 units, Spr (Reynolds) MWF 9

142. Information: The Communications Revolution in Contemporary Society—The nature of the communications revolution
and its impact on technological society, present and future. Fundamental concepts of communications and information theory; impact of communications technology on education (the future of books, libraries, teaching, etc.), politics, urban problems, human values (privacy, etc.); cable TV; society as an interactive organism; communications and ecology; communications and the nature of consciousness.

4 units, Win (Kincheloe) TTh 2:15-4:05


3 units, Win (Just) MWF 11

153. Ownership, Property, and Environment—Rights of possession in land, water, air, and scarce resources in relation to human values, social relationships, the technology of resources, and pollution. The efficacy of various socio-political systems, past and present, for equitable distribution of benefits, management of resources, and ecological responsibility.

4 units, Aut (Kreiss) given 1976–77

154. Law, Morality, and Technology—Legal instrumentalities used in encouraging, directing, controlling or restricting technological developments. The nature and function of legal and moral norms; the availability of legal mechanisms for influencing recent technological developments, the effects of constitutional and moral limitations on such developments. Case studies from various areas such as biomedical research; urban growth; electronic surveillance; punishment, responsibility, and mental deficiency; transportation and communications.

4 units, Spr (Rhinelander) MW 11

Section Th 2:15-4:05

160. Scriptorium: Calligraphy and Illumination—The influence of certain aesthetic and technological factors, such as the development of pens, pigments, vellums, and papers, on the written word, which reached its aesthetic climax just prior to the invention of printing. The above points are brought out by teaching the foundational and italic hands; technical and craft aspects of calligraphy and illumination will be supplemented by analysis of great manuscripts. Students will produce samples of finished calligraphy for evaluation. Limited to 20 students, preference to juniors and seniors.

3 units, Aut (Hutchinson, Minto)

W 7:30-9:30 p.m.

171. Technology and Work—Seminar on the relationship between changing technologies and the changing nature of work in modern industrial societies; the role of the worker and the altered nature of the work experience as a result of the impact of new production technologies.

4 units, Spr (Rosenberg) given 1976–77

174. Patterns of Secularization—(Same as Religious Studies 74.) Cross-cultural study of the transition from traditional religiously oriented civilization to modern, "secular" society. Topics covered: theories of secularization; religious incentives and impediments to secular world-views in traditional cultures (e.g., Israel, Greece, Europe, India, China, and Japan); the secularization of work and politics; the sacralization of consumption; secularization of elites, institutions, and "masses"; secular values and lifestyles; related sociocultural factors: urbanization, industrialization, science and technology.

3 units, Win (Davis) MWF 1:15

180. Energy and Society—(Same as Mechanical Engineering 180.) A unified analysis of the effects on man's environment of the production, distribution and consumption of energy. Treatment will include: the kinds and magnitude of energy resources; the various technologies for conversion to electric energy and other consumer forms; priorities and strategies for future development; the social conflicts between growing demands and environmental degradation; technological assessment; the legal and economic framework of the energy industry. Presentation of technical information will be in terms understandable to the non-engineering student. Prerequisites: high school physics and junior standing or consent of instructor.

3 units, Spr (Connolly, Liebes) MWF 9


3 to 5 units, Aut, Win, Spr (Staff)

by arrangement
199. Individual Work.
1 to 5 units, Aut, Win, Spr (Staff)
by arrangement

**UNIVERSITY PUBLICATIONS**

These University Publications contain information of general interest. Many Schools and Departments publish pamphlets of a more specific nature, and should be contacted directly for a complete listing.

**Aeronautics and Astronautics at Stanford**—available at the Office of the School of Engineering.

**Advisor's Handbook**—available at Academic Information Center.

**Approaching Stanford**—available at the Dean of Undergraduate Studies Office.

**Articles of Organization of the Faculty**—Inquire at Academic Secretary's Office.

**Asians at Stanford**—available at Admissions Office.

**Associated Students of Stanford University: Constitution and By-Laws**—inquire at ASSU Office.

**ASSU Course Review**—(review of selected courses through tabulation of questionnaires) inquire at the ASSU Office.

**Black Student, The**—available at Admissions Office.

**Charter of the Senate of the Academic Council of the Faculty of Stanford University**—available at the Academic Secretary's Office.

**Course Abstracts**—(quarterly compilation of data about Undergraduate courses) available for consultation at the Academic Information Center.

**Course Selection and Program Planning: A Guide for Freshmen**—available at Academic Information Center.

**Energy at Stanford**—Office of School of Engineering.

**Financial AIDS Information for Entering Undergraduates**—available at Financial AIDS Office.

**Founding Grant, The, with Amendments, Legislation and Court Decrees**—(limited quantity) inquire at the Secretary to the University's Office.

**Native American** student booklet—available at Admissions Office.


**Information Bulletin**—(general administrative procedures; rules governing withdrawal, leaves of absence; fee listings, etc)—available at Registrar's Information Window.

**Information for Prospective Undergraduate Applicants from Other Countries**—available at Admissions Office.

**Intercollegiate Center for Classical Studies in Rome**—(administered by Stanford) available at Overseas Studies Office.

**Library guides** (available at any major library):
- **Guide to Selected Reference Materials, Stanford University Libraries**
- **Guide to Stanford University Libraries**
- **Selected Facts: Stanford University Libraries**

**Pre-Law Handbook**—available at Academic Information Center.

**Preprofessional Handbook for Medicine and Allied Health Fields**—available at Academic Information Center.

**Senior Survey**—available at Academic Information Center.

**Senate Rules**—available at the Academic Secretary's Office.

**Sponsored Projects Policy Manual**—available at Sponsored Projects Office.

**Stanford International Studies**—available from the Center for Research in International Studies.

**Stanford Legislative and Judicial System**—available at the Office of the President.

**Stanford Magazine**—published by the Stanford Alumni Association.

**Stanford Memorial Church**—booklet on sale at Stanford Bookstore, Visitor Information Office, and Tresidder Union Store.

**Stanford Overseas Studies 1975**—available at Overseas Centers Office.

**Stanford Para Mi? ¡Seguro Que Si!**—available at the Admissions Office.

**Stanford Residences, 1975-76: A Descriptive Guide to the 1975 Undergraduate Spring Housing Draw**—available for consultation at the Dean of Student Affairs Office.

**Stanford University Bulletins:**
Available at the Registrar's Information
Window:

Information
Summer Session
Available at the School or Department:
Hopkins Marine Station
School of Law
Graduate School of Business
School of Medicine

Student Directory—on sale at the Stanford Bookstore.
Time Schedule—distributed to faculty and students by the Registrar's Office.
Women in Engineering — Inquire at the School of Engineering Office.
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