COURSES AND DEGREES 1973-74

Stanford University Bulletin
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Stanford, California
Published by the University
### University Calendar

#### Autumn Quarter, 1973

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept.</td>
<td>24-25</td>
<td>Monday-Tuesday Registration</td>
</tr>
<tr>
<td>Sept.</td>
<td>26</td>
<td>Wednesday Instruction begins</td>
</tr>
<tr>
<td>Sept.</td>
<td>27</td>
<td>Thursday Conferring of degrees</td>
</tr>
<tr>
<td>Sept.</td>
<td>30</td>
<td>Sunday Matriculation Sunday</td>
</tr>
<tr>
<td>Oct.</td>
<td>16</td>
<td>Tuesday Last day for registration</td>
</tr>
<tr>
<td>Oct.</td>
<td>23</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>22-25</td>
<td>Thursday-Sunday Thanksgiving Recess</td>
</tr>
<tr>
<td>Nov.</td>
<td>30</td>
<td>Friday Last day for filing A.B. and B.S. applications for January conferral</td>
</tr>
<tr>
<td>Dec.</td>
<td>10</td>
<td>Monday Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations</td>
</tr>
<tr>
<td>Dec.</td>
<td>10-14</td>
<td>Monday-Friday End-quarter examinations</td>
</tr>
</tbody>
</table>

#### Winter Quarter, 1974

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan.</td>
<td>7</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>Jan.</td>
<td>8</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>Jan.</td>
<td>10</td>
<td>Thursday Conferring of degrees</td>
</tr>
<tr>
<td>Jan.</td>
<td>15</td>
<td>Tuesday Last day for filing Fellowship and Graduate Scholarship applications</td>
</tr>
<tr>
<td>Jan.</td>
<td>30</td>
<td>Wednesday Last day for filing A.B. and B.S. applications for April and June conferral</td>
</tr>
<tr>
<td>Feb.</td>
<td>4</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>18</td>
<td>Monday Observance of Washington's Birthday (Holiday)</td>
</tr>
<tr>
<td>March</td>
<td>10</td>
<td>Sunday Observance of Founders' Day</td>
</tr>
<tr>
<td>March</td>
<td>18</td>
<td>Monday Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations</td>
</tr>
<tr>
<td>March</td>
<td>18-22</td>
<td>Monday-Friday End-quarter examinations</td>
</tr>
</tbody>
</table>

#### Spring Quarter, 1974

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>1</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>April</td>
<td>2</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>April</td>
<td>4</td>
<td>Thursday Conferring of degrees</td>
</tr>
<tr>
<td>April</td>
<td>19</td>
<td>Friday Last day for filing Undergraduate Scholarship applications, matriculated undergraduates</td>
</tr>
<tr>
<td>April</td>
<td>22</td>
<td>Monday Last day for registration</td>
</tr>
<tr>
<td>April</td>
<td>29</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>20</td>
<td>Monday Last day for filing Ph.D. Dissertations</td>
</tr>
<tr>
<td>May</td>
<td>27</td>
<td>Monday Observance of Memorial Day (Holiday)</td>
</tr>
<tr>
<td>June</td>
<td>6</td>
<td>Thursday Last day for filing A.M., M.S., Engineer theses</td>
</tr>
<tr>
<td>June</td>
<td>7-12</td>
<td>Friday-Wednesday End-quarter examinations</td>
</tr>
<tr>
<td>June</td>
<td>15</td>
<td>Saturday Senior Class Day</td>
</tr>
<tr>
<td>June</td>
<td>16</td>
<td>Sunday Commencement</td>
</tr>
</tbody>
</table>

#### Summer Quarter, 1974

<table>
<thead>
<tr>
<th>Date</th>
<th>Day</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>24</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>June</td>
<td>25</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>July</td>
<td>4</td>
<td>Thursday Independence Day (Holiday)</td>
</tr>
<tr>
<td>Aug.</td>
<td>16-17</td>
<td>Friday-Saturday Eight-week term examinations</td>
</tr>
<tr>
<td>Aug.</td>
<td>17</td>
<td>Saturday Eight-week term closes</td>
</tr>
<tr>
<td>Sept.</td>
<td>3</td>
<td>Tuesday Quarter closes</td>
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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.

Students 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 the College Board Advanced Placement Examination, subject to University approval, or on advanced placement tests administered after the student arrives on campus.

Honors programs are offered in a number of departments or cooperatively among several departments. These permit individualized study for the very capable student.

Specialization under the direction of a particular department, or under a group of departments in the case of interdisciplinary majors, is an essential part of every student's undergraduate experience.

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, the Undergraduate Writing Program, 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 are also exempted from the requirement. 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 a Stanford overseas campus can work toward meeting this distribution requirement in humanities and fine arts and in social sciences. Ordinarily courses meeting the requirement in mathematics, natural sciences, and technology are not offered at the overseas campuses. 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. Extradenartmental courses (e.g. Undergraduate Specials, SWOPSI, SCIRE) may not be applied toward fulfilling Writing or Distribution requirements.

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 selected for 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 Graduation who have applied in advance for graduation and who have fulfilled the following requirements. (See deadlines in *Time Schedule* calendar.)

1. Completed 180 (quarter) units of University work.
2. Completed Writing and Distribution requirements.
3. Completed curriculum requirements of the major department and the recommendation of that department. (Curriculum and other special requirements are listed under each department in *Courses and Degrees*.)
4. 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 and Distribution requirements may petition for a waiver of the requirement that the last 15 units be taken in residence.)
5. Completed three quarters in resident study.

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 Nursing 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.

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 Graduation for admission to candidacy for 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 approved 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.

**CO-TERMINAL 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 quarters after completing 180 units.
COTERMINAL BACHELOR'S AND MASTER'S DEGREES

In University Division, the coterminous 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 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).
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 coterminous 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).

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 been registered at Stanford University for at least three full quarters, or the equivalent, as a graduate student. A longer period of residence will be necessary at Stanford 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.

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. Communications should be addressed to the Graduate Study Office, Room 118, Old Union, Stanford University, Stanford, California 94305.

ADVANCED DEGREES

General University requirements for advanced degrees are stated in terms of time devoted to graduate study, or registration for graduate study, rather than in terms of units of credit. In case any of the work done
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.

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 118, 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 118, 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 typewritten copies of the dissertation, four copies of an approved abstract of the dissertation (600 words or fewer in length), and two signed copies of a publication agreement. The candidate will be charged a $40 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 fourth week of the final three quarters of candidacy. 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 in submitting language report(s) (Form G28) 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 pursuits. 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 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 Academic Council. In cases where 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. In any case, the Form G81 is due in the Graduate Study Office by the end of the next to the last quarter of candidacy. 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 direc-
tion 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 (the original, if carbon copies are submitted) 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 118, 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 $40 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.
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

The Summer Session of 1974 will be eight weeks in length, except in certain schools which will offer ten-week courses.

This announcement includes, for the Summer Session of 1974, only those courses which 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 1974.
GRADUATE SCHOOL of BUSINESS


Dean: Arjay Miller

Associate Deans: Robert K. Jaedicke, Samuel A. Pond, James C. Van Horne

Assistant Deans: Paul R. Johnson, William L. Lowe, Gerard M. Peterson, Robert W. Simon, Gary G. Williams


Lecturers: David L. Bradford, Steven C. Brandt, Mark D. Larkin, Samuel A. Pond, Dennis M. Rohan, Sterling D. Sessions, Edwin V. W. Zschau

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.
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 Adviser*—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 adviser. The adviser will aid the student in the selection of courses and will serve as consultant during his or her scholastic career. The adviser'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.

*Program in Earth Resources*—To augment Stanford's school-wide program in earth resources, a new, interdisciplinary curriculum in Exploration has been introduced. See section "Applied Earth Sciences" 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 Adviser*—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 adviser. The student, in consultation with the adviser, 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**

**Mechanical Processes and Earth Materials**

Stanford offers a program of study in the application of mechanics to problems in mining, structural geology, geomorphology, engineering geology, and geophysics. Faculty members from all departments in the School collaborate in offering opportunities for advanced course work and research in the physical behavior of rocks and other earth materials. Stanford earth scientists
are able freely to draw upon the knowledge of faculty in Stanford's Applied Mechanics and Materials Science departments, which are among the outstanding ones in the country. A combination of field, theoretical, and experimental work is emphasized in this program.

**PROGRAM IN ENVIRONMENTAL EARTH SCIENCES**

Environmental Earth Sciences are concerned with the effects of man's activities on earth processes and, conversely, with the influence of earth processes on the works of man. The flexible interdisciplinary programs described below are intended (a) to involve natural scientists and engineers in the planning and management of the environment, (b) to provide socio-humanistic environmental planners and managers with a natural-science and engineering background, and (c) to combine a knowledge of environmental characteristics and functioning with capabilities for modeling and predicting management effects.

The San Francisco Bay region, an area of rapid population growth, is a challenging field laboratory. Here, human activity has spread into areas that are replete with geologic hazards such as active faults, subsiding ground, and unstable slopes. With increasing population, problems of water distribution, waste disposal, marine pollution, and water and air pollution have been intensified.

**BACHELOR OF SCIENCE (an option in the Department of Applied Earth Sciences)**

The following requirements for the degree of Bachelor of Science are in addition to the University requirements.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol. Sci. 1</td>
<td>Introductory Biology</td>
<td>5</td>
</tr>
<tr>
<td>Biol. Sci. 21</td>
<td>Principles of Biology</td>
<td>4</td>
</tr>
<tr>
<td>Chem. 4, 5 or 31, 33</td>
<td>General Chemistry</td>
<td>8</td>
</tr>
<tr>
<td>Civ. Engr. 170</td>
<td>Man and His Environment</td>
<td>3</td>
</tr>
<tr>
<td>Comp. Sci. 105</td>
<td>Introduction to Computing</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 1</td>
<td>Interpreting the Earth</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 2</td>
<td>Earth History</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 101</td>
<td>Framework of Geology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 102</td>
<td>Introduction to Field Geology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 130, 131, 132</td>
<td>Environmental Earth Sciences</td>
<td>15</td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23</td>
<td>or 41, 42, 43</td>
<td>Analytical Geometry and Calculus</td>
</tr>
<tr>
<td>Physics 21, 23</td>
<td>(or part of 51, 53, 54, 55, 56)</td>
<td>Elementary Physics</td>
</tr>
</tbody>
</table>

The following is a sampling of courses that will interest students having suitable prerequisites:

- Biol. Sci. 22, 23. Principles of Biology
- Civ. Engr. 270. Water Quality in Water Resources Development
- Elec. Engr. 292A. Environmental Systems Analysis
- Engr. 161. Engineering Economy
- Food Res. Inst. 135. Population Problems
- Geol. 110. Structural Geology
- Geol. 133. Non-renewable Earth Resources and Man
- Geol. 150. The Oceans
- Geol. 151. Sedimentary Geology
- Geol. 190. Introduction to Probability and Statistics in Geology
- Geophysics 191. Geophysical Field Technique
- Indus. Engr. 50. Human Values in a Technological Society
- Law 252. Conservation Issues
- Law 373. Water Law
- Math. 113. Linear Algebra and Matrix Theory
- Pet. Engr. 103. Survey of the Petroleum Industry
- Mech. Engr. 137. Air Pollution
- Physical Sci. 10. Introduction to Meteorology
- Pol. Sci. 100. Introduction to Public Administration

**MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY**

See Department of Applied Earth Sciences.

**PROGRAM IN ECONOMIC GEOLOGY**

Economic geology is a broad field that draws from many subject areas. It is represented at Stanford by an interdisciplinary, interdepartmental program designed to serve graduate students oriented toward economic applications of geology in academic, industrial, or governmental work. For instruction and advising, it draws mainly upon faculty members of the School of Earth Sciences, and most students participating in the program will enroll in the School's Department of Applied Earth Sciences. The program provides opportunities to work toward the Master of Science and the Doctor of Philosophy degrees.

From the relevant courses offered at Stanford, the student can arrange a sequence to suit his or her particular interests and objectives, as well as to satisfy fundamental requirements of the program. Students may choose one of several subdisciplines within Economic Geology or they may develop, with the advice of their faculty advisers, a special program of unique nature. The overall aim is to aid the student in obtaining depth in a chosen field, as well as to provide basic coverage. Students will be able to undertake course sequences aimed at preparing them for careers in industry, research, or teaching. See Section on Applied Earth Sciences.
Program in Mathematical Geology

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

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 geology 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 geology.

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

- Appl. Earth Sci. 305. Applied Geomathematics II
- Geol. 190. Introduction to Probability and Statistics in Geology
- Geol. 214. Physical Processes in Geology
- Geol. 204A,B. Computer Applications in Earth Sciences
- Geol. 290. Applications of Probability and Statistics in Geology
- Geol. 232. Numerical Methods in Hydrogeology
- Geophysics 283. Geophysical Simulation

APPLIED EARTH SCIENCES

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

Chairman: Fredrick C. Kruger


Associate Professors: Robert W. Bartlett, Arvid M. Johnson, Ernest I. Rich, Kenneth L. Williams


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

- Economic Geology
- Exploration
- Mining
- Mineral Processing
- Metallurgy
- Mineral Economics
- Engineering Geology
- Hydrology
- Environmental Studies

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. 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.

Some specialization in the several branches of this option is possible by judicious choice of alternate courses and electives.

Courses Taken by All Undergraduates

<table>
<thead>
<tr>
<th>University Requirements</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Composition</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>Natural Science (satisfied by Departmental requirements below)</td>
<td></td>
</tr>
</tbody>
</table>
Departmental Requirements

Fundamental
Chem. 4, 5. General Chemistry 8
Physics 51-56. Engineering Physics 14
Math. 41-43, or 10, 11, 21, 22 and 23. 15
Orientation
Geol. 1. Geoscience I or Geol. 101. Framework of Geology 5
Geol. 161. Mineralogy and Crystal Chemistry or A.E.S. 284. Engineering Geology 4
Any 10 units of the following:
A.E.S. 101. Elements of Mining Engineering 3-5
Geol. 214. Physical Processes in Geology 5
Subtotal 74

ECONOMIC GEOLOGY OPTION

Course No. Subject Units
Geol. 290. Introduction to Probability and Statistics in Geology 3
Geol. 181. Petrology 4
Geol. 171. Introduction to Geochemistry 3
Mat. Sci. and Engr. 181. Thermodynamics and Phase Equilibria 4
Geol. 183. Optical Mineralogy 5
Geol. 273. Ore Genesis 3
Geophys. 190. General Geophysics 3
A.E.S. 172. Geological Thermodynamics 3
A.E.S. 281. Introduction to Ore Deposits 2
A.E.S. 282. Ore Deposits 4
A.E.S. 283. Laboratory Study of Opaque Minerals 4
A.E.S. 286. Airborne Exploration 3
A.E.S. 304. Computer Applications in Geology and A.E.S. 4
Subtotal 40
Electives 60
Total 173

MINING ENGINEERING OPTION

Course No. Subject Units
Civil Engr. 180. Elementary Structural Analysis 4
Civil Engr. 245. Advanced Construction Equipment and Methods 3
Geol. 110. Structural Geology 5
Geol. 191. Petrology 4
Engr. 161. Engineering Economy 3
Indus. Engr. 133. Industrial Accounting 4
A.E.S. 118. Mining Methods 2
A.E.S. 150. Introduction to Mineral Extraction Processes 3
A.E.S. 200. Introduction to Rock Mechanics 3
A.E.S. 219. Mine Exploration 5
A.E.S. 281. Introduction to Ore Deposits 4
A.E.S. 282. Ore Deposits 3
Subtotal 40
Electives 60
Total 174

Metallurgy Option

Course No. Subject Units
Chem. 171. Physical Chemistry 3
Engr. 50. Introductory Science of Materials 3
Math. 44. Advanced Calculus 3
Math. 130. Ordinary Differential Equations 3
A.E.S. 203A. Mineral Processing 3
A.E.S. 207. Metal Refining and Liquid Metals 3
A.E.S. 225. Surfaces and Interfaces, or A.E.S. 227. Applied Aqueous Thermodynamics 3
A.E.S. 173. Applied Chemical Kinetics and Diffusion 3
A.E.S. 234. Metallurgical Reaction Engineering 3
V.T.S. 144. Earth Resources and Man 3
Subtotal 40
Electives 60
Total 174

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 option, e.g., an M.S. earned in the process metallurgy option leads to a diploma labeled M.S. in A.E.S.—Process Metallurgy. Typical program 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 several courses in the Graduate School of Business 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).

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

Ore Deposits Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 281</td>
<td>Introduction to Ore Deposits</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 282</td>
<td>Ore Deposits</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 283</td>
<td>Reflected Light Microscopy</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 383</td>
<td>Studies of Metallic Ores</td>
<td>6</td>
</tr>
<tr>
<td>Geol. 273</td>
<td>Geochemistry of Ore-Forming Solutions</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Exploration Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 219</td>
<td>Mine Exploration</td>
<td>3–5</td>
</tr>
<tr>
<td>A.E.S. 295</td>
<td>Structural Setting of Major Mining Districts</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 296</td>
<td>Airborne Exploration—Radar</td>
<td>3–4</td>
</tr>
<tr>
<td>A.E.S. 297</td>
<td>Airborne Exploration—Infrared</td>
<td>3–4</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>14–18</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
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</tbody>
</table>

Petroleum Exploration Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 300</td>
<td>Advanced Work</td>
<td>6</td>
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<tr>
<td>Electives from following list</td>
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<td>24</td>
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<td>Total</td>
<td></td>
<td>30</td>
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</tbody>
</table>

Mineral Economics Option

<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>3–5</td>
</tr>
<tr>
<td>A.E.S. 296</td>
<td>Airborne Exploration—Radar</td>
<td>3–4</td>
</tr>
<tr>
<td>A.E.S. 297</td>
<td>Airborne Exploration—Infrared</td>
<td>3–4</td>
</tr>
<tr>
<td>A.E.S. 304</td>
<td>Computer Applications in Geology and A.E.S.</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 388</td>
<td>Offshore Exploration Seminar</td>
<td>2</td>
</tr>
<tr>
<td>A.E.S. 390</td>
<td>Geology of Energy Sources</td>
<td>3–4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
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</tbody>
</table>

Petroleum Exploration Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>A.E.S. 300</td>
<td>Advanced Work</td>
<td>6</td>
</tr>
<tr>
<td>Electives from following list</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

GROUP B

Geol. 190 | Introduction to Probability and Statistics in Geology | 3 |
Geophys. 190 | General Geophysics | 3 |
Geophys. 191 | Geophysical Field Techniques | 4 |
Pet. Engr. 150A,B,C | Formation Evaluation | |
A.E.S. 215 | Mineral Economics | 3–5 |
A.E.S. 296 | Airborne Exploration—Radar | 3–4 |
A.E.S. 297 | Airborne Exploration—Infrared | 3–4 |
A.E.S. 304 | Computer Applications in Geology and A.E.S. | 4 |
A.E.S. 388 | Offshore Exploration Seminar | 2 |
A.E.S. 390 | Geology of Energy Sources | 3–4 |
| Total | | 30 |

Total | | 30 |

Mining Engineering Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 308</td>
<td>Rock Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 215</td>
<td>Mineral Economics</td>
<td>3–5</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>
<tr>
<td>Electives</td>
<td></td>
<td>8–10</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
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</tbody>
</table>

Applied Geomathematics in Exploration Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geol. 190</td>
<td>Introduction to Probability and Statistics in Geology</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 288</td>
<td>Geochemical Prospecting</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 290</td>
<td>Legal Aspects of Geology</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 291A,B,C</td>
<td>Mineral Resource Exploration</td>
<td>6</td>
</tr>
<tr>
<td>A.E.S. 304</td>
<td>Computer Applications in Geology and Applied Earth Sciences</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 306</td>
<td>Quantitative Exploration Decision Making</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Total | | 30 |

Mineral Economics Option

<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>3–5</td>
</tr>
<tr>
<td>A.E.S. 230</td>
<td>Case Histories</td>
<td>3</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>Electives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>30</td>
</tr>
</tbody>
</table>

Total | | 30 |
SCHOOL OF EARTH SCIENCES

A.E.S. 287. Minerals, Politics, and Economics 3
A.E.S. 387. Resource Management 2
Electives from following list 8–10

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

A.E.S. 101. Elements of Mining 3–5
A.E.S. 150. Introduction to Mineral Extraction Processes
Pol. Sci. 207. Seminar in Government and Natural Resources
Indus. Engr. 229. Engineering Economy
Engr.-Econ. Sys. 231A. Decision Analysis

Mineral Processing and Extractive Metallurgy Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 203A.</td>
<td>Mineral Processing</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 207.</td>
<td>Metal Refining Processes</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 228.</td>
<td>Extractive Metallurgy Seminar</td>
<td>2</td>
</tr>
<tr>
<td>A.E.S. 232.</td>
<td>Project Analysis</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 236.</td>
<td>Metallurgical Systems Engineering Seminar</td>
<td>1–3</td>
</tr>
</tbody>
</table>


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

Environmental Earth Sciences Option

Students in the Environmental Earth Sciences Program are expected to have completed courses approximately equivalent to those of the core curriculum leading to the B.S. in Geology at Stanford.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geol. 130, 131, 132.</td>
<td>Environmental Earth Sciences</td>
</tr>
<tr>
<td>Electives (see* below)</td>
<td></td>
</tr>
</tbody>
</table>

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

* Individual environmental programs may be developed to meet the needs and career objectives of students. Special programs can accommodate careers in environmental geoscience related to biology, geography, geology, engineering, extractive industries, hydrology, law, medicine, and regional and urban planning. A large number of pertinent courses is available in the School of Earth Sciences and other Schools of the University.

Engineering Geology Option

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, Geophys. 190 and Geol. 214 or Engr. 11.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 284.</td>
<td>Engineering Geology</td>
</tr>
<tr>
<td>A.E.S. 285.</td>
<td>Engineering Geologic Mapping</td>
</tr>
<tr>
<td>Geol. 221.</td>
<td>Photogeology</td>
</tr>
<tr>
<td>Geol. 230.</td>
<td>Hydrogeology</td>
</tr>
<tr>
<td>C.E. 190.</td>
<td>Geotechnical Engineering</td>
</tr>
<tr>
<td>C.E. 290.</td>
<td>Soil Mechanics</td>
</tr>
<tr>
<td>Electives</td>
<td>8</td>
</tr>
</tbody>
</table>

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

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

A.E.S. 276. Field Trip 3
A.E.S. 308. Rock Mechanics 3
C.E. 291. Earth Structures 3
C.E. 293. Experimental Soil Mechanics 2
C.E. 207. Open Channel Hydraulics and Sedimentation Problems 4
C.E. 203. Environmental Fluid Mechanics II 4
C.E. 282B. Earthquake Engineering II 3

Special Applied Earth Sciences Option

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. 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. Business Economics 6
Bus. 210–11. Management Accounting or Bus. 410 or Indus. Engr. 133.
Industrial Accounting 6
Bus. 270. Organizational Behavior or Indus. Engr. 100. Industrial Organizations 4–5
Indus. Engr. 229. Engineering Economy 3
Engr.-Econ. Sys. 231A. 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
Courses Required for the Engineer's Degree*

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Graduate School of Business Courses</td>
<td>3</td>
</tr>
<tr>
<td>136</td>
<td>Use of Automatic Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>Indus. Engr. 229.</td>
<td>Engineering Economy</td>
<td>2</td>
</tr>
<tr>
<td>Indus. Engr. 230.</td>
<td>Advanced Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Indus. Engr. 252.</td>
<td>Operations Research</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 300.</td>
<td>Advanced Work (Thesis)</td>
<td>10</td>
</tr>
<tr>
<td>Stat. 110.</td>
<td>Statistical Methods in Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

* In addition to requirements for the Master's degree.

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
metallurgical plant work. Required for graduation in the Department.

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 inter-relationship of geological conditions and mining problems. Optional supplementary paper on problems in mining. Prerequisite: consent of instructor.

3 to 5 units, Aut (Kruger) MWF 8

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 (Parlee) by arrangement

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) by arrangement

107. Introduction to Probability and Statistics in Geology—(Enroll in Geology 190.)

3 units, Win (Switzer) TWTh 3:15

118. Mining Methods—Seminar using case histories to illustrate methods, equipment, and costs. Prerequisite: 101.

2 units, Win (Kruger) TTh 8, alternate years, given 1973–74

144. Non-Renewable Earth Resources and Man—(Enroll in V.T.S. 144.) 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 resources. Recycle technology and ultimate recycle limits. International mineral trade. Perspectives of developed resource consuming countries and under-developed resource supplying countries. The economics of conservation. Non-renewable resource policy and population policy of the United States: actual and optimum.

3 units, Spr (Bartlett) 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 stressed.

3 units, Aut (Bartlett) MWF 3:15

171. Introduction to Geochemistry—(Enroll in Geology 171.)

3 units, Aut (Krauskopf, Parks) MWF 9

172. Geological Thermodynamics—(Enroll in Geology 172.)

3 units, Win (Dickson) MWF 9

173. Applied Chemical Kinetics and Diffusion—Introduction to applied chemical kinetics with emphasis on solid/fluid and solid/solid chemical reactions in metal/mineral systems. Phenomenological diffusion with emphasis on mass transport problems associated with metal/mineral reactions. Atomic diffusion mechanisms in solids.

3 units, Spr (Bartlett) MWF 9

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

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

190. General Geophysics—(Enroll in Geophysics 190.)

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

191. Geophysical Field Techniques—(Enroll in Geophysics 191.)

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

GRADUATE COURSES

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

3 units lec; 2 units lab. Spr (Tiller) TTh 2:15–4:30

203A. 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 in-
clude sizing, solid-liquid separations, and gravity, magnetic, electrical, and flotation methods of solid-solid separation. Prerequisite: 150 or equivalent.

3 units, Aut (Parks) MWF 10, alternate years, given 1974–75

203B. Topics in Mineral Processing and Hydrometallurgy—Independent study of any topic in Mineral Processing or Hydrometallurgy, including all topics listed under 203A, and their use in integrated processes from theoretical, design, or operational points of view. May be repeated for credit. Open to undergraduates by consent. Prerequisite: 203A or equivalent.

1 to 4 units, Aut, Win, Spr (Parks) by arrangement

205. Applications of Probability and Statistics in Geology—(Enroll in Geology 290.)

3 units, Spr (Switzer) TWTh 3:15


3 units, Aut (Bartlett) MWF 9, alternate years, given 1973–74

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

215. Mineral Economics—Lectures, discussions on mineral importance, property acquisition, valuation financing, marketing, prices, geography, accounting, taxation, conservation, stabilization, government activities, international affairs, future supplies, environmental problems, foreign investment, energy problems, and labor relations pertaining to minerals, including petroleum, natural gas, and coal; surveys of individual minerals as commodities. Extra credit for individual studies.

3 to 5 units, Spr (Just) by arrangement

219. Mine Exploration—Lectures, discussion. A survey of how mines are found, including prospector, geological, geochemical and geophysical methods, organization and economic aspects. Extra credit for individual studies. Prerequisites: 281, 282 and Geology 110.

3 to 5 units, Win (Just, Guest Lecturers) by arrangement

220. Drilling and Blasting—Lectures and discussions on theory and practice of blast-hole drilling and blasting, surface and underground.

2 units, Spr (Just) by arrangement

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

3 units, Spr (Stevenson) 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, alternate years, given 1974–75

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

3 units, Win (Stevenson) MWF 10, alternate years, given 1974–75

227. Applied Aqueous Thermodynamics — (Enroll in Geology 271.) 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. Hydrometallurgical chemistry may be emphasized by concurrent enrollment in 203B.

3 units, Aut (Parks) MWF 10, alternate years, given 1973–74
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.

3 units, Spr (Parlee) by arrangement, alternate years, given 1974–75

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. A paper on selected topics is prepared by each student for distribution to the class.

3 units, Aut (Kruger, Guest Lecturers) T evening

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

4 units, Win (Kruger) TTh 8–10

232. Mineral Project Financial Analysis and Optimization — Introductory 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, Spr (Bartlett) MWF 1:15

234. 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.

3 units, Aut (Bartlett) MWF 9, alternate years, given 1974–75

236. Metallurgical Systems Engineering Seminar — Metallurgy as a profitable business. The case method is used to study the design of metallurgical process and plants. Prerequisites or concurrent: 232, 234.

1 to 3 units, Spr (Bartlett) by arrangement

267. Engineering Valuation and Appraisal of Oil and Gas Properties — (Enroll in Petroleum Engineering 267.)

3 units, Win (Miller) S 9–12, alternate years, given 1973–74

272. Geochemistry — (Enroll in Geology 272.)

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

276. Field Trip—A ten-day field trip to various mining and metallurgical operations, including Ruth and McGill in Nevada; Bingham, Carfield, 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. Transportation is provided but living expenses are the student’s responsibility. May be repeated for credit.

3 units, Spr vacation (Staff) by arrangement

281. Introduction to Ore Deposits—The nature, classification, mineral associations and origin of ore deposits. Historical development of ore genesis theory. Magmatic, metamorphic, sedimentary and surficial processes and their role in the formation of ore deposits. Laboratory study of ore minerals, including crystal chemistry and hand-specimen mineralogy. Prerequisites: Introductory Mineralogy (e.g. Geol. 161) and Petrology (e.g. Geol. 181).

4 units, Aut (Williams, Park), TTh 9, labs. by arrangement

282. Ore Deposits—Study of case histories of the principal types of ore deposits, with emphasis on economics, mineral associations, ore genesis, and controls of mineralization. Descriptive geometry techniques applied to ore deposits, and hand specimen studies of ore collections. Course is designed to develop exploration thinking. Prerequisite: 281 or consent of instructor.

5 units, Win (Park, Williams) TTh 10; one lec., two labs. by arrangement
283. Reflected Light Microscopy — (Enroll in Geology 164.)

4 units, Spr (Williams) by arrangement

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 (Jahns, Remson, Johnson)
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. The field area may be the subject of the student’s M.S. thesis. 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, Aut, Spr (Johnson) by arrangement

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

3 units, Win (Park), given 1974–75

288. Geochemical Prospecting — Use of trace element analysis of soils and stream sediment in exploration for ore deposits, including design of sampling systems, field sampling techniques, methods of chemical analysis, and mathematical treatment of data.

4 units, Spr (Staff) TTh 11; field trips and lab. by arrangement

290. Legal Aspects of Geology—Introduction to mining law, and oil and gas law, with discussion of related business enterprises and taxes. Introduction to water rights. Discussion of rights and liabilities resulting from landslides and other geologic hazards. Introduction to environmental law. Discussion of the geologist as a businessman, as an expert witness, and as a defendant. Introduction to legal research. Legal principles will be developed in part from study of case materials and actual court decisions. Presentation will consist of class dialogue as well as formal lectures.

3 units, Aut (Hughes) by arrangement

291A,B,C. Mineral Resource Exploration—A sequence course extending throughout the academic year in which class members will actually engage in exploration for mineral resources. The legal, economic, financial, statistical, and geological aspects will be treated as an integrated whole, with attention to definition of objectives, selection of regions for reconnaissance, and application of a variety of exploration techniques. Aspects of the course will be closely tied to material presented in A.E.S. 288, 290, and 306.

2 to 6 units each quarter, Aut, Win, Spr (Staff) by arrangement

295. Structural Setting of Major Mining 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, Win (Lyon) seminar TTh 1:15–3:05, alternate years, given 1974–75

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, Spr (Lyon) lec. TTh 1:15; lab. TTh 2:15–4:05

297. Airborne Exploration: Thermal Infrared and Other Geophysical Techniques — Thermal behavior of moisture distribution and surface materials to the underlying geology. Detection of faults, folds, anomalous
heat flows, thermal pollution, ocean current patterns, seasonal effects of vegetation and cultural patterns (roads, irrigation), using infrared and microwave measurements. Airborne geomagnetics, gamma-ray, and other geophysical measurements in exploration. 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 221 or consent of instructor.

3 to 4 units, Win (Lyon) TTh 1:15; lab. TTh 2:15–4:05, alternate years, given 1973–74

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

304. Computer Applications in Geology and Applied Earth Sciences—Use of digital computers and associated mathematical techniques in selected applications to structural geology, petrology, sedimentology, paleontology, ore deposits, and petroleum geology. Methods 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. 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 take either Computer Science 105 or 106 plus a FORTRAN short course.

4 units, Win (Harbaugh) MWF 11

305. Research Topics in Computing and Mathematical Applications—Course provides a forum for persons who wish to develop and apply computational and mathematical methods to their thesis research or other research projects. Credit given can be adjusted to the magnitude of the project.

2 to 8 units, Spr (Harbaugh) MW 10

306. Quantitative Exploration Decision Making—Seminar and review of the literature in the use of mathematics and digital computers in making economic decisions in exploration for petroleum and metals. Methods of map analysis, statistical petroleum and metals occurrence models, search strategy models, and formalized economic decision methods will be considered. A term paper is required.

3 units, Spr (Harbaugh) TTh 10

308. Rock Mechanics — Application of theory and laboratory studies to the determination of underground stress fields, the design of underground structures, and the design of large open excavations.

3 units, Spr (Staff or Visiting Professor) by arrangement, alternate years, given 1973–74

372. Organic Geochemistry and the Geochemical Environment of Life—(Enroll in Geology 278.)

2 units, Spr (Kvenvolden) 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 spectrography, optical spectrography, and electron microprobe analysis. Prerequisite: 282 or consent of instructor.

6 units, Spr (Staff) seminar and labs. 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, Aut (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 1973–74

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.

4 units, Win (Crandall, Visiting Lecturers) TTh 11; W 1


2 units, Win (Kruger) by arrangement, alternate years, given 1974–75

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 1973–74

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 135 are in the form of formal requirements, permitting the student to take elective courses totaling at least 45 units, or one-fourth 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 54 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</th>
<th>Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Interpreting the Earth</td>
<td>Aut, Win, Spr</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2. Earth History</td>
<td>Spr</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>101. Framework of Geology</td>
<td>Spr</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>102. Introduction to Field Geology</td>
<td>Sum</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>103A,B. Advanced Field Geology</td>
<td>Sum</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>110. Structural Geology</td>
<td>Spr</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>151. Sedimentary Geology</td>
<td>Win</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>152. Stratigraphic Geology and Paleoecology</td>
<td>Spr</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>161. Mineralogy and Crystal Chemistry</td>
<td>Aut</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>181. Earth Materials</td>
<td>Aut</td>
<td>5</td>
<td></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:

143. Principles of Paleontology | Win | 5 |
| 163. Optical Mineralogy | Aut | 4 |
| 171. Introduction to Geochemistry | Aut | 3 |
| 214. Physical Processes of Geology | Aut | 5 |

Geophys. 190. General Geophysics | Aut | 3 |

Total core course units | Max. | 54 |
in geology | Min. | 52 |
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 181. 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 (Analytical Geometry and Calculus) 15
2. For students entering Stanford with only high school algebra and trigonometry but desiring to take courses at a more rapid pace: Mathematics 41, 42, and 43 (Analytical Geometry and Calculus) 15
3. For students entering Stanford with credit in analytical geometry: Mathematics 41A, 42A, and 43A (Calculus) 12

**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) 12
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) 8

**Chemistry**

1. For the majority of students majoring in geology and with mathematical preparation equivalent to (or concurrent registration in) Mathematics 10 or 41: Chemistry 4 and 5 (General Chemistry for students in engineering and science) 8
2. In some instances the following sequence may be substituted for Chemistry 4 and 5 with consent of the adviser: Chemistry 31 and 33 (General Chemistry for students in chemistry, biology, and medicine). 8

Maximum possible required units in mathematics, physics, and chemistry 35
Minimum possible required units in mathematics, physics, and chemistry 28

**Electives**

A student entering Stanford with credit in high school algebra, trigonometry, and natural science normally will have a minimum of 45 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. Alternately, 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 to be taken, and the courses 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 and the number of courses offered within a given subdiscipline of Geology commonly exceed 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 eighth quarter of undergraduate work and before the end of the eleventh 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 areas of geologic research and study: General Geology, Structural Geology, Geomorphology, Environmental Geology, Hydrogeology, Sedimentary Geology, Paleontology and Palaeoecology, Mineralogy, Geochemistry, Petrology, and Mathematical Geology. Programs in Engineering Geology, Economic Geology, Mineral Exploration, Metallurgy, Geophysics, and Petroleum Engineering are administered in other departments of the School of Earth Sciences. Course work contained in the various programs involves offerings from these and other departments at Stanford.

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. should take no longer than four 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.

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 a Counseling Examination taken prior to initial registration. 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 Graduate Curriculum Groups and described in pamphlets available in the Geology Office, or they are to include those designated by an ad hoc Curriculum Group, comprising three or more faculty members selected by the student in consultation with his or her research adviser. Each ad hoc Curriculum Group and course sequence must be approved by the Graduate Committee of the Department.
Students who wish to use the Masters program to continue training in general geology may do so by completing the M.S. sequence in general geology.

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 about 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 Graduate Curriculum 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 or as a journal article. The group will notify the Department Graduate Committee of their decision. A copy of the manuscript is to be placed in the student's file.

6. The manuscript may either be accepted as an M.S. thesis by the Graduate Division of the University or accepted for publication in an appropriate journal.

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, 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, mineralogy, petrology, geomorphology, photogeology, economic geology, ground water, geochemistry, rock mechanics, and geophysics.

Requirements for the Degree — A minimum of three years (nine quarters) of 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 the week prior to initial registration the student must take the counseling examination which serves to define areas of strength and weakness at the undergraduate level, and to aid the academic adviser in planning the student's program.

The student is recommended by the Department of Geology for admission to candidacy to the Ph.D. program by the University Committee on Graduate Studies after completion of the oral candidacy examination and research advisory conference. The candidacy examination and research advisory conference is administered by a faculty Research Advisory Committee consisting of the Research Adviser and at least two other faculty members in the Department of Geology. The Research Advisory Committee is selected by the student in consultation with the academic adviser. Demonstration of foreign language proficiency may or may not be required of the candidate at the discretion of the Research Advisory Committee. The candidate's record must demonstrate outstanding scholarship and deficiencies in previous training noted during the candidacy examination must be removed. The M.S. degree is not a prerequisite for admission to the Ph.D. program, though development of knowledge and skills at the M.S. level is expected at the candidacy examination.

The candidate is to prepare, under the supervision of the Research Advisory Committee, a 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 consist of 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. 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**

**General Geology**

*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. (Students who have studied geology in Physical Science 3 will receive only 3 units credit for Geology 1.)

5 units, Aut (Krauskopf) MWF 8; lab. and field trips by arrangement
Win (Page) MWF 9; lab. and field trips by arrangement
Spr (Staff) 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 (Silberling) MWF 9; 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

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 relationships 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.

3 units, Spr (Jahns and Rich) 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. 7-21

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 (Silberling) June 18–July 26

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

4 units (Silberling) July 29–Aug. 12

104. Non-Renewable Earth Resources and Man—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 resources. Recycle technology and ultimate recycle limits. International mineral trade. Perspectives of developed resource consuming countries and under-developed resource supplying countries. The economics of conservation. Non-renewable resource policy and population policy of the United States: actual and optimum. No prerequisites.

3 units, Spr (Bartlett) MWF 11, given 1974

110. Structural Geology — Introduction to types, occurrences, and origins of structures in sedimentary, metamorphic, and plutonic rocks. Examples from various parts of the world. Applications of graphic solutions and mechanics to the analysis of folds and faults. Prerequisites: 1 and calculus: Recommended: 101, 102, 181.

5 units, Spr (Page, Johnson) MWF 9; lab. and field trips by arrangement

130. Environmental Earth Science 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.

5 units, Aut (Dickinson, 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 (Dickinson, 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: 131 or consent of instructor.

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

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, Aut (Evitt) MWF 11; alternate years, given 1974-75

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) MTTh 11; alternate years, given 1973-74

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 10; lab. W 1:15–4:05, alternate years, given 1973-74

150. The Oceans: An Introduction to the Marine Environment—Seventy-one percent of the earth's surface is covered by the ocean and it has played a predominant role in the history of the earth and its unique position in the solar system. 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 the effect of man's activities on the marine environment including the classic example of human impact on the San Francisco Bay estuarine system. Lectures, occasional laboratory demonstrations, one afternoon coastal 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, Win (Ingle) MWF 10; laboratory demonstrations, research conferences, and field trips by arrangement; alternate years, given 1973-74

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; lab.
MW 1:15–4:05 includes field exercises

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, population, and 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. Laboratories will be concerned with determinative mineralogy including hand specimen, optical and x-ray methods. Several field trips are planned. Prerequisites: 1, 101, 102, 181 and Chemistry 31 or 4 (may be taken concurrently).

4 units, Aut (Brown) TTh 9; lab.

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 minerals. Prerequisites: 161, Physics 55 or equivalent.

4 units, Aut (Liou) TTh 11; lab.

164. Reflected Light Microscopy — Use of reflected light microscopy in the study of opaque minerals, with emphasis on ore specimens. Physical, chemical and optical techniques, both qualitative and quantitative. Introduction to microstructural interpretation. Preparation of polished thin sections. Prerequisite: 163.

4 units, Spr (Williams) two lecs. and two labs. by arrangement

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, 181, Chemistry 5 or 33. 181 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 (Dickson, Luth) MWF 9

181. Earth Materials — An introduction to the study of rocks and minerals, the materials making up the solid Earth. Emphasis on the occurrences, physical chemistries and geneses of most abundant silicates, igneous and metamorphic rocks. Lectures will be concerned with the principles of how and why matter is organized into particular rocks and minerals, and under what conditions physical and chemical changes take place leading to different rocks and minerals. Laboratory study on rock-forming minerals, textures, structures, classification and systematic examination of most common igneous and metamorphic rocks. Two one-day field trips to local areas that display rocks of special interest. Prerequisites: 101, 102 or consent of instructor.

5 units, Aut (Luth 1973-74, Liou 1974-75) MWF 9; lab. MW 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) MW 10; TTh 1:15-4:05

190. 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. Prerequisite: concurrent registration in Mathematics 22 or 42.

3 units, Win (Switzer) given 1974-75
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 undergraduate students desiring an extension of field geology beyond 103B, and for graduate students 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 (Dickson) 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) MTWThF 10; research project, labs., and field trips by arrangement


3 units, Aut (Oxburgh) MWF 10; 1973–74 only

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 1973-74

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, Win (Rich) MWF 9; lab. W 1:15–4:05; field trips by arrangement, alternate years, given 1974–75

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 1973–74.
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)

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.

5 units, Aut (Ingle) MWF11; two lab. discussion periods by arrangement, alternate years, given 1973-74

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.

5 units, Win (Evitt) 3 lecs., 2 labs. by arrangement, alternate years, given 1974-75

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.

Spr (Evitt) units and hours by arrangement, alternate years, given 1974-75

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. Paleoceanographic and paloclimate 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.

4 units, Aut (Silberling) TTh 9; lab. TTh 1:15-4:05; field trip by arrangement

254. Carbonate Sedimentology — Petrography, classification, and field relations of carbonate rocks with emphasis on interpreting those formed in shelf environments. Lectures, reading, and petrographic laboratory study will treat the significance of skeletal and inorganic carbonate grains; interpretation of textures, fabrics, and megascopic structures; diagenetic and epigenetic alteration processes; dolomitization; associated evaporate and siliceous rocks; organic influence on facies patterns; distribution through time; and recent carbonate environments as analogs for interpreting ancient examples. Prerequisite: 163.

4 units, Aut (Silberling) TTh 9; lab. TTh 1:15-4:05; field trip by arrangement

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 de-
velopment through time in tectonic context.
A term paper is required.

4 units, Aut (Dickinson) MWF 9;
seminar and field trip by arrangement

257. Geochronology — General review of
paleontologic, radiometric, and paleomag-
netic methods of dating and correlation with
emphasis on stratigraphic applications. Con-
sideration of basic assumptions, utility, and
resolution of techniques based on different
groups of fossil organisms and on physical
and chemical approaches as applied to differ-
ent parts of the geologic record. Prerequi-
sites: 152 and 181.

4 units, Win (Silberling) MWF 9

261. Advanced Mineralogy—Crystal chem-
ical principles and current theories of chemi-
cal bonding as applied to minerals. Spectro-
scopic 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 struc-
tures. Introduction to the mineralogical lit-
erature. Prerequisite: consent of instructor.

3 units, Win (Brown) MWF 11

262. Structural Mineralogy — Matrix-alge-
braic development of the crystallographic
groups. Theory of x-ray diffraction from
crystals and amorphous solids; powder and
single-crystal diffraction techniques; ele-
ments of crystal structure analysis and re-
finement. Statistics in crystallography. High-
temperature x-ray techniques. Neutron dif-
fraction and inelastic scattering. Geologic
applications. Laboratories will consist of
single-crystal and powder x-ray investiga-
tions of metamorphic and igneous minerals.
Prerequisite: consent of instructor.

4 units, Spr (Brown) TTh 10;
labs. TTh 1:15-4:05

271. Low Temperature Aqueous Geochem-
istry—A systematic study of ideas and prin-
ciples needed for solving quantitative prob-
lems in aqueous geochemistry at tempera-
tures near 25°C and atmospheric pressure.
The use of thermodynamics in predicting the
feasibility and extent of chemical processes
such as dissolution and precipitation, hy-
drolysis and complexation, oxidation and re-
duction. Emphasis on resolution of general
questions into tractable problems and on
problem solving and graphical representa-
tion of results. Course is based on lectures,
problem sets, and discussion of problem
solutions. Prerequisites: 171, 172 or C.E. 273
or equivalent experience with chemical
thermodynamics.

3 units, Spr (Kvenvolden) MWF 9

272. Advanced General Geochemistry—Ap-
plication 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. T or W 1:15-4:05

273. Geochemistry of Ore Formation—The
modes of origin of ore and gangue mineral
associations. Lectures on: characteristic as-
ociations of minerals; chemical factors of
ore component transport and mineral depo-
sition; genetic implications of equilibrium
studies of chemical systems pertinent to ore
genesis; and isotopic, trace element, and
other geochemical properties of ore and
gangue minerals. Prerequisite: 171 or 172,
or consent of instructor.

3 units, Spr (Dickson) MWF 10

274. Geochemistry of Open Systems—De-
velopment of thermodynamic aspects of
classical phase diagrams in terms of entropy,
volume and chemical potential as independ-
ent variables. Steady state transport of com-
ponents in temperature and pressure gradi-
ents. Theory of infiltration and diffusion
metasomatism. Autometamorphism of igne-
ous rocks. Prerequisites: 171, 172, 173, 182.

3 units, Aut (Luth) MWF 9;
alternate years, given 1974-75

278. Organic Geochemistry and the Geo-
chemical Environment of Life — Course
unites aspects of geology and chemistry in
study of origin and occurrence and fate of
organic materials in geological environ-
ments. 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 intro-
ductive courses in geochemistry and organic
chemistry are helpful.

2 units, Spr (Kvenvolden) by arrangement

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 (Williams) 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 1974-75

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 use of conventional hydrothermal apparatus and electron microprobe. Prerequisite: 172 or 182 or consent of instructor.

4 units, Win (Liou) TTh 10; lab. M 1:15-4:05; alternate years, given 1974-75

290. 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 usage. Prerequisite: 190 or consent of instructor.

3 units, Spr (Switzer) alternate years, given 1974-75

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), Win (Johnson-Thompson), Spr (Compton) by arrangement

312. Physical Processes—Theories of Folding—In-depth studies of mechanical theories of folding. Begins with classic, single-layer theories of Smoluchowski, Ramberg, and Biot and ends with modern theories of folding of multilayers. Includes theory of characteristics as applied to faulting, monoclinal flexuring, kinking, concentric folding and sinusoidal folding. Prerequisite: 214.

2 units, Spr (Johnson) TTh 10; field trip by arrangement, alternate years, given 1973-74

322. Advanced Geomorphology—A systematic quantitative evaluation of the 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 1974-75

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, any quarter (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 in igneous petrology and closely allied fields, with emphasis on new data and concepts. No prerequisites;
training in petrology through B.S. degree recommended.

2 units, Spr (Dickson) M 1:15–4:05

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

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 1973–74

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 Professor: Jon F. Claerbout
Assistant Professor: Amos M. Nur
Research Associate: John P. Burg

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 Watts 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 microbarograph array, a high pressure and temperature rock deformation laboratory, and various instruments for field measurements. Some current research activities in the Department include analysis of lunar seismic data, geophysical monitoring of the San Andreas fault and paleomagnetic investigations. 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, or E) 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>
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<tbody>
<tr>
<td>Chemistry 4, 5</td>
<td>General Chemistry</td>
<td>Aut, Win</td>
<td>8</td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23 and 44 or Any</td>
<td>Analytical Geometry and Calculus</td>
<td>Any</td>
<td>18</td>
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<tr>
<td>Math. 130. Ordinary Differential Equations</td>
<td>Aut or Win</td>
<td>3</td>
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<tr>
<td>Geology 181. Earth Materials</td>
<td>Aut</td>
<td>5</td>
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<tr>
<td>Geophysics 185 (A, B, C, D, or E)</td>
<td>Aut, Win, Spr</td>
<td>6</td>
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<tr>
<td>Geophysics 190. Elementary Geophysics</td>
<td>Aut</td>
<td>4</td>
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<tr>
<td>Physics 51, 53, 54, 55 and 56. Elementary Physics</td>
<td>Win, Spr, Aut</td>
<td>14</td>
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<tr>
<td>Physics 110, 111. Mechanics</td>
<td>Win, Spr</td>
<td>6</td>
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<tr>
<td>Physics 120. Electricity and Magnetism</td>
<td>Aut</td>
<td>3</td>
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<tr>
<td>Geology 101. Framework of Geology</td>
<td>Spr</td>
<td>3</td>
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<tr>
<td>Geology 102. Intro. to Field Geology</td>
<td>Sum</td>
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<tr>
<td>Geology 110. Structural Geology</td>
<td>Spr</td>
<td>5</td>
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As electives in the Geophysics Curriculum the following courses are recommended: Geophysics 102, 191, Geology 103A and B or 201, Physics 57, 58, 100, 101, 121, Mathematics 131, 132, and Electrical Engineering 41A, 41B.

**Master of Science**

**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, or E).
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.

**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, or E). Ph.D. candidates in Geophysics are required to complete Physics 121 and two of the following: Physics 210, 211, Applied Physics 213, 214, Mathematics 220A, 220B, 220C. Additional advanced courses are to be selected from the following topics: Applied Physics, Astrophysics, Atomic and Nuclear Physics, Communication Theory, Electromagnetic Theory, Engineering Mechanics, Geology, Geophysics (200 level or higher), Materials Science, Physics of Solids, Thermodynamics. Applied Mechanics 203A and 203B are recommended for students interested in studies of theoretical wave propagation. In addition, students without practical electronics experience are strongly encouraged to take a laboratory course such as Engineering 41A, B or Physics 100, 101. 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 examina-
tion, 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 earthquakes can be controlled. Lectures, occasional laboratory demonstrations and several Saturday field trips.

3 units, Aut (Kovach, Boore) TTh 10, lab., field trips by arrangement

51. **Physics of the Earth** — This course is directed toward science, engineering, and mathematics majors interested in obtaining a general understanding of 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 worldwide 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, given 1974-75


3 units, Aut (Cox) MWF 8, given 1974-75

185A,B,C,D,E. **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 (Claerbout) by arrangement

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

2 units, Aut, Win, Spr (Cox) by arrangement, given 1974-75

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 re-
lated 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: Environmental Seismology — Current research concerning earthquake hazards and hazard reduction. Topics drawn from research in seismology, geology, and engineering.

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


4 units, Aut (Thompson) 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 (Kooch, Thompson, Lyón)
by arrangement

195. Elementary 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.

3 units, Aut (Boore) by arrangement

196. Seismology Laboratory — Practical exercises in seismology using records from local and teleseismic events. Required for those taking Geophysics 195.

1 unit, Aut (Boore) by arrangement

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, given 1974–75

260. Tectonophysics I — Theories of elasticity, viscoelasticity, friction and fracture as related to geotectonic processes. Application of dislocation theory to crustal and mantle deformation, faulting and creep. Special emphasis on current problems such as earthquake prediction and modification. Prerequisite: differential equations.

3 units, Win (Nur) MWF 11


3 units, Spr (Nur) MWF 11, alternate years, given 1974–75

262. Rock Mechanics — Physical properties and physical processes in rocks as related to geophysical processes. Emphasis on (1) mechanical behavior of rocks as a function of stress, temperature, time and water pressure; and (2) non-linear processes in rocks such as stress dependence of electrical resistivity on hydraulic permeability, and their applications to earthquake mechanics and prediction, and mantle deformation. Includes regular laboratory work.

4 units, Spr (Nur) lec. (3 units) lab. (1 unit); MWF 11


3 units, Aut (Boore), given 1974–75

271. Wave Propagation — Basic concepts: equations, wave motion, polarization, energy, intensity. Representation theorems, dislocation-body force equivalences. Reflec-
tion, refraction. Propagation in layered media. Group and phase velocity. Synthesis of waveforms, including finite difference techniques. Although mainly concerned with elastic media, the material is applicable to any type of wave propagation. Prerequisite: Applied Physics 213 or equivalent.

3 units, Win (Boore) MWF 9

280. Data Analysis—The objective is to prepare students to do computer analysis of geophysical data. Fourier transforms and matrices are reviewed. Model building by least squares. Principles of filter theory and wave propagation by means of rays are formulated in terms of sampled time. Special attention is paid to causality, prediction, time-frequency-statistical resolution, multichannel observations and waves in layered structures. No prerequisite but Electrical Engineering 261 is helpful.

3 units, Aut (Claerbout) MWF 9

281. Theoretical Geophysics—A broad class of useful mathematical models of the earth are characterized by material variations along only the depth coordinate. This reduces the various equations of classical physics to a similar mathematical form. Examples are considered from ocean acoustics, heat flow, diffusion, electromagnetic prospecting, and seismology. Then we consider electromagnetic and elastic anisotropy and the phenomenological coupling equations of irreversible thermodynamics. Prerequisite: Physics 61, 110 or 210.

3 units, Win (Claerbout) MWF 10

283. Geophysical Simulation—Use of a computer to simulate geophysical situations by means of difference approximations to the partial differential equations of classical physics. Special emphasis on the scalar wave equation in two dimensionally inhomogeneous material, reflection seismology, and numerical holography. Introduction to nonlinear flow. Prerequisite: Physics 120 and programming ability.

3 units, Win (Claerbout) given 1974–75

295. Physics of Planetary Interiors — A study of the available data of seismology, 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 the instructors.

3 units, Aut (Kovach, Nur) MWF 10, alternate years, given 1974–75

301. Problems in Geophysics.

Any quarter (Staff) by arrangement

385A,B,C,D,E. 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, given 1974–75

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: Environmental Seismology**—Current research concerning earthquake hazards and hazard reduction. Topics drawn from research in seismology, geology, and engineering.

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.**

2 units, any quarter (Staff) *by arrangement*

**400. Research in Geophysics.**

Any quarter (Staff) *by arrangement*

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**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

*Research Associates (By Courtesy):* Herman Dykstra, Thomas D. Mueller, Jacques Naar, Marshall B. Standing

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**OFFERINGS**

The study programs of the Department of Petroleum Engineering are designed to train graduates competent in the engineering technology of oil and gas production, prepare them for careers in professional engineering and research, and fit them for promotion in management leading to executive status. The undergraduate curriculum leads to the degree of Bachelor of Science. Owing to the scope of petroleum engineering, qualified students are encouraged to take graduate study. Graduate programs lead to the degree of Master of Science, Petroleum Engineer, Petroleum Engineer (Management Option), and Doctor of Philosophy.

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**LABORATORY FACILITIES**

The Department occupies the Lloyd Noble Petroleum Engineering Building dedicated exclusively to petroleum engineering. It contains five laboratories for instruction and 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 new Mitchell Earth Sciences Building. Laboratories and additional student study rooms and research laboratories are also located in the Mitchell Building.

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**PROGRAMS OF STUDY**

**UNDERGRADUATE**

The four-year program provides a foundation for a career in petroleum engineering. Basic sciences and engineering are stressed. Breadth is provided through courses in the social sciences and humanities. The mean grade in required courses in the fields of mathematics, chemistry, physics, and earth sciences must be C or better.

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**Course Program for Undergraduates**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 1, 2, 3</td>
<td>General Chemistry, or Chem. 4, 5</td>
<td>13 or 8</td>
</tr>
<tr>
<td>Chem. 171</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 40</td>
<td>Elementary Surveying</td>
<td>4</td>
</tr>
<tr>
<td>Comp. Sci. 106</td>
<td>Introduction to Computer Science</td>
<td>3</td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23, 44</td>
<td>Analytical Geometry and Calculus</td>
<td>18</td>
</tr>
<tr>
<td>(Mathematics 40 series may be substituted for the 20 series)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations or Statistics 110</td>
<td>3 or 4</td>
</tr>
<tr>
<td>Math. 45</td>
<td>Advanced Calculus II</td>
<td></td>
</tr>
<tr>
<td>English 1, 2</td>
<td>Freshman English</td>
<td>6</td>
</tr>
<tr>
<td>Physics 51, 53, 55</td>
<td>Mechanics, Sound, Electricity, Light, and Heat</td>
<td>12</td>
</tr>
<tr>
<td>Physics 54, 56</td>
<td>Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Engr. 11</td>
<td>Engineering Mechanics (Statics and Strength of Materials)</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 12</td>
<td>Engineering Mechanics (Dynamics)</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 21</td>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 32</td>
<td>Introduction to the Thermosciences</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 41</td>
<td>Circuits, Electronics, and Electromechanics</td>
<td></td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 1</td>
<td>Geoscience I</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 2</td>
<td>Geoscience II</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 122A</td>
<td>Petrology</td>
<td>4</td>
</tr>
<tr>
<td>Pet.E. 103</td>
<td>A Survey of the Petroleum Industry</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 150A, 150B</td>
<td>Formation Evaluation</td>
<td>6</td>
</tr>
<tr>
<td>Pet.E. 151A</td>
<td>Petroleum Reservoir Fluids</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 151B</td>
<td>Fluid Behavior in Reservoir Rocks</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 151C</td>
<td>Drilling Fluids</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 151D</td>
<td>Petroleum Reservoir Fluids Laboratory</td>
<td>3</td>
</tr>
</tbody>
</table>
GRADUATE DEGREES

The petroleum industry is 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 in Petroleum Engineering requires a comprehensive two-year program of graduate study. This degree emphasizes professional practice rather than research.

The degree of Engineer in Petroleum Engineering (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 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.

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>Pet.E. 151E</td>
<td>Core Analysis Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 152</td>
<td>Development and Production Technology</td>
<td>2</td>
</tr>
<tr>
<td>Pet.E. 160</td>
<td>Report on Oil Field Training</td>
<td>1</td>
</tr>
<tr>
<td>Pet.E. 170</td>
<td>Elements of Petroleum Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 172</td>
<td>Natural Gas Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Social Sciences (University-wide Requirements)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Humanities (University-wide Requirements)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Technical Electives from the following:*</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Geophys. 190</td>
<td>General Geophysics</td>
<td>3</td>
</tr>
<tr>
<td>Geophys. 191</td>
<td>Geophysical Field Techniques</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 102</td>
<td>Optimization</td>
<td>3</td>
</tr>
<tr>
<td>Oper. Res. 152</td>
<td>Introduction to Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>Physics 57</td>
<td>Atomic Physics</td>
<td>3</td>
</tr>
<tr>
<td>Mech. Engr. 230</td>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 41A</td>
<td>Circuits Lab. I</td>
<td>1</td>
</tr>
<tr>
<td>Free Electives</td>
<td>16-17</td>
<td></td>
</tr>
</tbody>
</table>


† Electives are to be selected with the approval of the student's advisers.
be applied to overcoming deficiencies in undergraduate training. At least 30 units in engineering and closely allied fields must be taken in advanced work, that is, work beyond the Master's degree requirements and in addition to research (Pet.E. 360). These may be taken from the list below for the Ph.D. degree or may be other approved courses. He or she must have a B average in courses given by the School of Earth Sciences. He or she must prepare a thesis representing 15 units of research, meeting the approval of the supervising instructor and the University Committee on Graduate Studies.

**Engineer (Management Option)**

The objective is to round out the student's training in professional engineering and to provide him with a background in business administration.

A minimum of two years (six quarters) of graduate study is required, as a registered student at Stanford. The candidate must complete 90 units of course work 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. 200–201. Business Economics I and II
- Bus. 210–211. Management Accounting I and II
- Bus. 220–221. Business Finance I and II
- Bus. 303. Economic Forecasting
- Bus. 321. Investment Management
- Bus. 366. Management Information Systems
- Ind. Eng. 229. Engineering Economy
- Ind. Eng. 230. Capital Budgeting

Additional units needed to make up the required 90 may be electives selected with the consent of the student's adviser. He or she must maintain a C average in Graduate School of Business courses. In all other courses he or she must maintain a B average. He or she 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.

**Doctor of Philosophy**

The degree of Doctor of Philosophy is conferred upon evidence of high attainment in Petroleum Engineering, 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. He or she 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 from the following list, and other courses approved by the Department.

**Math and Applied Math**

- Math. 115. Fundamental Concepts of Analysis 3
- Math. 130. Ordinary Differential Equations 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 Computer Programming 3
- Comp. Sci. 135. Numerical Methods 3
- Comp. Sci. 137. Numerical Analysis 3
- Comp. Sci. 138. 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
Chem. 171. Physical Chemistry 3
Geol. 203A. Instrumental and Analytical Techniques in Earth Sciences 1
Geol. 372. Organic Geochemistry and the Geochemical Environment of Life 2
Geophys. 190. General Geophysics 3

Engineering
Chem.E. 120. Equilibrium in Thermodynamic Systems 3
Chem.E. 130A. Transport Phenomena: Momentum Transport 3
Chem.E. 130B. Transport Phenomena: Energy Transport 3
Civil Engr. 264. Ocean and Coastline Engineering 3
Civil Engr. 265. Flow in Permeable Media 4
Engr. 296A,B. Engineering Teaching 1 ea.
Engr. 298. Fluid Mechanics 1
Ind. Eng. 229. Engineering Economy 3

General
Geol. 287. 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. He or she 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 his or her research and writing his or her thesis, 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. These examinations 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.

His or her record must indicate outstanding scholarship. He or she must pass the Departmental qualifying examination. He or she must fulfill the requirements of the minor department, if a minor is elected. He or she must pass the University oral examination, which is essentially a defense of the dissertation problem. He or she 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 the Graduate Division. Candidates for the degree who fail to meet this deadline will be required to reapply 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 Petroleum Industry—Arranged to give the students a comprehensive view of organization and operation of petroleum industry. Exploration; drilling and off-shore drilling; development and production methods of oil fields; transportation and storage; refining and petrochemicals; marketing. Chemical properties of petroleum and its products. Prerequisite: Chemistry 3 or consent of instructor.
3 units, Spr (Brigham) MWF 11

3 units, Aut (Ramey) MWF 10

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. Petroleum Reservoir Fluids — Lectures, problems. Chemical, physical properties of reservoir fluids. Gas laws, behavior of liquids, phase equilibria, viscosities of hydro-

3 units, Win (——) 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. Petroleum 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 (——) 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 (——) T 1:15; lab. TTh 2:15-5:05

152. Development and Production Technology — Lectures, demonstrations, field trips. Oil field equipment for drilling, production. Prerequisite: 103.

2 units, Spr (Miller) T 9-11, alternate years, given 1974-75

160. Report on Oil Field Training—Student required to submit report covering at least two consecutive months of industrial experience related to petroleum engineering.

1 unit, any quarter (Staff) by arrangement

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

3 units, Spr (Miller) MWF 9


3 units, Aut (Brigham) MWF 8


Any quarter (Staff) by arrangement


3 units, Win (Miller) S 9-12, alternate years, given 1973-74


1 unit, any quarter (Staff) by arrangement


3 units, Aut (Miller) MWF 9


3 units, Win (Miller) MWF 9

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

2 units, Spr (Miller) Th 9-11

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

3 units, Spr (——) by arrangement

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

3 units, Spr (Ramey) MWF 10
   *Any quarter (Staff) by arrangement*

   *3 units, Aut (Marsden) MWF 9*

   *3 units, Win (Ramey) MWF 9*

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.
   *3 units, Aut (Brigham) MWF 8*

280B. Modern Fluid Injection—Continuation of 280A.
   *3 units, Win (Brigham) MWF 11*

   *3 units, Spr (Brigham) MWF 8*

284. Non-Newtonian Fluids in Petroleum Production Engineering—Properties and applications of non-Newtonian fluids in drilling, completions, cementing, fracturing, production improvement, transportation, and secondary recovery.
   *3 units, Win (Marsden) MWF 9*

360. Advanced Work in Petroleum Engineering—Graduate level work in either experimental, computational or theoretical research. Advanced technical report writing.
   *Any quarter (Brigham, Marsden, Miller, Ramey) by arrangement*
Emeriti: A. John Bartky, Oliver E. Byrd, W. H. Cowley, Paul R. Hanna, Ernest R. Hilgard, Paul DeH. Hurd, Maud M. James, Maud L. Knapp, James D. MacConnell, Quinn McNemar, Daniel M. Mendelowitz, Wilbur Schramm, Jesse B. Sears, Pauline S. Sears (Professors); Margaret Barr, Luell Guthrie, Ernest P. Hunt, Marian S. Ruch (Associate Professors)

Dean: Arthur P. Coladarci

Associate Deans: William J. Iverson (Academic Affairs), Richard C. Still (Business Affairs)


Lecturers: Guy H. Browning, William H. Strand

Research Associates: Richard E. Clark, Terry Deal, Maurice Fisher

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 State Board of Education that credentials be granted.

Acceptance of Work Done Elsewhere — Students transferring with advanced or graduate standing from other universities may have substantially equivalent training accepted in lieu of the courses required at this University in education and in the major and minor fields.

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 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. Re-
quirements for degrees and credentials differ even when the candidate is preparing for both at the same time.

Degree Credential
A.M. Standard Teaching Credential (Secondary)
A.M. Standard Supervision Credential (requires two years of postgraduate education)
Ph.D. Standard Administration Credential

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.

Field of Concentration 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 program of study for the various fields of concentration 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 for his or her field of concentration to aid him or her 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 field chosen by the student. Each program as finally approved will designate one area of special interest as a major field of concentration.

The fields of concentration for the Doctor of Education and Doctor of Philosophy degrees are listed below. Members of the faculty of the School of Education who are specialists in a particular area serve as advisers to students who have selected that field of concentration.

Administrative and Organizational Studies
Comparative and International Development Education
Curriculum and Teacher Education, with concentrations in any of the following fields:
  - Art
  - Design and Evaluation of Educational Programs (General Curriculum, Evaluation, Elementary Education, Secondary Education)
  - Foreign Languages (Second Language Learning and Bilingual Education)
  - Language Arts or English
  - Mathematics
  - Music
  - Physical Education
  - Science
  - Social Studies
  - Teacher Education
Socio-Humanistic Studies:
  - History of Education
  - Philosophy of Education
  - Sociological and Anthropological Studies
Mathematical Methods in Educational Research
Political and Economic Studies
Psychological Studies:
  - Child Development
  - Counseling Psychology
  - Educational Psychology
Other possible fields of concentration may be arranged for applicants with the approval of the Committee for Academic Affairs.
Application for formal admission into the doctoral programs is expected during the fourth 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

Curriculum and Teacher Education (with specializations in the following areas:
Art, Language Arts or English, Mathematics, Foreign Languages [Second Language Learning and Bilingual Education], Music, Physical Education, Science, Social Studies, Elementary Education, General Curriculum)

Early Childhood Education

Physical Education with Specialization in Dance

Secondary Teacher Education Program*

Social Foundations of Education

Other possible fields of concentration may be arranged for individual advanced graduate applicants when approved by the Master of Arts Committee of the School. Candidates for the degree in Curriculum and Teacher Education must have completed student teaching or other practicum, or have at least one year 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. 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 University for three quarters after the conferring of the Bachelor's degree. One full-time quarter (a minimum of 12 units) 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, 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, or relevant teaching experience.

3. Three quarters of full-time residence (or equivalent) are a requirement for this degree. This may be satisfied by the candi-

* A program for candidates who are seeking initial preparation for the Secondary Teaching Credential as well as for the Master's degree. See "Teaching Credential (Secondary)" 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 (Secondary)" for pertinent details.
date's attending a series of summer quarters.

4. A minimum of 45 quarter units of graduate study is required. At least 36 of these units must be completed at Stanford.

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 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, of which at least one full quarter (a minimum of 12 quarter units) must be outside the field of education. Evaluation of Stanford 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 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. Applicants 45 years of age and over are not admitted to the doctoral program in education.

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 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 sys-
tems or in specialized institutions, or are preparing to conduct research as faculty members of colleges or universities.

**Residence** — Nine 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 Stanford 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. Graduate course work beyond the Master's degree taken seven or more years ago will not ordinarily be included in the doctoral program. Applicants 45 years of age and over are not admitted to the doctoral program in education.

**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.

Persons desiring to work for California credentials are required, at the beginning of their training program, to present evidence of their qualifications to a committee on credentials. The function of the committee is to encourage those applicants who, in the judgment of the committee, are qualified to pursue credential programs. The Credential Secretary in the School of Education should be consulted as to the necessary procedure.

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

**ADMINISTRATION AND SUPERVISION CREDENTIALS**

The Stanford School of Education is authorized to recommend the supervision and administration credentials described below. 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 Standard Supervision Credential** authorizes the holder to serve as supervisor, consultant, coordinator or equivalent supervisory or intermediate administrative position. The Supervision Credential is designed to prepare the applicant to serve in an area in which the basic credential gives authority to teach or serve: elementary principalship, secondary principalship, junior college principalship, elementary school supervision, secondary school supervision, junior college supervision, subject field supervision, supervision of special education, supervision concerning instructional aids, or any additional
capacity when approved by the State Board of Education.

The Standard Administration Credential authorizes the holder to administer and supervise schools as a superintendent or in any intermediate level administrative position and, under approved circumstances, as principal or supervisor.

**Standard Supervision Credential Requirements**

1. Two years of acceptable postgraduate education including a Master's degree or other acceptable postgraduate degree requiring not less than five years of education. If the Master's or other postgraduate degree is not in an academic subject matter area, the two years of postgraduate education shall include 18 quarter units of course work in academic subject areas.
2. The possession of a valid basic credential.
3. Five years of successful full-time classroom teaching experience in public schools, or in private schools of equivalent status.
4. The two years of acceptable postgraduate education shall include one of the following:
   a) Completion of an approved supervisory internship program.
   b) Completion of a program of study, including a minimum of 18 quarter units of professional education, designated by the Committee on Credentials as appropriate to the area in which the applicant expects to serve. The program shall be approved by the adviser in the School of Education and filed with the Credential Secretary.

**Administration Credential Requirements**

1. Three years of acceptable postgraduate education with one of the following degrees:
   a) A Master's degree in an academic subject matter area.
   b) An acceptable Doctor's degree. If the Doctor's degree is not in an academic subject matter area, the three years of acceptable postgraduate course work must include 36 quarter units of upper division or graduate course work in an academic subject matter area or areas.
2. The possession of a valid basic credential.
3. A minimum of five years of successful full-time classroom teaching experience in public schools or in private schools of equivalent status.
4. The three years of acceptable postgraduate education shall include either:
   a) Completion of an approved administrative internship program, or
   b) Completion of a program of study, including a minimum of 36 quarter units of professional education, designated by the Committee on Credentials as appropriate to the area in which the applicant expects to serve. The program shall be approved by the adviser in the School of Education and filed with the Credential Secretary.

**Teaching Credentials**

The Stanford School of Education is authorized to recommend the following teaching credential:

**Standard Teaching Credential (Secondary)**, which authorizes the holder to teach in grades 7 through 12 any subjects named as majors or minors on the credential.

**General Requirements**

Candidates for a teaching credential must present evidence of meeting standards in the following:

1. A certificate of mental and physical fitness from the University Health Service.
2. Approval of candidate's competency in oral expression.
3. Fulfillment of the U.S. Constitution Requirement, either by passing an examination or by taking satisfactory course work. The following courses at Stanford will satisfy this requirement: Political Science 10, or History 151 or 152.
4. Approval by the appropriate committee, based on scholarship and other requisites, for successful teaching.

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.

* Stanford does not offer training at this time for the credential in elementary education.
SECONDARY TEACHER EDUCATION PROGRAM (INTERNSHIP)

The Stanford Secondary Teacher Education Program is a twelve-month, fifth-year program which leads to a California credential for teaching in secondary schools and, in most cases, to a Master of Arts degree in Education. It begins in June with a summer quarter of intensive preparation in the processes 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. Although a teaching minor is not required, candidates should note that an acceptable teaching minor may help them find placement in local schools and obtain a teaching position when they complete the program.

2. Closing date for filing applications. Completed applications (available from the Secondary Teacher Education 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 (Apptitude Test) is required for admission.

4. Notice of admission. Candidates will be notified of their acceptance into the program no later than April 1, 1974. 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. In return, the intern receives about one third of the salary for a beginning teacher (approximately $2000). 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. Candidates may also complete the requirement of the program through holding nonsalaried student teaching positions.

6. Requirements. To complete the program in Secondary School Teaching, the candidate must satisfy the following requirements. Requirements marked (*) are normally completed prior to admission. Requirements marked (**) are normally substantially completed prior to admission, but provision has been made within the program for their completion. Other requirements are normally completed as a part of the program itself.

* a) A four-year college course and a Bachelor's degree with 68 quarter units (45 semester hours) in general studies, including work in at least four of the following six fields:

1) Humanities, excluding foreign languages but including a year of English. This field is required as one of the four.

2) Social sciences (anthropology, economics, geography, history, political science, psychology, sociology).

3) Natural sciences (biological sciences, physical sciences).

4) Mathematics (requiring as a prerequisite an understanding and knowledge of high school algebra and geometry).

5) Fine arts (history, theory, appreciation, criticism, and practice in art, drama, music).

6) A foreign language.

Only 9 quarter units (6 semester hours) of courses included in the general studies requirements listed above may be used as
part of a teaching major or teaching minor.

**b) A teaching major consisting of a minimum of 36 quarter units (24 semester units) of upper division or graduate courses. This State minimum requirement is typically exceeded by Stanford's requirements. 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, Biological Sciences, English, Mathematics, a Modern Language, Music, Physical Education, Physical Sciences, Social Studies.

c) Interns will be responsible for a 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, including the micro-teaching clinic in the summer quarter and the internship during the academic year.

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, secondary education, and micro-teaching.

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, 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

Junior-senior courses: 100–199; graduate courses: 200–299; courses for experienced teachers or advanced graduates: 300–399; seminars and directed study and research: 400–499.

The various courses are distributed as follows:

Foundations of Education (Digits 00–19), e.g., 215, Psychological Foundations of Education
Administration (Digits 20–29), e.g., 320A, B, C, Advanced Educational Administration
Guidance and Personnel (Digits 30–39), e.g., 230A, Guidance in Elementary Schools
General Curriculum and Methods (Digits 40–49), e.g., 246B, Internship in Teaching
Statistics, Evaluation and Research (Digits 50–54), e.g., 250A,B, Statistical Analysis in Educational Research I
Physical Education (Digits 55–59 and 70–79), e.g., 358, Special Assignments, Physical Education
Special Curriculum and Instruction in Other Fields (Digits 60–69 and 80–99), e.g., 261A, B, C. Curriculum and Instruction in Secondary School Art

Graduate

These courses are open to seniors with consent of adviser and instructor of course.

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) W 2:15–4:05

108. Seminar on Education and Politics in Europe—(Same as Political Science 127B.) The politics of educational innovation in selected countries of Western Europe; education and political socialization and recruit-
110. Cultural Pluralism: Classroom-Curricular Strategies — The primary objective of the course is to examine past, present and future models of Education (policies, practices, curriculum, evaluation and research) as responses to the cultural and social needs of diverse racial and ethnic groups in America. Analytical and theoretical concepts from Anthropology, Sociology and Psychology will provide the cognitive content of the course. The major themes of the course will center around social and cultural change theory, the school as a social system, cultural and value transmission in the school, race-ethnicity and social class in America and contemporary school-community dynamics. The students will be encouraged to extract important and meaningful principles and techniques which can be immediately useful in the understanding and resolving of everyday classroom problems which revolve around cultural pluralism. This activity would form the experiential content of the course. Whereas, the course would have maximum benefit for students in teacher education it can also serve the interest of graduate students whose research interests may eventually concern questions of cultural dynamics in the schools. Graduate and upper division undergraduates admitted with consent of instructor.

4 units, Aut (Deslonde) by arrangement
Spr (Deslonde) MW 10-12

111. Developmental Psychology — (Enroll in Psychology 111.)

113. Adolescent Development — (Enroll in Psychology 113.)

114. Power and Conflict in Education: An Experiential Course in Sociology — (Same as Sociology 139.) An experimental course in the sociology of education open to both graduate and upper division students, dealing with power, stratification, and conflict in American society as these are reflected in the educational system. This is a multi-media course that uses a complex mix of simulation games, films, small group discussions, field activities, and lectures. Each student joins an “experience team” that acts both as a self-analytic group observing its own behavior and as a task group that does the course activities together. There is a required week-end retreat at the beginning of the quarter.

5 units, Win (Baldrige), given 1974-75

115X. The Black Experience in American Schools — The course will examine the existing literature in history, sociology and social psychology for an extensive analysis of the Black experience in American schools. The student will extract appropriate findings related to other non-white ethnic groups and explore the implications for future research, teaching and/or educational policy. The course may be helpful to any student whose eventual research or teaching will involve Black students in educational settings. Junior and senior students admitted with consent of instructor.

4 units, Spr (Deslonde) Th 11-12:30

120. Organizational Decision Making — (Same as Sociology 161 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 8:30-10 a.m.

136A. Behavior Modification: Introduction — (Same as Psychology 139A.) Rationale, concepts and issues in application in educational settings. Implementations of behavior change program.

3 units, Aut (Zifferblatt) by arrangement

136B. Behavior Modification: Review of Literature and Research Methodology — (Same as Psychology 139B.) Intensive design methodologies and their rationale. Review of literature in areas of interest (set-
tings or behavior change strategies). Development of research project.

3 units, Win (Zifferblatt) by arrangement

136C. Behavior Modification: Application in Educational and Related Settings—(Same as Psychology 139C.) Practical experience in program design, application and consultation. Visits to behavior modification settings.

4 units, Spr (Zifferblatt) by arrangement

146. Practice Teaching in Music in the Elementary School.

1 to 2 units, any quarter (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, Spr (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, alternate years, given 1973–74

160. Introduction to Statistical Methods I—(Enroll in Statistics 160, formerly Statistics 107.) 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 introduction to probability theory, including tests of hypotheses, estimation and confidence intervals.

5 units, Aut (Chernoff) MTWThF 2:15
Spr (Gordon) MTWThF 1:15
4 units, Sum (——-) by arrangement

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.

3 units, Aut (Ruff) lec. M 8–10; lab. W 8–10 and one hour by arrangement

180. Directed Reading in Education.

2 to 4 units, any quarter (Staff) by arrangement

184. Literature for Adolescents—Required of credential candidates with a teaching major or minor in English. An opportunity for juniors and seniors to read and discuss ten to fifteen books written for adolescents. Some attention will be given also to the teaching of literature. Open only to experienced teachers and students preparing to teach.

3 units, Aut (Grommon) Th 4:15–6:05

190. Directed Research in Education.

2 to 4 units, any quarter (Staff) by arrangement

200. History of Education—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 to 4 units, Aut (Gross) W 7–10 p.m.
4 units, Sum (Gross) MTWTh 4:15 and by arrangement

201. History of Education in the United States—(Same as History 201.) Analysis of selected turning points in education in relation to such topics as religion, political socialization, race relations, immigration, and urbanization.

3 units, Win (Tyack) TTh 11 and one hour by arrangement

202. Contemporary Problems in Social Institutions—(Same as Sociology 134 and Political Science 280A.) 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) given 1974–75

204. Introduction to Philosophy of Education—Educational policies and practices analyzed to locate philosophical assumptions and key concepts. Construction of coherent educational theories. No previous study of philosophy assumed.

4 units, Aut (Thomas) MW 2:15–4:05
Spr (Pacheco) TTh 10
Sum (Pacheco) by arrangement
205. Philosophies of Education—The epistemology, axiology, and metaphysics of contemporary philosophies compared for their significance in guiding educational policy and research.

  

  4 units, Win (Thomas) MW 2:15-4:05

206. 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, Sum (Bock)

MTh 9-11

207. 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

208. Personality and Social Structure—(Same as Sociology 176.) 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 4:15

209. Problems of Development Education in Africa—The course will focus on three major issues: (1) integrative and disintegrative functions of education; (2) the politics of educational reform; (3) a reappraisal of educational colonialism and neocolonialism.

  

  3 units, Win (Weiler) M 12-2

210. Research Problems in Sociology of 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 structure on schools, school systems; American cultural values and their influence on education; school system as formal organization in mass society.

  

  4 units, Aut (Cohen) MW 9-11

Sum (—-) MTWThF 9

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, Aut (Tyack) T 7-9 and one hour to be arranged

Win (Cohen) M 4:15-6:05,

W 4:15-5:05

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 policies of educational innovation in three countries: (a) Great Britain (comprehensive education); (b) West Germany (Gesamtschulen); and (c) the U.S. (desegregation and public school financing). 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 (Weiler) TTh 4:15-6:05

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) M 7-9

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 (Gage) TTh 3:15-5:05
Spr (Gage) by arrangement
Sum (Staff) MTWTh 10 and by arrangement

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 to 5 units, Aut (Castañeda) Th 7-10 p.m.
and by arrangement
3 units, Sum (Castañeda) T 2:15-5:05

217. Development of Scientific Explanation in Children—Examination of studies of children’s explanations of scientific phenomena and of conceptions guiding the study designs.

4 units, Aut (Bridgham), TTh 1:15-3:05

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) M 7-9

220. Introduction to Public School Administration—School district organization for administration; emphasis upon development, function of school administration.

4 units, Aut (Hatton) Th 7-10 p.m.
4 units, Sum (Strand) MTWThF 10

221. Elementary School Administration and Supervision—Systematic study of the roles of the elementary school principal and supervisor. For teachers and candidates for administrative and supervisory credentials.

3 units, Win (Hatton) W 9-12

222. Secondary School Administration and Supervision—For teachers and candidates for administrative and supervisory credentials. Systematic treatment of full range of problems of administration of schools that include grades 7-12. Administration viewed from vantage point of the principal.

3 units, Win (Hatton) W 9-12
4 units, Sum (-----) MTWThF 11

223. Public School Law—Nature of legal responsibilities faced by public school administrators; resources available for solution of legal problems; review of social welfare legislation and laws relating to children. Specifically designed to meet requirements for California administrative and counseling credentials.

3 units, Spr (Strand) M 3:15-6:05

224. School Staff Personnel Problems—For experienced teachers, administrators. Recruitment, selection, placement of teachers; orientation of new teachers; administrative responsibilities for in-service education; staff participation in salary scheduling and other aspects of economic welfare of teachers; administrator-teacher relations; codes of ethics; merit rating; certification, tenure.

3 units, Spr (Hatton) W 4:15-6:05
4 units, Sum (Strand) MTWThF 11

225. Field Practice in School Administration and Supervision—Field practice in school administration and supervision that will meet requirements for California Standard Administration and Standard Supervision Credentials. Consent of instructor required.

1 to 6 units, Aut, Win, Spr (Staff)
by arrangement

226. Educational Institutions 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) F 1:15-4:05

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.

3 units, Spr (Hatton) F 1:15-3:05

228. Research in Higher Education—An analysis of recently completed or ongoing studies involving higher education. Substance of studies will change periodically.

3 units, Spr (Mayhew) M 3:15-6:05

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.

3 units, Aut (Staff) by arrangement, given 1974–75
4 units, Sum (Staff) by arrangement, given 1974–75

230A. Guidance in Elementary Schools—Review of modern guidance practices. Particularly directed to needs of teachers, administrators, guidance workers.

3 units, Win (Staff) MW 3:30–5:30

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 instructor.

3 units, Win (Thoresen) by arrangement, given 1974–75

232. Research in Counseling: Research and Introduction to Systems—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.

2 units, Spr (Krumboltz, Staff) 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 (Krumboltz) 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 (Krumboltz, Staff) by arrangement

239A,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

240A. Secondary Education: Instructional Problems—An orientation to the American Secondary School with a focus on the problems of teaching. Limited to Secondary Interns.

3 units, Sum (Staff) MTWTh 2:15


2 units, any quarter (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, Aut (Walker) MW 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 to 5 units, Win (Castañeda) Th 7–10 and by arrangement

3 units, Sum (Castañeda) Th 2:15–5:05

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 (Dowley) MW 4:15–5:30
246A. Instruction Laboratory: Microteaching—Training and practice in specific skills of teaching. Microteaching is a closely controlled teaching encounter. Candidates teach 5- or 10-minute lessons at first to one student and later to increased numbers of students. These lessons are subjected to a critique by supervisors and students. Limited to Secondary Interns.

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

248. Directed Teaching in the Junior College. (Student must provide own transportation.)

3 to 6 units, Win, Spr (Staff) by arrangement

249. College Curriculum and Instruction—Curriculum and methods of teaching in the undergraduate college.

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


4 units, Win, Spr (Staff) MWF 11:00-12:30

250C,D. Statistical Analysis in Educational Research II — Continuation of Education 250B: Emphasis on analysis of multiple variables 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. Prerequisites: 250B or equivalent and consent of instructor.

4 units, Aut, Win (Staff) MWF 12:30-2:00

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 11

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: Statistics 160 or Psychology 60.

3 to 4 units, Aut (Cronbach)

MW 2:15-4:05

254. Anthropological Research Methods with Implications for Education—(Same as Anthropology 286.) 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. Where appropriate, students will be encouraged to collect their own field data locally, or to carry out analyses of available live data.

3 to 5 units, Win (Textor) by arrangement

255. Human Abilities — (Same as Psychology 155.) The nature, development, and measurement of intellectual abilities. Prerequisites: Psychology 1 and Psychology 60, or equivalent.

3 units, Spr (Snow) MWF 10

CURRICULUM AND INSTRUCTION IN SECONDARY SCHOOL MAJOR TEACHING FIELDS

As a part of the Standard Teaching Credential (Secondary) program, a candidate is
required to complete the four-quarter sequence of Curriculum and Instruction courses in the field of his teaching major.

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

261A. 3 units, Sum (Staff) MTWTh 3:15
261B. 2 units, Aut (Eisner) T 4:15-6:05
261C. 2 units, Win (Staff) T 4:15-6:05

262A,B,C. Curriculum and Instruction in Secondary School 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 (Grommon) TTh 2:15-4:05
262B. 2 units, Aut (Grommon) T 4:15-6:05
262C. 2 units, Win (Grommon) T 4:15-6:05, given 1974-75


263A. 3 units, Sum (Staff) MW 2:15-4:05
263B. 2 units, Aut (Staff) T 4:15-6:05
263C. 2 units, Win (Staff) T 4:15-6:05


264A. 3 units, Sum (Staff) MTWTh 3:15
264B. 2 units, Aut (Politzer) T 4:15-6:05
264C. 2 units, Win (Politzer) T 4:15-6:05


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

266A,B,C,D. Curriculum and Instruction in Secondary School 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 (Nixon) MTWTh 3:15
266B. 2 units, Aut (Nixon) WF 9
266C. 2 units, Win (Nixon) WF 9
266D.* 2 units, Spr (Nixon) WF 9

267A,B,C. Curriculum and Instruction in Secondary School 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 (Bridgham) T 4:15-6:05
267C. 2 units, Win (Bridgham) T 4:15-6:05

268A,B,C. Curriculum and Instruction in Secondary School 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. 3 units, Sum (Gross) MTWTh 3:15
268B. 2 units, Aut (Gross) T 4:15-6:05
268C. 2 units, Spr (Gross) T 4:15-6:05

(For Social Studies Minors)

277. Human Physical Performance Research — Emphasizes relevant literature and laboratory research experience. Prerequisite: 177 or equivalent.

3 units, Win (Ruff) TTh 8-10

281. Linguistics for Teachers of Modern Languages — Principles of phonology, morphology, and syntax applied to the learning and teaching of foreign languages.

4 units, Sum (Politzer), given 1974-75

282. Linguistics and the Teaching of English — (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

* This course requirement may be waived at the discretion of the instructor.
283. Spanish Linguistics—(Same as Spanish 190.)
3 units

288. Methods of Teaching French—(Same as French Teacher Training 288.)
3 units, Win (Politzer), W 4-6 and by arrangement; alternate years, given 1973-74

291. Methods of Teaching German—(Same as German Studies 302.)
2 units, Spr (Lohnes) TWTh 11

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.)
3 units, Win (Staff) MW 7-9

298. Practice Teaching in a Second Language or Bilingual Education in the Elementary School.
1 to 2 units, any quarter (Politzer) by arrangement

299. Children's Literature—General survey of children's literature for both pre-school and elementary school years.
3 units, Win (Staff) M 4:15-6:05 and by arrangement

COURSES FOR EXPERIENCED TEACHERS OR ADVANCED GRADUATE STUDENTS

300. Education and Law — (Same as Law 300.) 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, Brest) F 9:00-11:30, given 1974-75

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) Th 9-11 plus tutorial

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, Win (Tyack) Th 9-11 and by arrangement
Spr (Tyack) T 7-9 p.m. and by arrangement

303A. Philosophical Analysis of Educational Problems — A topical seminar offering critical analysis of an educational problem. Focus in 1974: ethnic studies programs in higher education. This seminar will critically examine the following characteristics of ethnic studies programs and courses: (1) how they have evolved in the university; (2) the politico-philosophical assumptions on which they are based; (3) alternative models of such programs; (4) the relationship of ethnic studies curricula to the total university curriculum; and (5) aspects of bilingual and bi-cultural curricula. Special attention will be given to Chicano Studies curricula. Prerequisite: consent of instructor.
4 units, Win (Pacheco) T 7-10 p.m.

304. Philosophy and Empirical Research—An exploration of conceptual problems in empirical research in education and the
contributions of systematic philosophizing to controlled inquiry. Prerequisite: 204 or 205 or consent of instructor.

4 units, Win (Thomas) TTh 2:15-4:05

305. Comparative Ideologies and Education—Construction of a democratic theory of education; consideration of conflicting views of American fascism, marxism, conservatism, and pragmatic liberalism.

4 units, Aut, Spr (Thomas) TTh 2:15-4:05

Sum (Pacheco) 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

306B. Education and Political Development—(Same as Political Science 222.) 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 (Weiler) TTh 1:15-3:05

306C. Education and Sociocultural Change — (Same as Anthropology 228.) 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, team research, and other experiential techniques will complement a discussion-group format.

4 to 7 units, Spr (Textor) TTh 2:15-4:05

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 capability 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, Win (Bock) M 2:15-4:05

308. The Social Psychology of Organizational Settings—(Same as Sociology 276.) 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) TTh 4:15-6:05

309. The Social Psychology of Modernization—(Same as Sociology 215.) 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

310/210. Research Problems in Sociology of Education — (Same as Sociology 220.) A course for both doctoral and master’s level students. Lectures are the same, but assignments and discussion sections are separate. Master’s degree students enroll for 210, doctoral students for 310. Doctoral students with
no previous background in behavioral science research will do both sets of assignments (310 and 210) and will be given 6 units of credit instead of 4.

Lectures: The lectures will cover the evaluation and potential usefulness of research literature in the sociology of education to problems of educational practice and policy. The student should gain an overall picture of the research process. Sociological topics to be considered include professionalization, analysis of power relations, evaluation and influence processes, status and stratification.

Sections: The students will be expected to develop the ability to evaluate and criticize available research literature in the sociology of education. On the master's level, group projects will involve practical uses of sociological concepts and methods for the educational decision-maker. On the doctoral level, the projects will involve the development of testable propositions in an area of sociology of education where the applications of the research have potential importance to current problems of the field.

4 units (6 units for doctoral students doing both kinds of assignments)
Aut (Cohen) MW 9–11

311. Socialization of Pre-Adults in Contemporary U.S. Society—(Same as Psychology 245.) Study of socialization of children into systems of society with special attention to the school as a socializing institution. Particular attention will be given to social class and ethnic differences in socialization processes and outcomes.

3 units, Spr (Staff) TTh 9

312A. The Low Status Student: Race and Social Class — (Same as Sociology 248A.) 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 248B.) 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 heterogenous 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 (Cohen) TTh 3:15–5:05

313A,B. Economics of Education — Major attention devoted to the “production,” distribution, and financing of education; contribution of education to economic growth and development; 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.
313B. 3 units, Spr (Carnoy, Levin) M 7:30–9:30 p.m.

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, Aut (Gross), given 1974–75

315. Cultural Transmission—(Same as Anthropology 256.) 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.
4 units, Sum (——) MTWTh 11
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

317. Introduction to Research on Teaching
—Introduction to theory, methodology, and substantive findings of research on teaching and teacher education. Prerequisites: Education 215, Psychology 60.

2 to 4 units, Win (Gage) MTWTh 9, alternate years, given 1974-75

318. Social Psychology and Educational Practice—An advanced course applying the concepts of social psychology to educational practice. Deals with role theory, consistency theory, interpersonal perception. For doctoral students in Psychological Studies. Open to other students with consent of instructor. Prerequisites: Education 215, Psychology 60.

2 to 4 units, Win (Gage) MTWTh 9, alternate years, given 1973-74

319. Motivation in the Educational Process
—Research findings on attentional and motivational processes, including pupil traits and situational determiners. For doctoral students in Psychological Studies. Open to other students with consent of instructor. Prerequisites: Education 215, Psychology 60.

2 to 3 units, Aut (Staff) TTh 2:15

320A,B,C. Advanced Educational Administration—Designed primarily for advanced degree candidates in school administration. Prerequisite: 221 or equivalent, or consent of instructor.

320A. Organization Theory in Educational Administration.

3 units, Aut (Strand) W 7-10 p.m.

320B. Interpersonal Relationships in Staff Development and Personnel Management.

3 units, Win (Strand) W 7-10 p.m.

320C. Administrative Relationships in Education.

3 units, Spr (Strand) W 7-10 p.m.

321. Problems in Elementary School Administration and Supervision—Designed to provide students interested in school administration and supervision an opportunity to examine these functions in light of the changes taking place in the program and organization of the elementary school. Prerequisite: 221 or equivalent or consent of instructor.

3 units, Aut, Win, Spr (Staff) by arrangement

322. Policy Formation in Higher Education
—A critical analysis of policy documents and recommendations concerning higher education with especial attention given to the work of the Carnegie Commission on Higher Education, the Assembly on University Goals and Governance and the Task Forces on Higher Education.

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


4 units, Aut (Kirst) MW 11:00-12:30

323B. Education and Public Policy: The Governance of Elementary and Secondary Education—Analysis of formal structures and political behavior of key actors in education governance. Includes relationships of school governance to general government, impact of collective negotiations, and community control.

4 units, Win (Kirst) MW 11:00-12:30

323C. Education and Public Policy: Evaluation of Education Policy—This course will examine the uses and misuses of evaluation of federal and state programs to revise educational programs at all levels. Focus will also be on the gaps and uncertainties of evaluations as seen by Presidential advisers, governors, and legislators. Cases such as Headstart and Title I ESEA will explore the interaction of politics and technical evaluation.

3 units, Spr (Kirst) M 3:15-6:05

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.

3 units, Aut (Hatton) M 7-10 p.m.
325B. Planning in Educational Administration—An analysis of principles, methods and problems in relating educational goals and programs to school operation.

3 units, Win (Staff) M 7–10 p.m.

325C. Planning in Educational Administration—Interrelations of educational programs, environment, roles and organizations. Critical analysis of problems relating to process.

3 units, Spr (Staff) M 7–10 p.m.

326A. Educational Finance—Principles and problems involved in financing public schools. Major emphasis is placed upon developing a relevant set of analytical techniques from economics and political science that will enable the student to conceptualize and solve problems in school finance.

4 units, Aut (Levin) TTh 4:15–5:45

326B. Financial Decision Making in Education—This course emphasizes the use of modern decision-making tools for allocating resources within the schools. Attention will be devoted to the concepts of educational production functions, resource markets, prices, cost-effectiveness analysis, instructional technology, and program-planning and budgeting systems.

4 units, Win (Levin) TTh 4:15–5:45

326C. Workshop in Financing Education—Independent research in school finance will be undertaken by students, and research design, implementation, and results will be discussed in class. Prerequisite: consent of instructor.

2 to 4 units, Spr (Levin) by arrangement

327. Survey Design and Analysis—(Same as Sociology 213.) 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, Spr (Baldridge) MW 9–11

328. Change and Innovation Processes in Complex Organizations—(Same as Sociology 219.) A study of organizational change which focuses both on deliberate and non-deliberate types of change. Particular attention will be paid to administrative strategies for promoting desired changes in professional organizations, such as schools, universities, welfare agencies. Topics about change will include structural design, human relations strategies, evaluation processes, long-range strategic planning, political dynamics, etc. Prerequisite: Education 329 (Sociology 204) or Sociology 105a or 105b.

4 units, Win (Baldridge) M 2:15–5:05

329. Fundamentals of Organization Theory—(Same as Sociology 203.) Deals with sociological theories about complex organizations and bureaucracies. The course is intended as a basic requisite for all advanced courses in organization theory taught in the School of Education and the Department of Sociology and is highly recommended for students intending to work in that area. Topics include: descriptive and normative classical theories of organization; decision-making and choice processes; professionals in organizational settings; organizations and conflict; environmental pressures on organizations; radical critiques of the role of bureaucracies in the larger society; etc.

5 units, Aut (Baldridge) MW 9–11 and by arrangement

333. Leadership in Organizations—(Same as Sociology 159 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 1:30–3:05

334. Counseling Practicum—Supervised experience in the Counseling and Psychological Services unit of the Cowell Student Health Center. Pre- and post-doctoral students with prior counseling or clinical experience work under supervision providing individual and group counseling and testing services. Practice is supplemented by a training seminar and directed reading. Requires a minimum of 8 hours a week. By consent; advanced application required. May be repeated for credit.

2 to 4 units, Aut, Win, Spr (Browning, Staff) by arrangement

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 (Krumboltz, Staff) by arrangement

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 researchable problems in general curriculum.

4 units, Aut (Eisner) TTh 1:15-3:05

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

344. Alternative Models for Elementary Education—Theory, practices, trends, issues in curriculum development and instruction in the elementary school. For experienced elementary school personnel and advanced degree students from areas of concentration other than elementary education.

4 units, Aut (Shaftel) TTh 2:15-4:05

Sum (Shaftel) MW 3:15-5:05

345. Sociodrama and Related Techniques—Designed to help classroom teachers explore the rationale and skills for role-playing, dramatic play, and related techniques as teaching tools for inter-personal relations, cross-cultural understanding, and decision-making in the social studies.

4 units, Spr (Shaftel) TTh 4:15-6:05

347. An Overview of American Higher Education—Contemporary examples of institutions of higher education and an analysis of their functions and problems. Recommended for candidates for the junior college credentials and for others concentrating in higher education.

3 units, Aut (Mayhew) M 3:15-6:05

348. Modes of Research in Curriculum and Instruction—An advanced course for doctoral students in Curriculum and Instruction. A critical discussion of the possible aims, methods, and approaches of research in curriculum and instruction and an intensive examination of the types of studies undertaken in a few important sub-areas of the field. Prerequisites: 250B and 340 or equivalents.

3 to 4 units, Spr (Walker) MWF 9

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

4 units, Sum (Bush) MW 3:15-5:05

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 advanced doctoral students in Psychological Studies and other areas. Admission by consent of instructor.

3 units, Win (Snow) T 7-10 p.m.

351A,B. Advanced Statistical Analysis in Educational Research—Applied multivariate analysis including multiple regression, canonical analysis, discriminant analysis, factor analysis, cluster analysis. Prerequisites: Statistics 220 or equivalent and consent of instructor.

4 units, Aut, Win (Staff) MWF 11-12:30

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.

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, Spr (Cronbach) MW 2:15-4:05, alternate years, given 1973-74

354. Curriculum Evaluation—Functions of evaluation, outcomes to be measured, design of evaluation programs, qualities desired in evaluation instruments. For advanced doc-
toral students concerned with curriculum research or program evaluation. Limited to 15; advance registration required.

3 to 4 units, Win (Cronbach) MWF plus one hour to be arranged, alternate years, given 1973-74

355. Instrumentation Workshop — For students developing achievement tests, ability tests, questionnaires, or other instruments. Each student pursues his own project and participates in review of projects of others. Limited to 12; advance registration required.

1 to 4 units, Aut (Cronbach) by arrangement

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

3 units, Aut (Nixon) M 8–10, W 8–9
4 units, Sum (Nixon) MTWThF 9

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

3 units, Win (Nixon) M 8–10; W 8–9

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.

1 to 5 units, any quarter (Nixon, Ruff) 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.

2 to 3 units, Sum (Nixon) MT 8

362. Teaching English in Two-Year Colleges — Review of literature about purposes of and programs in community colleges, characteristics of students who attend them, and English programs offered. Major emphasis will be upon methods of teaching English in community colleges and upon visiting English and reading classes.

3 units, Aut (Grommon) T 1:15–3:05

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.

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) TTh 10–12

383. Recent Developments in Foreign Language Education—Basic assumptions, findings of scientific study of language as applied to language teaching methods. Use of audio-visual aids in language class. Programmed instruction in foreign languages.

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


3 units, Win (Politzer) M 4:15–6:05 and by arrangement

388. Foreign Language Education and Bilingual Education in the Elementary School — Discussion of the rationale, curriculum, methods, and materials of foreign language instruction and of bilingual education in the elementary school. Problems of organization of bilingual curricula and of articulation of foreign language and bilingual curricula with the high school.

3 units, Aut (Politzer) M 4:15–6:05 and by arrangement

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 edu-
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, Win (Begle) by arrangement, alternate years, given 1974-75

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, Win (Staff) Th 1:15-3:05
1 to 3 units, Sum (Staff) T 1:15-3:05
and by arrangement (Limited to NSF Institute participants)

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, Win, Spr (Begle) by arrangement


3 to 4 units, Win (Cross) T 3:15-5:05


4 units, Spr (Shaftel) MW 2:15-4:05

399. Reading in Elementary Schools — For experienced teachers, graduate students. Reviews research, curriculum issues, instructional procedures related to program of reading in elementary schools.

3 units, Win (Staff) W 4:15-6:05 and by arrangement

399A. New Techniques in Reading Instruction (Primary Grades).

2 units, Sum (Staff) MTWThF 8-10
(June 24–July 5)

399B. New Techniques in Reading Instruction (Intermediate Grades).

2 units, Sum (Staff) MTWThF 8-10
(July 8–19)

SEMINARS AND SPECIAL COURSES FOR ADVANCED GRADUATE STUDENTS

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 1974-75

401B. Seminar in the History of American Education: Urban Education — Research seminar, focusing in 1974 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) by arrangement

402. Clinical Seminar in Early Education—The seminar is organized around field work and group discussion on educational programs for students from low-income and minority backgrounds. The seminar includes visits with teachers, aides, parents, administrators and others in the field.

3 units, Win (Hess) Th 3:15-5:05

404. Seminar in the Philosophy of Education — Intensive study of student-selected topics. Emphasis may shift between epistemology and value theory each quarter, to be announced one quarter in advance. Seminar designed for majors in philosophy of education; others admitted on consent of instructor.

4 units, Win (Pacheco) W 10-12
Spr (Thomas) W 7-10 p.m.

405. Philosophy, Education, and Society—(Same as Philosophy 215.) A detailed philosophical examination of some aspects of the relationship between school and society. Seminar designed for majors in philosophy of education; others admitted on consent of instructor.

4 units, Win (Pacheco) T 7-10 p.m.

406H. Research Colloquium in International Development Education—A continuing colloquium for the discussion of research proposals and findings of students and faculty in International Development Education and related areas. Emphasis is placed upon a common research preparation ex-
SCHOOL OF EDUCATION

experience, and upon basic and remedial methodological training.

3 units, Aut, Win, Spr (Textor) W 12–2

407. Research Methodology: Practicum —
The seminar will review a selected number of dissertations representing various social science approaches to the study of educational problems; these dissertations will be systematically examined from the point of view of methodological adequacy and rigor. Prerequisite: consent of instructor.

4 units, Aut (Weiler) M 2:15–4:05

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 (Weiler) M 2:15–4:05


1 to 3 units, Aut, Win (Hess)
by arrangement

1 to 3 units, Spr (Staff) by arrangement


1 to 3 units, Aut, Win (Hess)
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, any quarter (Snow, Staff)
by arrangement

418A,B,C. Advanced Research in Organization Theory I, II, III—(Same as Sociology 289A,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 (Staff) M 3:15–5:05

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, Spr (Gage) MW 4:15–6:05,
alternate years, given 1974–75

420. Seminar in Educational Administration—Advanced seminar in general educational administration. Analysis of current research and of problems and opportunities emerging from field work and internship assignments.

2 to 5 units, Aut, Win, Spr (Strand)
by arrangement

423A,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, Win, Spr (Baldrige) M 7–10

423A. Seminar in Education and Public Policy: State School Administration Policy —This seminar will focus on trends in state policy and administration including an in-depth study of California. Topics to be considered are: Impact of the “New Federalism,” coordination of policy among levels of education, and the response of local schools to state regulation. Several guest speakers from California state government will be used.

3 units, Win (Kirst) M 3:15–6:05

423B. Seminar in Education and Public Policy: Research Strategies and Policy Analysis —Topical seminar including research techniques for policy formulation and examination of current controversial issues. Seminar in 1973 examined the 30 volumes of hearings before the U.S. Senate Select Committee on Equal Educational Opportunity.

3 units, Spr (Kirst) F 9–12

424A,B. Seminar in College Administration —Curricular, instructional, administrative,
and philosophical developments in collegiate administration with a special emphasis on individual institutions.

424A. 3 units, Win (Mayhew) T 1:15–4:05
424B. 3 units, Spr (Mayhew) T 1:15–4:05

425A,B,C. Seminar in Planning and Technology in Educational Administration—Designed for advanced candidates in educational administration. The three quarter sequence will examine the process of planning in relation to organizational and community goals, personnel involved, policy development and administration, and implications for resource allocation, and the use of a variety of technologies in planning and implementation.

425A. 3 units, Aut (Staff) Th 3:15–6:05
425B. 3 units, Win (Staff) Th 3:15–6:05
425C. 3 units, Spr (Staff) Th 3:15–6:05

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, any quarter (Krumboltz and Staff) T 7:30–9:30 p.m., biweekly

440. Seminar in the School Curriculum — Designed for doctoral students in the field of education interested in the development of curriculum theory and curriculum research. Students will develop and present theoretical models and proposals for the empirical study of curriculum problems. Prerequisite:

2 to 4 units, Spr (Walker) Th 10–12

444. Seminar in Elementary School Education—Enrollment limited to doctoral candidates in elementary school education and to those in special curriculum fields who plan to work primarily with the elementary school. Major issues and problems of elementary school education analyzed; relevant research literature explored; research problems formulated.

2 to 4 units, Aut (Shaftel) W 4:15–6:05 and by arrangement


Any quarter (Staff) by arrangement

459. Seminar on Physical Education Issues—Selected issues and problems in physical education.

3 units, Spr (Nixon) M 8–10; W 8

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 5 units, Win (Eisner) by arrangement

462A,B,C. Seminar in English Education.
462A. History of English as a School Subject and of the Preparation of Teachers of English.

3 units, Aut (Grommon) W 1:15–4:05

462B. Curricular Developments Related to English in the Schools.

3 units, Win (Grommon) W 1:15–4:05

given 1974–75

462C. Research in the Learning and Teaching of English; Programs for the Academic and Professional Education of Prospective and Experienced Teachers of English.

3 units, Spr (Grommon) W 1:15–4:05

given 1974–75

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 (Begle and Walker) by arrangement

Win (Bush and Deslonde) by arrangement

Spr (Eisner and Shaftel) by arrangement

470. Practicum.

By arrangement

480. Directed Reading — For advanced graduate students.

By arrangement
   2 to 4 units, Spr (Politzer) M 4:15–6:05 and by arrangement

483. Seminar in Mathematical Models of Learning and Instruction—(Same as Philosophy 210B.) Discussion of current work in mathematical models, with emphasis on theoretical concepts and problems of data analysis. For advanced students.
   1 to 3 units, Win (Suppes) M 12 and by arrangement

490. Directed Research — For advanced graduate students.
   By arrangement

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) by arrangement

493. Seminar in Applied Statistics—Discussion and continuing practicum on research problems.
   2 to 3 units, Aut, Win, Spr (Staff) T 12 and by arrangement

494. Seminar in Science Education—Consideration of researchable problems in science education, relevant research, and research strategies which may be applicable. For advanced students.
   2 units, Aut, Win, Spr (Bridgham) Th 7:30-9:30 p.m.

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.
   2 to 4 units, Win (Gross) W 7–10 p.m.

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) W 7–10 p.m.
SCHOOL of ENGINEERING

Dean: William M. Kays
Associate Deans: Robert H. Eustis (Academic Affairs), John G. Linvill, L. Farrell McGhie, Robert L. Street (Research), Lauress L. Wise (Student Relations)
Assistant Dean: Alfred D. Kirkland, Robert M. Lindquist
Secretary of the Faculty: George M. Homsy
Professor of Space Science and Astrophysics: Peter A. Sturrock
Consulting Professor of Engineering: Hans M. Mark

The School of Engineering offers four-year undergraduate programs leading to the degree of Bachelor of Science, or in the case of Architecture and Urban Design 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 ten academic departments: Aeronautics and Astronautics, Applied Mechanics, 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 and the program in Product Design. An undergraduate program in Architecture is offered in the Department of Mechanical Engineering and a graduate program in Urban Planning is offered in the Department of Civil Engineering.

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 are permitted to 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, including trigonometry. Placement tests are given by the Department of Mathematics during the registration period. Students who do not place high enough in the test will be required to take Mathematics 0, Algebra and Trigonometry, in addition to the normal graduation requirements in engineering. 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 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 important requirement of "Functional Balance" (see explanatory section below). 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 requirements in the areas of mathematics, natural sciences, and technology will be satisfied automatically by the engineering program). Students who qualify for advance placement will be held to correspondingly fewer units in the math and sciences areas.

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 (minimum) are required by the University for graduation (see the first section of this bulletin for details).

Social Sciences

Three courses (minimum) 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 and Social Sciences units be at least 23.

Technology and Society

Every engineer needs to have an appreciation of the role of technology in society in order to make the value judgments he 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 partial list of courses and seminars 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, training in the use of computers, and understanding of statistics or probability theory. The minimum preparation should normally include work to the level of Mathematics 43, some competence in computer programming, and a basic knowledge of statistics. The ability to deal with ordinary differential equations and with matrices is important in many areas of engineering, and stu-
students are encouraged to select additional courses in these topics.

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 Physics 51 to 56 (14 units) will normally be 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.

The additional science courses should be selected by the student with some consideration of a probable engineering program. Chemistry 4 and 5 are of particular importance to students anticipating programs in the general areas of chemical engineering, applied thermodynamics, and materials science. Additional courses in organic chemistry are desirable for chemical engineers. Physics 57 to 58 will be of interest to students interested in areas of engineering relying heavily on quantum physics, such as materials science and electrical engineering. Biology 1 and 21, 22, and 23 will be of interest to students anticipating programs in environmental engineering, biotechnology, and related fields. Geology 1 is of importance to those interested in the design of civil engineering structures and construction.

Engineering Breadth (30 units minimum)

Every engineering student should include in the program course work selected from a variety of disciplines in order to:

1. to obtain a look at the principles and techniques of the several branches of engineering as an aid in career selection,
2. to gain a general viewpoint by seeing basic principles in a variety of forms as they find application in diverse disciplines,
3. to secure protection against the hazards of too much specialization too early, and
4. to gain an introductory knowledge of several of the engineering sciences as preparation for work on complex problems.

Accordingly, each student is expected to select at least 30 units of courses from not fewer than five of the eight categories listed below. To ensure breadth, the courses selected in at least three of the five chosen categories should lie in areas not directly related to the major program of study as defined by the Engineering Depth sequence. (Note—No more than 10 units in any one category can be counted toward satisfaction of this breadth requirement.) There are many courses which may be used in each of the categories. The following list gives typical courses. (Consult individual course descriptions for prerequisites.) Substitutions may be made with adviser's approval.

Alternatively, a student may, with the help of the adviser, draw up a combination of courses which provides technical breadth and is compatible with his or her unique career goals. Such a program can be approved by the Undergraduate Council if it satisfies the spirit of the breadth requirement. There are many introductory courses offered by various departments which are suitable for this purpose. Students are urged to consider all the various possibilities before making definite course selections.

1. Mechanics of Solids and Fluids

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 4</td>
<td>Applied Mechanics II</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 5</td>
<td>Applied Mechanics III</td>
<td>3</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>Physics 110</td>
<td>Intermediate Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr.140</td>
<td>Fluid Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr.140L Fl. Dynamics</td>
<td>Demonstration Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Mech. Engr.33</td>
<td>Introductory Fluids Eng.</td>
<td>3</td>
</tr>
</tbody>
</table>

More advanced courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>Appl. Mech. 280A,B, Biochematics</td>
<td>3, 3</td>
<td></td>
</tr>
<tr>
<td>Civil Engr. 107</td>
<td>Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 114</td>
<td>Mechanics of Materials</td>
<td>4</td>
</tr>
<tr>
<td>Physics 111</td>
<td>Intermediate Mechanics</td>
<td>3</td>
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2. Electromagnetism, Electric Circuits, and Devices

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 41, 41A, 42, 42A</td>
<td>Circuits, Electronics and Electromechanics</td>
<td>4, 1, 4, 1</td>
</tr>
<tr>
<td>Engr. 44</td>
<td>Basic Electronics</td>
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</table>

More advanced courses

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>Elec. Engr. 101</td>
<td>Circuits I</td>
<td>3</td>
</tr>
<tr>
<td>Elec. Engr. 141</td>
<td>Electromagnetic Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>Physics 120</td>
<td>Intermediate Electricity and Magnetism</td>
<td>3</td>
</tr>
</tbody>
</table>

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>Physics 170</td>
<td>Thermodynamics, Kinetic Theory and Statistical Mechanics</td>
<td>3</td>
</tr>
</tbody>
</table>
SCHOOL OF ENGINEERING

Chem. 171. Physical Chemistry
Mat. Sci. 181. Thermodynamics and Phase Equilibria

More advanced courses
Chem. Engr. 110. Equilibrium in Thermodynamic Systems

4. MATERIALS SCIENCE AND PROPERTIES
Engr. 50. Introductory Science of Materials
Mech. Engr. 111. Failure Prevention

More advanced courses
Civil Engr. 118. Materials Engineering
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
Comp. Sci. 106. Introduction to Computing
Phil. 160A. Symbolic Logic
Phil. 162A. Theory of Automata

More advanced courses
Comp. Sci. 111. Introduction to Computer Organization, Machine and Assembly Languages
Comp. Sci. 140A. 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. Utilization of Computers
Phil. 160B. Symbolic Logic

6. SYSTEMS ANALYSIS AND CONTROL
Engr. 104. Dynamic Response
Engr. 105. Control System Analysis and Design
Indus. Engr. 108. Work Design and Measurement

More advanced courses
Engr. 206. Control System Analysis and Design
Indus. Engr. 160, 164. Analysis of Production Systems; Production Engineering Problems
Engr.-Econ. Sys. 201A,B,C. Introductory System Analysis

7. MASS AND ENERGY TRANSFER
Chem. Engr. 20. Introduction to Chemical Engineering
Chem. Engr. 120. Separations Processes
Chem. Engr. 120L. Separations Processes Demonstration Laboratory
Chem. Engr. 150. Heat and Mass Transfer
Chem. Engr. 150L. Heat and Mass Transfer Laboratory
Mat. Sci. 182. Rate Processes in Materials
Mech. Engr. 230A. Heat Transfer

8. DECISION PROCESSES, ENGINEERING ECONOMY, AND DESIGN
Engr. 102. Optimization
Engr. 161. Engineering Economy
Mech. Engr. 103. Manufacturing Technology
Oper. Res. 152. Operations Research

More advanced courses
Engr. 235A,B. Engr. Systems Design
Engr.-Econ. Sys. 212A,B. Price and Income Theory
Engr.-Econ. Sys. 231A,B. Decision Analysis
Mech. Engr. 115A. Introduction to Product Design

Engineering Depth (36 units minimum)
The rapid advance in scientific knowledge and technological achievement requires even higher technical proficiency in the engineer. The undergraduate should select a coordinated series of courses to gain mastery of the important principles and techniques in a well-defined field and some experience in their application to significant problems.

There are three ways in which a student may satisfy the depth requirement. (1) Departmental Majors. One may complete 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). (2) Interdisciplinary Majors. One may complete one of the sequence of courses suggested by the Undergraduate Council. These acknowledge growing needs for engineering education not confined to a traditional discipline. (3) Innovative Majors. One may, with the help of an adviser, propose a combination of courses to meet 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, experimen-
tation, 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, experimentation, and communication. 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 curriculum. This is particularly important for interdisciplinary and innovative programs that are to be accredited.

Accreditation

The Engineers Council for Professional Development (ECPD), an organization formed by the several professional societies, 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 School of Engineering.

In addition to standards of quality, ECPD criteria for accreditation include approximately one year of work in the basic sciences and mathematics, approximately one year of study in the engineering sciences, and at least one half year of study with emphasis on design, synthesis, and a systems point of view. Accredited programs meet these criteria through the basic mathematics, science, engineering-breadth and engineering-depth requirements and the functional balance requirement.

The following undergraduate curricula are accredited: Chemical Engineering, Civil Engineering, Electrical Engineering, Industrial Engineering, Materials Science and Engineering, and Mechanical Engineering. An Aeronautics and Astronautics curriculum is accredited at the Master's degree level (and may be for the B.S. degree). Interdisciplinary Majors and Innovative Programs may be accredited under General Engineering if, on careful examination, they are found to meet the ECPD accreditation criteria. Innovative or other programs which, in the opinion of the Undergraduate Council, do not meet the ECPD accreditation criteria will be designated simply Engineering.

Students who seek accreditation of Interdisciplinary or Innovative programs must specifically petition the Undergraduate Council therefor. The petition must include a cogent explanation of how the program meets the ECPD criteria outlined above. It should be submitted as early as possible, and in no case later than when submitting the program for general Undergraduate Council approval (see under Interdisciplinary Majors and Innovative Majors below).

Finally, a program is offered and described below under the heading "Engineering and Society Program."

**ENGINEERING MAJORS**

The 36-unit engineering depth requirement permits the student to select a major course of study and obtain a limited amount of specialization. There are three categories of engineering majors, described below.

**I. Department 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.

**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. 132</td>
<td>Theory and Practice of Identifications</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 173</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 174</td>
<td>Physical Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 175</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 110</td>
<td>Equilibrium in Thermodynamic Systems</td>
<td>3</td>
</tr>
<tr>
<td>Chem. Engr. 120</td>
<td>Separations Processes</td>
<td>3</td>
</tr>
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Mechanical Engineering

M.E. 101. Visual Thinking 3
M.E. 103. Manufacturing Technology 4
M.E. 107. Mechanical Systems 3
M.E. 111. Failure Prevention 3
M.E. 113. Engineering Design 3
M.E. 131A,B,C. Thermosciences 14
Engr. 104. Dynamic Response
or M.E. 161. Engineering Vibrations 3
Any M.E. course in the 100 or 200 series 3

II. Interdisciplinary Majors

The Undergraduate Council is responsible for specialties that cross departmental lines. Students must obtain approval of their programs by the Undergraduate Council; they should be submitted during the junior year, but in any case not later than the end of the fifth week of the third quarter preceding graduation, and should include a statement that describes a well-defined educational objective and the approval of the student's adviser. If ECPD accreditation is sought, see additional instructions in the section “Accreditation” above. Additional information 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 3
Civil Engr. 114. Mechanics of Materials 4
Mech. Engr. 131A. Thermosciences: Thermodynamics 5
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 3
Restricted Electives 6

Product Design*

Mech. Engr. 103. Manufacturing Technology 4
Mech. Engr. 115A,B. Introduction to Product Design and Environmental Design 6
Art 40. Basic Drawing and Painting 2
Art 50. Basic Sculpture 3
Art 60. Basic Design 3
Art 160. Design 3

* Refer to Mechanical Engineering section of this bulletin for graduate programs in Product Design.
III. Innovative Majors

Any student, with the help of his or her adviser, may propose a unique combination of courses to meet particular career goals. Such a program should be submitted to the Undergraduate Council during the junior year, but in any case not later than the end of the fifth week of the third quarter preceding graduation. A coordinated sequence of courses that provides mastery of the important principles and techniques in a well-defined field will ordinarily be approved (though not necessarily accredited). If ECPD accreditation is sought, see additional instructions in the section “Accreditation” above. Programs for other interdisciplinary majors, such as Bio- or Premedical-Engineering, Environmental Engineering (see also Civil Engineering), Urban Planning (see also Civil Engineering), Ocean Engineering, may be developed within the framework of the innovative major. Lists of courses in these areas are available from the Office of the Dean, School 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 and Society Program

The increased complexity of social and scientific problems is such that an undergraduate program reflecting the interrelation of engineering, science, and societal subjects forms a desirable basis for many careers. The School of Engineering offers the Engineering and Society Program to meet this need.

The following requirements are prescribed for this Program: Writing (two courses, unless a student is exempt from all or part of this requirement); Humanities and Fine Arts (three courses minimum); Social Sciences (three courses minimum); Mathematics (21 units); Science (24 units); a plan of courses in Engineering and Society forming a coherent program to satisfy a well-defined educational objective (64 units, of which at least 36 units must be in courses in engineering); Functional Balance, including a minimum of nine units of analysis; Free Electives (sufficient for a total of 180 units—typically between 40 and 50 units). A list of suggested courses is available.

Students who elect the Engineering and Society Program must obtain approval of their programs by the Undergraduate Council. Petitions requesting admission to the Program should be submitted not later than the end of the fifth week of the third quarter preceding graduation, and should contain a statement describing a well-defined educational objective, the program of courses relevant to this objective that meets the requirements listed above, and the approval of the student’s adviser. Students in this Program who wish to pursue graduate studies in engineering may require more than three quarters to complete departmental Master’s degree requirements.

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. A worthwhile strategy for the bioengineering undergraduate may thus be to supplement his major in some branch of engineering with basic courses in biology and chemistry, such as:

Biol. 1. Introductory Biology
Biol. 21, 22, 23. Principles of Biology
Human Biology 1. Man and Nature
Human Biology 2A. Cells, Organisms, and Societies
Human Biology 2B. Behavior as Adaptation
Chem. 1, 2, 3 or 4, 5. General Chemistry (Note that pre-medical students are usually required to have a full year of chemistry.)
Chem. 121. Organic Chemistry

The student with further free electives might then choose from such courses as:
Engr. 104. Dynamic Response—Its prerequisites provide basic engineering background
Biol. 153. The Physiological Basis of Behavior
Civ. Engr. 170. Man and his Environment
Elect. Engr. 208. Biological Information Processing

Program Planning

An engineering curriculum provides a cumulative educational experience, and attention must be paid to course prerequisites. The study of mathematics should begin in
the freshman year. Physics is a prerequisite for many engineering courses and should be started in the Winter Quarter of the freshman year. However, if the sequence Engr. 3, 4, 5, which introduces first-year students to engineering mechanics is selected, physics may be postponed. The engineering breadth courses may be spread over the first three years. The engineering depth sequences ordinarily require at least two years for their completion and should be started no later than the third year. Sample programs are available in the office of the Dean of Engineering.

In selecting courses for his undergraduate curriculum, each student should take into consideration his plans for graduate study. Many graduate programs of study have undergraduate courses as prerequisites; students who enter graduate programs without these prerequisites may have to spend extra time making up deficiencies. Consult your adviser if you have any questions about admission to graduate study.

In addition, some students may eventually seek professional engineering registration; consult your adviser as to desirable courses to take in preparation for the Engineer-in-Training and the Professional Registration examinations.

Combined A.B. and B.S. Degree Programs

A Stanford undergraduate may work simultaneously toward the A.B. and B.S. degrees (for example, an A.B. in Economics and a B.S. in Civil Engineering). The degrees may be awarded in the same quarter or in different quarters. Usually five years will be needed for the combined program.

To qualify for both degrees a student must:
1. file a petition of intent during the tenth or eleventh quarter, endorsed by appropriate representatives of the two departments in which he or she expects to receive degrees;
2. include with the application a proposed B.S.-M.S. program of courses;
3. be admitted by the school or department in which he or she seeks the M.S.;
4. complete 15 full-time quarters or the equivalent, or three full quarters after completing 180 units;
5. complete all requirements for the B.S. program; and
6. complete the requirements for the M.S. program.

Consult the Office of the Dean of Engineering for procedural details.

Dual Degree Programs

Stanford University cooperates with certain liberal arts colleges (presently Centenary College, Claremont Men's College, the College of Idaho, Knox College, Pacific Lutheran College, George Pepperdine College, The University of Redlands, 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" pro-
gram 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 Mechnique 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 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 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
Flight Mechanics
Gaskinetics
Guidance and Control
Physical Gas Dynamics
Propulsion
Transportation
Waves and Vibrations

APPLIED MECHANICS

Continuum Mechanics
  Elasticity, Plasticity, Viscoelasticity, Shells and Plates, Instabilities (elastic, plastic, dynamic)
  Stress Waves in Solids
Composites Fracture of Solids
Experimental Stress Analysis
Dynamics
  Rigid Bodies, Space Dynamics, Vibrations (linear and nonlinear)
Fluid Mechanics
  Dynamics of Ideal Fluids and Gases
  Viscous Flow
Geophysical and Astronomical Fluid Mechanics
Applied Optimal Control
  Optimal Trajectories, Feedback, Control, Filtering, and Smoothing
Biomechanics
  Bone Fracture and Repair, Joint and Tissue Mechanics, Orthopaedic Procedures

ENGINEERING

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**
- Civil Engineering Management
- Civil Engineering Materials
- Construction Management
- Engineering-Economic Planning
- Environmental Engineering
- Hydrology
- Hydromechanics
- Nuclear Civil Engineering
- Reliability Engineering
- Soil Mechanics and Foundations
- Structural Engineering
- Structural Mechanics
- Transportation
- Urban Planning
- Water Resources

**Electrical Engineering**
- Computer Systems
- Engineering in Medicine
- Lasers and Quantum Electronics
- Microwave Acoustics
- Network Theory
- Plasmas
- Radioscience
- Space Engineering
- Signal Processing Systems
- Solid State Devices and Integrated Systems
- Solid State Devices and Systems
- Solid State Phenomena and Materials
- Statistical Theory of Communication and Control

**Hydrology**
(See separate section in this bulletin.)

**Industrial Engineering**
- Computer Utilization
- Economic Systems Planning
- Management Systems Design
- Systems Analysis and Synthesis

**Materials Science and Engineering**
- Physical Metallurgy
- Electronic Properties of Solids
- Mechanics of Solids
- Magnetic Behavior of Solids
- Mechanical Behavior of Solids
- Thermodynamics of Solids
- Biomaterials
- Reaction Kinetics in Solids
- Polymer Science
- Crystal Growth
- X-ray and Electron Diffraction and Spectroscopy

**Mechanical Engineering**
- Energy Systems
- Thermodynamics
- Heat Transfer
- Fluid Mechanics
- Plasma Gasdynamics
- Engineering Design
- Kinematics, Control Systems
- Product Design
- Nuclear Engineering
- Optimization

**Operations Research**
- Applied Probability
- Dynamic Programming and Mathematical System Theory
- Inventory, Queueing, and Reliability Theory
- Linear, Nonlinear, and Integer Programming
- Networks, Graphs, and Combinatorial Theory

**Space Science**
(See separate section in this bulletin.)

For further details see the department sections following.

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 advisers, to select courses in departments other than their own to achieve a broader appreci-
ation 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 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, Nuclear Engineering) 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.

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 intimately allied 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 interdepartmental in nature (e.g., Bioengineering, Nuclear Engineering) 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 programs 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. 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 Professors: Daniel B. DeBra, Bruce B. Lusignan

Assistant Professor: J. David Powell

Lecturer: Egon Loebner

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 (see list "Engineering Courses of General Interest" in the Engineering and Society section of this bulletin).

In addition, certain departmental courses are of general interest and without prerequisites; consult the list referred to above.

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 (DeBra) 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. Experiments are performed to sharpen perception, develop the ability to face emotional situations, focus misdirected energy, identify manipulation, develop accurate intuition and judgment, improve communications, and illuminate such interpersonal issues as inclusion, control, and cooperation. The methods used in the course are experimental. 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 (Roth, Wilde) W 1:15-5:05
   Win, Spr (Roth, Wilde) T 1:15-5:05

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 (Kane) 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 41.
3 units, Win (Kane) MWF 11

5. Applied Mechanics III—Continuation of 4. Prerequisites: 4, Math 11 or 41.
3 units, Spr (Kane) 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, its use in solving engineering problems, and to the technical and social 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.
3 units, Win (Reynolds) MWF 11; 1 to 2 additional units (term project) by arrangement

10. Aeronautics and Astronautics — The principles of flight of airplanes, missiles, satellites, and spacecraft are explained physically, with a minimum amount of mathematics. The history of the development of these vehicles is sketched and biographic information is given on the great inventors, scientists, engineers, designers, pilots, and industrialists who have contributed to the growth of aeronautics and astronautics. Open to all students who have taken some mathematics and physics in high school.
3 units, Spr (Mayers) TTh 11:00–12:15

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 42.
4 units, Aut (Mayers) MWF 9; problem sessions by arrangement
Win (Gere) MWF 9, W 2:15–4:05
Spr (Richards) MTWF 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, Aut (Bershader) MWF 9, problem sessions by arrangement
Win (Weaver) MTWF 9
Spr (Staff) MTWF 9

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 9; lab. M or T 1:15–4:05
Win (Bershader) MWF 9; lab. M or T 1:15–4:05

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 (Staff) MWF 8
Win (Staff) MWF 8

41. 4 units, Aut (L. Manning) MWF 9;
2-hour problem session
Win (Heiwell) MWF 10;
2-hour problem session
Spr (Smith) MWF 9;
2-hour problem session
42. 4 units, Win (L. Manning) MWF 9; 2-hour problem session  
   Spr (Helliwell) MWF 10; 2-hour problem session

41A. Laboratory I—To accompany 41.  
   1 unit, Aut, Win, Spr (Helliwell) one 3-hour lab. by arrangement

42A. Laboratory II—To accompany 42.  
   1 unit, Win, Spr (Helliwell) one 3-hour lab. 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 41. 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 (Pound) MWF 11  
   Win (Sherby) MWF 11  
   Spr (Stevenson) MWF 10

102. Optimization — Mathematical ways of finding the best values of design, decision, or operating variables. Nonlinear and polynomial optimization under constraint. Direct optimum-seeking methods. Dynamic programming and partial optimization of large systems. Prerequisite: elementary differential calculus.

3 units, Aut (Wilde) MWF 11


3 units, Aut (Staff) MWF 11  
   Win (Staff) MWF 11


3 units, Aut (Widrow) MWF 10  
   Win (Staff) MWF 8  
   Spr (Bryson) MWF 11

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

174. Nuclear Science—(Same as Chemistry 143.) Properties of the atomic nucleus; elements of quantum mechanics; nuclear structure, stability, and energetics; modes, kinetics, and statistics of radioactive decay; alpha, beta, gamma, and neutron radiations; nuclear reactions; fission and fusion; interaction of radiation with matter; radiation detection and spectroscopy; radiation chemistry; applications in chemistry and engineering. Prerequisites: Physics 57 or equivalent.

3 units, Aut (P. Kruger) TTh 11:00-12:15

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. Prerequisite: Mathematics 43.

3 units, Win (Connolly) MWF 9
199. 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

OTHER COURSES OF INTEREST

Political Science 138A,B. Problems of Arms Control and Disarmament—General international politics; international law and relations, stressing political, legal, and technological problems of arms control. 138A is a prerequisite to 138B; the second quarter will provide for individual research.

138A. 5 units, Win (Lewis, Barton, Craig, D. Dunn, T. Ehrlich, J. Lederberg, W. Panofsky, Paret, A. Peterson) MTWTh 1:15

138B. 5 units, Spr (Lewis, Barton, Craig, D. Dunn, T. Ehrlich, J. Lederberg, W. Panofsky, Paret, A. Peterson) MTWTh 1:15

COURSES OF INTEREST PRIMARILY TO GRADUATE STUDENTS


3 units, Win (Wilde) MWF 1:15

204. Introduction to Heuristics of Invention and Discovery—This course aids in the actualization and development of innate potentials for invention and discovery. Students are prepared to make patentable inventions, each in his own chosen field of interest or specialization. Knowledge generating skills of scientific observation, formal reasoning, practical action and heuristic intuition are studied and practiced. Special emphasis is given to retroduction, as taught by Charles Sanders Peirce and to physical analogy, as taught by James Clerk Maxwell. Library work and writing assignments deal with explorations of creativity and detailed analyses of the latest patents covering the chosen fields. Open to all senior and graduate students.

3 or 4 units, Win (Loebner) TTh 1:15–2:45

206. Control Systems Analysis and Design—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.

3 units, Win (Staff), Spr (DeBra) MW 1:15; lab. by arrangement

207. Digital Control—Study of the digital computer as an element in feedback control systems. Sampling, z-transforms, state variables, quantizing, digital filters. Introduction to multivariable control. Laboratory experiments. Prerequisite: 105.

3 units, Win (Powell), Spr (Franklin) TTh 11; one 3-hour 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 (Crawford) alternate years, given 1974–75

215. Experimental Plasma Physics Laboratory—Comprehensively equipped teaching laboratory facilities are available for students wishing to carry out directed studies in experimental plasma physics. An extensive set of experiments has been developed which introduce the student to selected basic plasma phenomena. These emphasize the characteristics and methods of production of various laboratory plasmas, and involve dc, rf, and optical diagnostic techniques. Alternative experiments may be pro-
posed for consideration. Prerequisite: consent of instructor.

1 or more units, any quarter (Staff) by arrangement

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. Systems designed in previous years include: satellites to explore Mars, to monitor the earth's weather and natural resources, and to provide educational TV to developing countries; ocean systems to develop the sea's resources; and plans for urban resource development by working directly with community action groups have also been designed. Over 20 speakers from government agencies, industry, and local communities provide the necessary background. At the end of the second quarter, the class publishes a final report on the system.

235A. 3 units, Win (Lusignan) T 1:15-3:05, Th 1:15; two hours by arrangement
235B. 3 to 5 units, Spr (Lusignan) 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.

1 unit, 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

296A,B. Seminar on Engineering Teaching — Weekly presentations and discussions for guidance of those who intend to make a profession of engineering teaching. Open to all. Graduate students from all engineering departments are especially invited. Seminars in the winter quarter will relate particularly to teaching, and in the spring quarter particularly to the other responsibilities of the teacher such as administration, curricula, publication of books and papers, research, and professional duties. 296A need not precede 296B. A student completing this seminar may elect to receive either a letter grade or a pass.

296A. 1 unit, Win (Skilling) T 3:15-5:05
296B. 1 unit, Spr (Skilling) T 3:15-5:05

297. Seminar for Engineers from Developing Nations—A seminar which is a required part of the International Program for Engineering Studies and may be taken by other interested students. Speakers and topics will be selected of interest to students who will return to engineering roles in developing countries. The topics chosen will emphasize the interrelation of the discipline of engineering to economics, business, politics and education.

1 unit, Aut, Win, Spr (McWhorter) M 7-9 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 un-
der 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 has been organized around eleven themes: Biomaterials; Biomechanics; Biophysics; Biostatistics; Design for Medical Applications; Environmental Engineering; Information Processing for Biological Systems; Information Processing in Biological Systems; Integrated Circuits for Medical Electronics; and Transport Phenomena in Biological Systems. For example, in the Biomechanics program research is being conducted on bone elasticity, and cardiovascular dynamics; in the Information Processing for Biological Systems program adaptive computer techniques are being utilized for interpreting EKG's, EEG's and for administering drug dosages; and in the Transport Phenomena in Biological Systems program research is being carried out on membrane transport and enzyme engineering. In the Electrical Engineering Department a superb integrated circuits facility is used in research on implantable low power electronics, microelectrodes for biorecording and biostimulation, and micro-sensors of biologic functions. In essentially all cases, research in the School of Engineering is carried out in collaboration with faculty of the Medical School or with 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: Irmgard Flügge-Lotz, Nicholas J. Hoff, Alfred S. Niles (Professors)

Chairman: Arthur E. Bryson

Vice Chairman: Daniel Bershader


Associate Professors: Donald Baganoff, Daniel B. DeBra

Assistant Professor: J. David Powell

Senior Research Associates: Sotiris P. Koutsoyannis, Samuel C. McIntosh


**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. The teaching program provides courses leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy. The Department of 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
- Aeroelasticity
- Aerophysics
- Aerospace Structures
- Aerospace Systems Synthesis and Design
- Analytical and Experimental Methods in Solid and Fluid Mechanics
- Biomedical Solid and Fluid Mechanics
- Biomechanics
- Gaskinetics
- 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:

- Acoustics and Aerodynamic Noise
- Thermal Effects in Structures—Structural Problems of Reentry
- Creep Effects in Structures
- Stability and Postbuckling Behavior of Thin Shells
- Maximum Strength Analysis of Structures
- Static and Dynamic Behavior of Sandwich and Composite Structures
- Continuum Mechanics—Viscoelasticity
- Dynamic Response—Wave Propagation
- Unsteady Aerodynamic Theory
- Aerospace Vehicle Dynamics—Aerelastic Phenomena
- Viscous Flow—Boundary Layer Theory
- Hypersonics—Mathematical Methods of Fluid Mechanics
- High Temperature Gas Dynamics—Nonequilibrium Flow
Plasma Dynamics and Magnetoaerodynamics
Attitude Control and Instrumentation for Space Vehicles and Aircraft
Astrodynamics—Orbit Perturbations
Contactor Control—Optimal Control
Biomedical Fluid Mechanics—Hemodynamics
Aerophysics—Optical Studies of Shock-Heated Gases and Plasmas

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); spacecraft 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 secs; 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 laser scattering experiments in shock-heated gases to obtain information on kinetic processes in plasma formation. 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.

Also adjacent 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 highly 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.

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.

**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 aeronautical 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 86 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. In addition to satisfying the Department's requirements for the Master's degree (or their substantial equivalent), the candidate must complete: (1) 24 units of approved electives, of which 9 units shall be in mathematics and the remainder usually selected from one of the following fields: (a) Acoustics, (b) Aerodynamics, (c) Aerospace Structures, (d) Astronautics, (e) Experimental Methods, (f) Guidance and Control, (g) Physical Gasdynamics, (h) Plasma Dynamics and Magnetohydrodynamics, (i) Propulsion; (2) 15 units of Engineer's Thesis; and (3) 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 the passing of an examination given by the Department. This oral examination is given twice a year (January and May). Research on the doctoral dissertation may not be formally started prior to passing the Qualifying Examination. The Department also requires the passing of an examination in the reading knowledge of French, German, or Russian. Detailed information about the nature and individual scheduling of both the Qualifying and Language Examinations can be obtained from the Department. 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 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. Fellowships sponsored by Gift Funds, Stanford University, and Industrial Affiliates of Stanford University in Aeronautics and Astronautics carry grants up to $5,000 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 $250 per month, plus tuition. Research assistants are normally given the opportunity of full-time summer employment at the minimum rate of $500 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.)

129. Colloquium on Life Science Problems in Space Exploration — Basic physiological principles with special emphasis on the cardiovascular, 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, Spr (Bershader) lec. Th 1:15-2:05; lab. Th 2:15-5:05 or T 1:15-4:05

135. Introductory Acoustics—The objective of this course is to introduce the student to the basic concepts of acoustics and their applications to selected problems. The presentation will consist of lectures with experimental demonstrations: acoustic or sound waves; sound propagation through liquids and gases; plane and spherical waves; harmonic waves; energy, intensity, and power of sound; acoustic fields of simple sound radiators; acoustic impedance; reflection and refraction at interfaces; absorption of sound by solid materials; acoustic properties of materials. Applications of these concepts to problems of sound attenuation and noise reduction.

3 units, Aut (Karamcheti) MWF 1:15

188. Experimental Plasma Physics Laboratory—(Enroll in Engineering 215.)

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 8:35-9:50

200A. Engineering Analysis of Flight Vehicles—Functions of wing, fuselage, tail, control surfaces, and engine. Steady flight equilibrium; climb, cruise, steady turn, descent. Rigid body equations of motion; stability derivatives. Linearized wing theory in two and three dimensions and at subsonic and supersonic speeds; estimation of stability derivatives, air loads, and drag. Introduction to propeller and rotor theory. Prerequisite: 100 (may be taken concurrently) or equivalent.

3 units, Aut (Bryson) MWF 9


3 units, Win (Bryson) MWF 9

201. Fundamentals of Acoustics — Acoustic equations for a stationary homogeneous fluid–wave equation; sound energy and sound intensity; plane, spherical, and cylindrical waves; sound sources (simple and multipoles); inhomogeneous wave equation and its solution; harmonic waves; transmission of sound through different media—reflection, refraction, and transmission; radiation of sound from spheres, cylinders, and plane surfaces; moving sound sources and Doppler effect; sound propagation in ducts and enclosed regions, dispersion, attenuation, group velocity; absorption and dispersion of...
sound owing to viscous and heat conduction effects; sound absorption and dispersion owing to relaxation processes. Prerequisite: first year graduate standing in Engineering Applied Sciences, or consent of instructor.

3 units, Win (Karamcheti) MWF 10

202. Acoustics and Aerodynamic Noise—Acoustics of a uniformly moving homogeneous fluid, and of a nonuniformly moving inhomogeneous fluid; geometrical acoustics; sound propagation in atmosphere and water; introduction to nonlinear acoustics; equations of aerodynamic sound generation: Lighthill's equation; monopoles, dipoles, and quadrupoles; sound generation by dilatations, fluctuating forces, and stresses; radiated sound field in an unbounded medium; radiated sound field in a medium containing solid surfaces; discrete frequency fluid-mechanical sound: vortex noise, aeolian tones, edgetones generated by jets, vortices, wakes, and other free shear layers interacting with rigid surfaces; noise from turbulence; jet and rocket noise; boundary layer and wake noise; noise from propellers, helicopter rotors, and V/STOL; noise from rotating machinery (compressors, turbines, fans); duct noise; aircraft noise; sonic boom; attempts at suppressing noise from various sources. Prerequisite: 201.

3 units, Spr (Karamcheti) MWF 11

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 — 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: 135 or equivalent.

3 units, Win (Steele) by arrangement

206A. Fluid Dynamics—(Enroll in Applied Mechanics 242.)

206B. Fluid Dynamics—(Enroll in Applied Mechanics 243.)

207. Mechanics of Viscous Flow — (Enroll in Applied Mechanics 244.)


3 units, Aut (Chang) MWF 10, alternate years, given 1974–75

AERONAUTICS AND ASTRONAUTICS

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The theorems, development of the basic field equations for flow with friction and heat transfer. Thermodynamic considerations. Similarity parameters. Specialization of 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. Analysis of airfoils, wings, slender bodies, and unsteady lifting systems in M = 0 flow. Linearized potential equation for subsonic and supersonic flow; applications to similarity laws, thin wings, elementary solutions, drag of slender bodies, swept wings. Prerequisite: 210A.

3 units, Win (Baganoff) MWF 1:15


3 units, Spr (Van Dyke) MWF 1:15

211A. Physical Gas Dynamics— (Enroll in Mechanical Engineering 211A.)

211B. Physical Gas Dynamics— High-speed, high-temperature flow of gas mixtures in local thermodynamic and chemical equilibrium; physical and chemical basis of rate equations; flows with vibrational and chemical nonequilibrium. Prerequisites: 211A and 210B, or equivalent background.

3 units, Spr (Bershader) MWF 2:15

214. Numerical Methods in Fluid Mechanics— Methods for numerical solution of gasdynamic equations in Eulerian and Lagrangian form. Applications include method of characteristics, method of integral relations, and other methods used to solve initial value problems for gases in equilibrium and non-equilibrium flow. Accuracy, stability, and programming complexity are considered.

2 units, Win (Lomax) TTh 9, alternate years, given 1974–75

216. Hypersonic Flow Theory — Aerodynamics at supersonic speeds so great that nonlinearities are essential: improvements on linearized theory; Newtonian, shock-layer, and other methods for blunt bodies; blast-wave theory and self-similar solutions; viscous interaction; numerical methods. Prerequisite: completion of or concurrent registration in 210C.

3 units, Spr (Van Dyke) MWF 8, alternate years, given 1974–75

217. Geophysical Fluid Dynamics— (Enroll in Applied Mechanics 248.)

218. Similitude 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, Aut (Van Dyke) MWF 9, given 1973–74

219. 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 9

220. Advanced Physical Measurements in Gas Dynamics — Experiments on special problems in gas dynamics conducted on a project team basis, and making use of departmental facilities such as the shock tubes, supersonic jet, subsonic wind tunnel, or ballistic range. Emphasis is placed on optical methods such as laser interactions, schlieren and shadow techniques, and interferometry and spectroscopy. One lecture hour and
three laboratory hours per week. Prerequisite: 131 or equivalent.

3 units, Spr (Bershader) lec. and lab.
W 1:15–5:05, by arrangement

221. Physics of High-Velocity Motion Through the Atmosphere—Physical properties of the earth’s atmosphere and analysis of the airflow environment surrounding fast-moving vehicles over a range of altitudes. A treatment of the overall dynamics and energetics of such motion is intended to give initial perspective. There follows a combined macroscopic and microscopic study of the component physical phenomena, which include especially dissociating and ionizing shock waves, and the various forms of thermal transport. Plasma properties of the shock layer and wake are discussed. Given special emphasis is an introduction to the nature of high-temperature, multi-component boundary layers and their role as buffers in matching the viscous, thermal, and chemical behavior of the fluid flow to the drag and heating of the vehicle surface.

3 units, Aut (Bershader) TTh 1:45–3:05, alternate years, given 1973–74

222. Optical Methods in Engineering Science — Aspects of the interaction of matter with radiation of importance for the research engineer. Unified treatment of emission, absorption, refraction and scattering from the atomic/molecular optics point of view. Fundamentals of laser action in gases, including gas-dynamic and chemical lasers. Special topics include a review of shadow and Schlieren methods; and conventional, spectral and holographic interferometry as time permits.

3 units, Aut (Bershader) TTh 1:45–3:05, alternate years, given 1974–75


3 units, Win (Hansen) TTh 11:00–12:15

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 and dissociation.

3 units, Aut (Baganoff) TTh 2:15–3:30

226. Stellar and Galactic Astronomy—Introduction to stellar, galactic, and extragalactic astronomy: stars, galactic structure, the interstellar medium, galaxies. Stellar evolution: star formation, energy generation, the H-R Diagram. Modern developments, pulsars, and X-ray stars. Techniques and technical problems. Prerequisite: Two years of college physics, chemistry, or engineering, or Physics 101.

3 units, Win (Johnson) MWF 1:15

227. Space Physics—(Enroll in Applied Mechanics 240.)


3 units, Spr (Chang) MWF 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


**239. Fluid Mechanics Problems in Pollution Control**—The processes by which air pollutants are generated, transported, and ultimately removed from the atmosphere involve many of the basic principles of fluid mechanics. Similarly, the dispersion of water pollutants and several of the mechanisms used for their removal are based upon the principles studied by aeronautical and chemical engineers. The objective of this course is to explore applications of fluid mechanics to problems of the formation and control of environmental pollution. Subjects to be included are: the natural atmosphere, its composition and motion; processes of pollutant formation in electrical and automotive power generation; dispersion in the atmosphere and chemical reactions producing smog; natural processes by which pollutants disappear; emission control techniques; problems of thermal and chemical pollution in water; and the global air-water-soil balance. Student interest will guide the relative emphasis given to each subject. Prerequisite: graduate standing in engineering or science and an upperclass course in compressible fluid mechanics.

3 units, Spr (Griffith) WF 2:40-3:55

**240A. Analysis of Aerospace 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 Aerospace Structures**—Effects of deflectional, rotational, and extensional elastic restraint; introduction of Lagrangian multiplier, Dirac delta function, and Galerkin methods; bending/torsion of plates with nonuniform 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 and 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 Aerospace Structures**—Unified approach to structural analysis; inertia effects; sandwich and composite structures; applications of classical and modified variational principles to kinematically and constitutively non-linear behavior 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 (Mayers) MWF 10

**241A,B,C. Introduction to Aerospace Systems Synthesis 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 aero dynamic 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**
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 (Powell) MWF 12


3 units, Aut (Herrmann) TTh 2:15–3:30

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 (Steele) MWF 3:15, alternate years, given 1973–74

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 (Steele) MWF 3:15, alternate years, given 1973–74

244C. Aeroelasticity—Continuation of 244B. The unrestrained elastic flight vehicle. Modern unsteady aerodynamic theory. Experimental aeroelasticity. Special topics of current interest such as aeroelastic optimization and new developments in unsteady aerodynamic theory. Prerequisite: 244B.

3 units, Spr (McIntosh) MWF 3:15, alternate years, given 1973–74

245A. Theory of Elasticity—(Enroll in Applied Mechanics 202A.)

245B. Theory of Elasticity—(Enroll in Applied Mechanics 202B.)

245C. Theory of Elasticity—(Enroll in Applied Mechanics 202C.)

246. Theory of Plates—(Enroll in Applied Mechanics 207.)

247. Theory of Shells—(Enroll in Applied Mechanics 208.)


3 units, Aut (Steele) MWF 1:15, alternate years, given 1973–74

248B. Thin Shell Analysis—Membrane theory for ellipsoids, conoids, and hyperbolic paraboloids. Inclusion of bending for shells of revolution. Inextensional and edge zone solutions. Necessity for appropriate edge constraint. In the last third of the course will be given an introduction to differential geometry and the tensor treatment of the general surface. Prerequisite: 248A.

3 units, Win (Steele) MWF 1:15, alternate years, given 1974–75


3 units, Spr (Steele) MWF 1:15, alternate years, given 1974–75

248D. Thin Shell Analysis—Continuation of 248B: Linear and nonlinear stability of shells. Snap-through of shallow domes. Buckling of cylindrical, conical and spherical shells. Recent developments. Prerequisite: 248B.

3 units, Spr (Steele) MWF 1:15, alternate years, given 1973–74

253. Waves and Vibrations—(Enroll in Applied Mechanics 203.)
256. Mechanics of Composite Systems — (Enroll in Applied Mechanics 269.)

260. Aerospace Structures Laboratory — Measurement of strain; measurement of displacement and motion; surface displays (photoelastic, brittle lacquer, and Moiré fringe techniques); heat and pressure sensing; methods of load application; project experiment on aerospace structural component related to properties of materials, buckling, maximum load, vibration, creep, or aerodynamic heating. Prerequisite: 131 or equivalent.

3 units, Spr (Sendelbeck) lec. T 9; one lab. by arrangement

265. Experimental Stress Analysis — (Enroll in Applied Mechanics 205.)


3 units, Spr (Powell) TTh 9:35-10:50

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 (DeBra) MWF 8, alternate years, given 1974-75


3 units, Win (DeBra) MWF 8


3 units, Spr (Bryson) TTh 11:00-12:15

273. Digital Autopilots — Digital control with emphasis on applications where computing capacity is limited. Design aspects to minimize the effects of limited word length. Choice of sampling rate. Effect of sharing processor between many control functions. Case studies of recent digital autopilot designs. Prerequisite: Engineering 207.

3 units, Aut (Powell) MWF 10


3 units, Spr (DeBra) MWF 8, alternate years, given 1974-75


3 units, Win (Breakwell) MWF 11


3 units, Spr (Breakwell) TTh 11:00-12:15

gin's theory for linear pursuit problems. Imperfect information and decoy. Markov games. Non-zero sum and many-player games. Prerequisite: 278A or equivalent.

3 units, Aut (Breakwell) MWF 11

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 (Breakwell) 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 nonlinear oscillations and orbital analysis; non-linear resonances. Prerequisite: 279A.

3 units, Spr (Breakwell) MWF 10, alternate years, given 1974-75

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 1974-75

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 1974-75

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 1974-75

ysis and their applications. Prerequisite: 291A.

3 units, Spr (Chao) T 9 and Th 9:35–10:50, given 1974–75

294A. Introduction to Nonlinear Continuum Mechanics — (Enroll in Applied Mechanics 214A.)

294B. Introduction to Nonlinear Continuum Mechanics—(Enroll in Applied Mechanics 214B.)


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. Short-Haul Transportation — (Enroll in Graduate Special 420A,B.)

**APPLIED MECHANICS**

Emeriti: Wilhelm Flügge, Irmgard Flügge-Lotz, Miklós Hetényi, Lydik S. Jacobsen, Donovan H. Young (Professors)

Chairman: George Herrmann

Professors: Arthur E. Bryson, George Herrmann, Thomas R. Kane, Erastus H. Lee, John R. Spreiter

Assistant Professors: David M. Barnett, Wilson C. Hayes, Russell L. Mallett

**Affiliated Faculty**


**Offerings and Facilities**

Provisions are available for one, two, or three years of advanced training in solid and fluid mechanics, dynamics, automatic control, and biomechanics leading to career opportunities in industrial and governmental research establishments, in technical development in industry, and in universities and institutes of technology. Programs of study are also offered for mechanical, aeronautical, and civil engineers who find that their work involves them in advanced mechanics, and necessitates a year or more of graduate study to acquire a deeper grasp of fundamental concepts and advanced methods.

The Timoshenko Center 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
Programs of Study

Bachelor of Science

Applied Mechanics operates exclusively on the graduate level and requires the B.S. degree for admission. Suitable preparation for graduate study can be found in the undergraduate curricula of the Departments of Civil and Mechanical Engineering.

Master of Science

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this bulletin. These requirements, as well as the Applied Mechanics requirements, must be fulfilled.

To secure the recommendation of the Department of Applied Mechanics for the Master's degree, a candidate admitted to graduate standing with a B.S. degree in Engineering (or the equivalent) must complete a program of course work consisting of 9 or more units of free electives (any graduate course offered by Stanford University), 9 units of approved electives (a list of these may be obtained from the departmental office), and 27 units of the required courses AM 202A, 202B (theory of elasticity), AM 221, 222 (dynamics), AM 242, 243 (fluid mechanics), and AM 250, 251, 252 (mathematics). However, a required course should be replaced with an approved elective carrying three or more units of credit if it can be established that knowledge of the subject matter in question has been or is to be acquired without taking the course. Approval of such replacements should be requested in a letter directed to the Chairman of the Department and endorsed by the student's adviser. Special programs which depart from the above requirements can be arranged, for example for students with industrial or research experience in order to permit study in depth of some particular aspect of Applied Mechanics.

At least 45 units of course work must be completed with a minimum grade point average of 2.75. In computing this average, all Stanford courses for which letter grades were given and which were not used to satisfy requirements of another degree are taken into account. The program of study must be approved by the Student's adviser and then be submitted to the Department for approval prior to the third week of the quarter preceding the one in which the degree is to be awarded. No thesis is required.

The program assumes that, at the time of admission, the student is adequately prepared for graduate study in Applied Mechanics, particularly as to Mechanics of Materials, Ordinary Differential Equations, and Dynamics. Otherwise the student will be required to remedy the deficiency by taking appropriate courses during his graduate study. In this case more than the three quarters of residence normally needed to complete the program may be necessary.

Engineer

The University's basic requirements for the degree of Engineer are discussed in the section "Degrees" in this bulletin. These, as well as the Applied Mechanics requirements, must be fulfilled.

To secure the recommendation of the Department of Applied Mechanics for the degree of Engineer, a candidate admitted to graduate standing with a Bachelor's degree in Engineering (or the equivalent) must complete a thesis for which up to 15 units of credit may be granted. In addition, he must complete a program of course work consisting of 15 or more units of free electives (any graduate course offered by Stanford University), 33 units of approved electives (a list of these may be obtained from the departmental office), and 27 units of the required courses 202A, 202B (theory of elasticity), 221, 222 (dynamics), 242, 243 (fluid mechanics), and 250, 251, 252 (mathematics). However, a required course should be replaced with an Approved Elective carrying three or more units of credit if it can be established that knowledge of the subject matter in question has been or is to be acquired without taking the course. Approval of such replacements should be requested in a letter directed to the Chairman of the Department and endorsed by the student's adviser.

At least 90 units of work must be completed with a minimum grade point average of 3.00. In computing this average, all Stanford courses for which letter grades were given and which were not used to satisfy requirements for a Bachelor's degree are taken into account. Up to 45 units of credit may be granted for a Master's degree. The program of study must be approved by the student's adviser and then be submitted to the Department for approval prior to the third week of
the quarter preceding the one in which the degree is to be awarded.

**Doctor of Philosophy**

The University's basic requirements for the Ph.D. degree are discussed in the section "Degrees" in this bulletin. These, as well as the Applied Mechanics requirements, must be fulfilled.

Admission to candidacy for the Ph.D. Degree in Applied Mechanics (in contrast to admission to graduate standing in the University) requires passing a Qualifying Examination given by the Department and obtaining approval of a program of study. To secure the recommendation of the Department of Applied Mechanics for the Ph.D. degree, an admitted candidate must complete the program of study, submit an acceptable dissertation, and pass a Final University Oral Examination.

The Qualifying Examination is given in January and May of each year. To be admitted to this examination, a student must have a minimum grade point average of 3.25 in all Stanford graduate courses for which letter grades were given and which were not used to satisfy requirements for a Bachelor's degree. Students are advised to take the Qualifying Examination as soon as possible after completion of 30 units of graduate course work. The level and range of the Qualifying Examination are indicated by the following Stanford courses: 250, 251 and 252 or 253 (mathematics), 202A, 202B (elasticity theory), 221, 222 (dynamics), 242, 243 (fluid mechanics), Engineering 105, 106, Electrical Engineering 363A (automatic control), Materials Science 205, 238 (mechanical properties of materials). Each student is examined orally for one-half hour in each of four subjects, one of these being mathematics. Students wishing to be examined in automatic control, or in mechanical properties of materials, select the remaining two subjects from among elasticity theory, dynamics, or fluid mechanics.

The program of study must contain at least 135 units of work. Up to 45 units may be granted for a Master's degree. The program must include 18 units of free electives (any graduate course offered by Stanford University), 45 units of approved electives (a list of these may be obtained from the departmental office), and 27 units of the required courses 202A, 202B (theory of elasticity), 221, 222 (dynamics), 242, 243 (fluid mechanics), and 250, 251, 252, or 253 (math.). However, a required course should be replaced with an approved elective carrying three or more units of credit if it can be established that knowledge of the subject matter in question has been or is to be acquired without taking the course. Approval of such replacements should be requested in a letter directed to the Chairman of the Department and endorsed by the student's adviser. The program of study must be approved by the adviser and then be submitted to the Department for approval prior to the third week of the quarter preceding the one in which the degree is to be awarded.

Dissertation research is begun when the student has found a faculty member willing to act as dissertation adviser. Up to 45 units of credit may be earned for dissertation research.

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 of Applied Mechanics 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.

All Ph.D. candidates are expected to participate each quarter in one of the following seminars: 295, Solid Mechanics; 298, Fluid Mechanics; 297, Theory of Systems (or Aeronautics 297, Flight Control and Guidance).

**Fellowships and Assistantships**

University Fellowships are open to all (prospective) graduate students. See "Student Aid Funds" in the Information Bulletin obtainable from the Registrar. In addition, several special fellowships and assistantships are offered. Information and application forms (due March 1) may be obtained through the secretary of the Department of Applied Mechanics.

**Courses**

Compatibility and uniqueness of solutions. Fundamental equations of the linear theory of elastic media. Torsion and bending of bars. Prerequisites: Civil Engineering 114 and Mathematics 130, or equivalents.

3 units, Aut (Chao) MWF 9


3 units, Win (Chao) MWF 10


3 units, Spr (Chao) TTh 11:00–12:15


203A. 3 units, Spr (Herrmann) TTh 2:15–3:30
203B. 3 units, Spr (Herrmann) TTh 11:00–12:15, alternate years, given 1973–74

205A. Experimental Stress Analysis — Two dimensional theory of elasticity. Strain gage instrumentation. Rosette analysis. Brittle and birefringent coatings. Moiré. Experimental design, similitude and statistical methods. Laboratory applications to static and dynamic problems. Prerequisite: CE 114 or equivalent.

3 units, Win (Hayes) TTh 8; one lab. by arrangement

205B. Experimental Stress Analysis — General optics. Photoelastic materials. Two- and three-dimensional photoelasticity. Recording and interpretation of photoelastic data. Laboratory applications to static and dynamic problems. Prerequisite: AM 205A or consent of instructor.

3 units, Spr (Hayes) TTh 8; one lab. by arrangement

205C. Advanced Work in Experimental Mechanics — Individual projects on selected subjects. Limited enrollment. By arrangement with instructor. Prerequisite: consent of instructor.

3 to 5 units, Aut, Win, and Spr (Hayes) by arrangement


206A. 3 units, Spr (Herrmann) TTh 2:15–3:30, alternate years, given 1974–75
206B. 3 units, Aut (Herrmann) alternate years, given 1975–76

207. 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, Win (Mallett) MWF 9, alternate years, given 1973–74


3 units, Spr (Mallett) MWF 9, alternate years, given 1973–74


3 units, Aut (Lee) MWF 1

3 units, Win (Lee) MWF 11, alternate years, given 1973–74

214A. **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: 202A.

3 units, Win (Lee) TTh 11:00–12:15, alternate years, given 1973–74

214B. **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: 214A.

3 units, Spr (Lee) MWF 10, alternate years, given 1973–74

216A. **Strength and Microstructure** — (Enroll in Materials Science 205.)

216B. **Fracture of Solids** — (Enroll in Materials Science 238.)


3 units, Aut (Lee) MWF 2:15, alternate years, given 1974–75


3 units, Win (Lee) MWF 2:15, alternate years, given 1974–75

221. **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

222. **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

223. **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 9–11

224. **Rigid Body Dynamics in Spaceflight** — Description of orientation, angular velocity, and angular acceleration in terms of Euler angles, Euler parameters, and direction cosines. Forces acting on space vehicles. Attitude stability of satellites in circular and elliptic orbits. Gyroscopic devices, energy dissipation. Prerequisite: 222 or Aeronautics and Astronautics 242B.

3 units, Spr (Kane) T 2:15–4:05 and Th 2:15, alternate years, given 1974–75

225. **Theory of Vibrations** — (Enroll in Aeronautics and Astronautics 243.)

226. **Kinematic Synthesis of Mechanisms** — (Enroll in Mechanical Engineering 222.)

227. **Advanced Kinematics** — (Enroll in Mechanical Engineering 223.)

231. **Nonlinear Oscillations** — Derivation and classification of nonlinear differential equations governing various phenomena of mechanics. Phase plane trajectories and integrals of the equations of motion of autonomous systems.

3 units, Win (Kane) W 2:15–4:05 plus one hour by arrangement, alternate years, given 1973–74

232. **Nonlinear Oscillations** — Response curves and stability criteria for forced oscillations of systems with nonlinear characteristics. Systems with several degrees of freedom.

3 units, Spr (Kane) W 2:15–4:05 plus one hour by arrangement, alternate years, given 1973–74

233. **Stability of Motion** — A study of the

3 units, Win (Kane) T 2:15-4:05 plus one hour by arrangement, alternate years, given 1974-75

235A. Optimal Trajectories and Control Logic—(Enroll in Aeronautics and Astronautics 278A.)

235B. Optimal Estimation and Control Logic in the Presence of Noise—(Enroll in Aeronautics and Astronautics 278B.)

235C. Differential Games—(Enroll in Aeronautics and Astronautics 278C.)

236. On-Off Control Logic—(Enroll in Aeronautics and Astronautics 277.)

240. 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


3 units, Aut (Spreiter) TTh 2:15-3:30

243. Fluid Dynamics—Continuation of 242. Introduction to mathematical analysis of effects of compressibility, rotation, and density stratification on the flow and wave motion of an inviscid fluid. Subsonic, transonic, and supersonic flows with application to nozzles, the solar wind, thin wings, and slender bodies. Reciprocity and flow reversal theorems of acoustics and linearized compressible flow. Equilibrium, stability, wave motion and flow of rotating and stratified fluids with applications to problems of engineering, geophysical, and astronomical interest.

3 units, Win (Spreiter) TTh 2:15-3:30


3 units, Spr (Spreiter) TTh 2:15-3:30

245. Transonic Flow Theory—Description and mathematical analysis of flows in which both subsonic and supersonic velocities occur. Aeronautical application to nozzles, wings, bodies, and wing-body combinations. Discussion of shock-wave boundary-layer interaction, and of wind-tunnel wall interference effects in transonic testing. Astronomical application to the solar wind, and the accretion and mass loss of stars. Prerequisites: 242 and 243, or Aeronautics and Astronautics 210B.

3 units, Spr (Spreiter) given 1974-75

248. Geophysical Fluid Dynamics—Introduction to fluid flow and wave phenomena in the atmosphere, oceans, and interior of the Earth, and their mathematical represen-
tation. 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 possible slow convection of the "solid" mantle of the Earth. Prerequisite: 243.

3 units, Spr (Spreiter) TTh 8:35-9:50

250. Mathematical Methods in Applied Mechanics—A study of linear algebra, matrix calculus, difference equations and systems of differential equations. Applications are emphasized and the concept of a linear operator is used to unify the subjects. Topics include: linear algebraic equations, vector space concepts, eigenvalue problems and eigenvector expansions, functions of matrices, Laplace transforms, transition matrices, linear operators and function spaces concepts. Prerequisite: Knowledge of advanced calculus and elementary ordinary differential equations.

3 units, Aut (Mallett) MWF 11

251. Mathematical Methods in Applied Mechanics—Study of engineering applications leading to partial differential equations and the concept of the mathematical model. Study of properties of these equations and development of methods of solution based on ordinary differential equation theory. Introduction to generalized infinite series solutions, Sturm Liouville theory, special functions and the method of characteristics. Prerequisites: Mathematics 45 and 130 or equivalent.

3 units, Win (Mallett) MWF 8

252. Numerical Methods in Applied Mechanics—Study of numerical analysis and approximation theory with emphasis on engineering applications. Matrix methods, finite difference and polynomial approximation procedures, direct and iterative solution techniques are developed. Application to algebraic, ordinary and partial differential equations arising in initial, boundary and eigenvalue problems for discrete and continuous physical systems. Discussion of optimization if time permits. Emphasis on development of viable computational methods and efficient use of digital computers. Students will program and execute problems on Stanford's IBM 360/67 system. Prerequisites: An elementary knowledge of FORTRAN, matrix algebra, ordinary and partial differential equations.

3 units, Spr (Mallett) T 8-10, Th 8


3 units, Spr (Van Dyke) MWF 10


3 units, Spr (Chao) TTh 1:00-2:15

270. Special Problems in Applied Mechanics—Directed study for graduate students on subject of mutual interest to student and a staff member. Student must find faculty sponsor before registering.

1 to 5 units, any quarter (Staff) by arrangement

280. Physiology for Engineers and Physical Scientists—Cellular biophysics. Physiology of human musculoskeletal, circulatory and respiratory systems. Prerequisite: graduate standing or consent of instructor.

3 units, Aut (Hayes) MW 4:15-5:30

281. Biomechanics—Engineering mechanics applied to the human musculoskeletal system. Biological tissue mechanics. Viscoelastic properties. Large deformations. Applications to bone, muscle and synovial joints. Whole body and component dynamic response. Topics of current research interest are emphasized.

3 units, Win (Hayes) MW 4:15-5:30

285. Special Problems in Orthopaedic Biomechanics—Multidisciplinary approach (engineers, physical therapists and orthopaedic surgeons) to the analysis of orthopaedic procedures. Participants choose a subject of current interest, propose a research plan and
then perform preliminary analysis and experimentation. Prerequisite: AM 281.

3 units, Spr (Hayes) hours by arrangement

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 (Mallett) Th 3:45

296. Seminar in Flight Control and Guidance—(Enroll in Aeronautics and Astronautics 297.)


Aut, Win, Spr (Staff) by arrangement


Aut, Win, Spr (Staff) by arrangement

CHEMICAL ENGINEERING*

Chairman: Andreas Acrivos
Professors: Andreas Acrivos, Michel Boudart, David M. Mason
Associate Professors: John E. Lind, Jr. (on leave 1973–74), Robert J. Madix. Visiting: John P. O’Connell
Assistant Professors: George M. Homsy, Channing R. Robertson
Lecturer: Alan S. Michaels
Affiliated Faculty:


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, and applied chemical kinetics and reactor 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. 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 taken to fulfill the requirements 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.

Engineer

The degree of Engineer is awarded upon completion of six 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.

Doctor of Philosophy

The Ph.D. degree is awarded upon completion of a minimum of nine quarters of study plus the following departmental requirements:

Unit and Course Requirements — A minimum of 60 units of course work is required for the Ph.D. degree, 24 of which normally are chosen from among the graduate-level lecture course offerings in Chemical Engineering. The remaining 36 may be from courses in the basic sciences and the School of Engineering, including up to six units of 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 which is usually taken at the end of the second quarter of residence. The candidate presents orally to the Chemical Engineering faculty a comprehensive review and analysis of a technical paper assigned in his or her chosen field of interest. Upon satisfactory performance in this examination, the student is permitted to proceed with a research topic and should be prepared to choose a research adviser at this time.

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. Application should be made 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 — The concepts of momentum, mass and en-
nergy transport in equilibrium and rate processes are developed in detail in this course and their use illustrated by two case studies. In the first, energy and material balances in flowing systems are used to design a solid-waste disposal plant having municipal refuse as an input and a useful energy resource as an output. Elements of economic analysis and air pollution control are included. The second case study deals with the structure and function of the mammalian kidney; in particular, a simple model of glomerular ultrafiltration is developed to demonstrate the utility of modeling physiological systems. This is followed by an in-depth study of artificial kidney devices and the analytical approaches commonly employed to describe their mass transfer characteristics.

3 units, Win (Robertson, Homsy) MWF 1:15

20L. Introduction to Chemical Engineering Laboratory—The laboratory section consists of a small number of local plant trips in order to acquaint the class with current practices in waste disposal and uses of artificial kidneys. Pass/no credit. To be taken concurrently with 20.

1 unit, Win (Homsy, Robertson) by arrangement

110. Equilibrium in Thermodynamic Systems—Review of the postulates of thermodynamics; properties of nonideal systems including mixtures; phase equilibria including the critical region of mixtures; chemical equilibria; flow processes; heat engines and refrigeration. Prerequisite: Chemistry 171 or Engineering 32.

3 units, Win (O'Connell) 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 (Madix) MWF 10

120L. Separations Processes Demonstration Laboratory—Experiments in separations processes. To be taken concurrently with 120.

1 unit, Spr (Madix) by arrangement


3 units, Spr (Mason) by arrangement

140. Fluid Dynamics—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; unsteady viscous flow; creeping flow; potential flow; boundary layer theory; turbulence; macroscopic momentum, mass, and energy balances; free-surface phenomena; surface tension; water waves; stratified flows; atmospheric motions; blood flow. Prerequisites: Mathematics 130 and 131 or equivalent recommended.

3 units, Aut (Robertson) TTh 9:30–10:45

140L. Fluid Dynamics Demonstration Laboratory—The student is asked to design, build, and extract data from an apparatus which demonstrates any physical principle of fluid motion. In addition, exceptional student-built devices from previous years are available for use and improvement or modification. Examples include: a fluidics-driven artificial heart, an analog computer model of the artificial heart, a laser-Doppler flowmeter, a linear shear-flow tank, and a diffuser with a hydrogen bubble flow visualization attachment. To be taken concurrently with 140.

1 unit, Aut (Robertson) by arrangement

150. Heat and Mass Transfer—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. Fick's Law, binary and multicomponent 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) TTh 9:00–10:15

150L. Heat and Mass Transfer Laboratory—Experiments in heat and mass transfer. Unsteady state thermal conduction, heat transfer to boiling liquids, heat transfer by natural convection including the Knudsen
region, radiation, and convective diffusion in liquids. To be taken concurrently with 150.

1 unit, Win (Homsy) 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 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 — An intensive course treating mathematical problems commonly arising in Chemical Engineering with applications in modeling of separations processes, heat and mass transfer, fluid mechanics and chemical reactor design. The emphasis is 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 and variational calculus. Prerequisites: Mathematics 113, 130, 131 or equivalent; knowledge of Fortran.

3 units, Aut (Homsy) TTh 10:00-11:15

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: kinetics of free and supported enzymes; experimental and theoretical approach to renal transport mechanisms; hemodialyzer design; irreversible thermodynamic treatment of membrane transport in synthetic and biological systems.

3 units, Win (Robertson) TTh 1:15-2:30


3 units, Spr (Homsy) TTh 1:15-2:30, alternate years, given 1974-75

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 catalyst, thermal properties of reacting fluids, combustion and electrode processes; facilitated transport; oscillatory reactions.

3 units, Spr (Mason), by arrangement

206. Engineering Thermodynamics — The correlation and prediction of thermodynamic properties, particularly of multicomponent, multiphase systems. Prerequisite: basic knowledge of thermodynamics, 110 or equivalent.

3 units, Spr (O'Connell) TTh 10:30-11:45

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, Aut (Acrivos) TTh 8:00-9:15

210B. 3 units, Win (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 operations. 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, semiconductivity, 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 1:15–2:30

214. Advanced Topics in Applied Mathematics — A special topics course intended for advanced graduate students desiring a detailed treatment of numerical/analytical techniques in applied mathematics and numerical analysis. The first half of the course deals with the use of ADI, Direct, and Fourier methods for solving initial/boundary value problems on a mesh. Examples will be chosen from fluid mechanics and heat and mass transport. The second half treats variational calculus and the method of weighted residuals, and their application to problems in hydrodynamic stability, turbulence, and creeping flow. Prerequisite: an introductory course in applied mathematics, e.g., 200, Mechanical Engineering 260A,B, Applied Mechanics 250, 251, 252, or equivalent.

3 units, Spr (Homsy) by arrangement, alternate years, given 1973–74

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) gas and 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. Adsorption and Catalysis (Boudart)
272A,B,C. Applied Chemical Kinetics (Mason)
273A,B,C. Bioengineering (Robertson)
275A,B,C. Surface Reactivity (Madix)
277A,B,C. Stability of Fluid Motions (Homsy)

290. 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

298. 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 as well as selected colloquia of other departments recommended by their advisers. 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, Wilhelm Flügge, Eugene L. Grant, Miklós Hetényi, Alfred S. Niles, 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

Associate Professor: James Douglas
Assistant Professors: A. Bruce Dotson, Helmut Krawinkler, James O. Leckie, Leonard Ortolano

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, highways, hydraulics, pollution control, public works administration, structures, and many others. Laboratory facilities are available in fluid mechanics, environmental engineering, civil 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 Civil Engineering Department, in collaboration with other departments of the University, offers graduate programs with particular strength in:

- Civil Engineering Management
- Civil Engineering Materials
- Construction Management
- Engineering-Economic Planning
- Environmental Engineering
- Hydrology
- Hydromechanics
- Nuclear Civil Engineering
- Reliability Engineering
- Soil Mechanics and Foundations
- Structural Engineering
- Structural Mechanics
- Transportation
- Urban Planning
- Water Resources

Research work under these programs is carried out in four major facilities—the hydraulics laboratory, the George Havas Building which houses water quality and environmental engineering laboratory facilities, and the materials laboratory complex that houses the materials, concrete, and soil mechanics laboratories. New structural engineering laboratories will be completed in 1973–74. Office space is provided for most of the graduate students who are acting as research or teaching assistants.

Programs in Quality of the Environment

Programs in quality of the environment directed toward conservation and management of major resources and enhancement of the urban environment are available in the Department of Civil Engineering. The impact of man and his technological and economic activities on the environment is emphasized. Engineering, social, political, and economic principles of resource management and pollution control are stressed. The faculty and course offerings feature special strength in engineering-economic planning, environmental engineering, transportation, water resources, and urban planning. Course offerings are scheduled to permit either intensive study in a single area or interrelated study between areas. The program in Nuclear Civil Engineering emphasizes the impact of the nuclear age on current environmental problems.

The Department welcomes applicants with backgrounds in all areas of engineering and science who are interested in applying their specialized abilities to the solution of environmental problems. Comprehensive introductory courses in each major area of study are given to provide a common basis of understanding among those with dissimilar backgrounds. Programs of study are highly flexible to allow for diversity and to encourage the development of either intensive or broadened abilities.
SCHOOL OF ENGINEERING

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. Suggestions for Restricted Electives in Civil Engineering also are available from the Civil Engineering Department office. 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: Civil Engineering Management, Civil Engineering Materials, Construction Management, Engineering-Economic Planning, Environmental Engineering, Hydrology, Hydromechanics, Nuclear Civil Engineering, Reliability Engineering, Soil Mechanics and Foundations, Structural Engineering, Structural Mechanics, Transportation, Urban Planning, 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 as they will be required to make up specified basic undergraduate civil engineering subjects.

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.

Urban Planning — Students interested in urban planning but without undergraduate preparation in Civil Engineering may work toward the degree of Master of Science in Engineering (Urban Planning). Students following this program will be required to complete a minimum of 45 units for this degree. Students with undergraduate preparation in engineering or science may be able to complete the requirements (listed below) in one academic year. Students whose undergraduate work is in fields other than engineering or science will need additional time to complete necessary undergraduate prerequisites.

**Subject Area**

<table>
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<tr>
<th>Subject Area</th>
<th>Units</th>
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<tr>
<td>Planning core (12 units from among Civil Engr. 220, 222, 224, 227, 228, 273)</td>
<td>12</td>
</tr>
<tr>
<td>Analytic courses (12 units from among Civil Engr. 223, 225, 226, 233, 236, Engr. 161 or I.E. 229, CS 106)</td>
<td>12</td>
</tr>
<tr>
<td>Urban Planning Specialty (12 units from among Civil Engr. 247, 250, 251, 252, 253, 254)</td>
<td>12</td>
</tr>
<tr>
<td>Free electives</td>
<td>9</td>
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Admission and graduation requirements are the same as for the Civil Engineering Master’s degree described above.

ENGINEER

A minimum of six quarters of graduate work including a thesis 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.

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 engineers who expect to engage in a professional career in research, teaching, or technical work of an advanced nature in the planning, design, and analysis of civil engineering systems. 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.

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 $6,000. A generous student loan program is available. In addition, a number of Water Quality Office, Environmental Protection Agency Traineeships, are available for students with an interest in water pollution aspects of Environmental Engineering or Nuclear Civil Engineering.

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, 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 1:15–5:05
Spr (Douglas) TTh 11; lab. MW 1:15–5:05 or TTh 1:15–5:05

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 — Physical properties of concrete and its constituents. (Limited to 24 students.)

3 units, Aut (Parker) W 1:15–5:05 and F 1:15–4:05

118. Materials Engineering — Materials limitations in design: yielding, fracture, creep, fatigue. Operational measurements and their
relation to use. Factors in the selection of materials. Prerequisite: Engineering 11.

*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*

131. Highway Engineering—Soils, soil conditioners, asphalts, and concrete as highway materials; design and construction procedures for highway embankments, undercourses, and pavements. Prerequisite: junior standing.

*3 units, Spr (Oglesby) TTh 8 and M 1:15–4:05*

140. Advanced Surveying—Additional study of surveying. Prerequisite: 40 or equivalent.

*3 or more 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; engineering ethics. Prerequisite: junior standing.

*3 units, Aut (Oglesby) TTh 11:00–12:15; Win (Fondahl) MWF 11*

144. Construction Estimates and Costs — Estimates, costs from viewpoint of contractor, construction engineer; details of estimating, emphasis on labor, material, equipment, overhead costs.

*3 units, Aut (Douglas) MWF 10; Win (Parker) TTh 8 and M 1:15*

145. Construction Equipment and Methods — Construction procedures, equipment; job planning and scheduling, selection and efficient use of excavation and hauling equipment, related problems. (May be taken concurrently with 131.)

*3 units, Aut, Spr (Parker) WF 8; lab. M 1:15–4:05*

150. Introduction to Urban Planning—The history of cities and planning; basic principles for understanding cities; selected contemporary urban issues and problems; planning—its potential as well as its limitations, its technique and future.

*3 units, Aut (Dotson) TTh 11:00–12:15*

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 (Staff) MWF 8*

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. Desirable prerequisite: 170 or equivalent. (Graduate students enroll in 228.)

*3 units, Win (Ortolano) MWF 9*

172. Air Pollution—(Enroll in Mechanical Engineering 137.)

173. Energy and Society—(Enroll in Mechanical Engineering 180.)

174. Nuclear Science — (Enroll in Engineering 174.)

176. Nuclear Energy—(Enroll in Engineering 176.)

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. Prerequisites: Introduction to matrix methods, Engineering 11 and C.E. 114.

4 units, Aut (Weaver) MWF 9 and W 2:15–4:05

181. Design of Steel Structures — Concepts of elastic and limit design of structures. Elastic and plastic design of structural elements, i.e., beams, girders, columns, and connections. Design of trusses, moment resistant building frames, and simple bridge systems. Prerequisite: 180.

3 units, Win (Krawinkler) TTh 2:15–3:45

182. Design of Reinforced Concrete Structures — Reinforced concrete beams, slabs, columns, footings, and retaining walls. Ultimate strength design and serviceability requirements. Introduction to prestressed concrete and shell roof design. Prerequisites: 114 and 180.

3 units, Spr (Krawinkler) MW 10 and 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 (Staff) MWF 11; lab to be arranged

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 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

201. Environmental Fluid Mechanics I—Technological and ecological problems such as ocean waste disposal, thermal pollution, water quality in fresh water distribution systems and storm sewer 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

203. Environmental Fluid Mechanics II—Designed to provide further technical background for the analysis and solution of environmental problems; an extension of 201, but 201 is not a prerequisite. Coastal and estuary technology including tides, ocean and coastal currents, water waves, estuary dynamics as related to tides and density stratification, and coastal sediment transport. Modeling and design including hydraulic (physical) modeling, dimensional considerations, and case studies and examples from estuary and coastal problems. Prerequisite: knowledge of fundamentals of fluid mechanics (e.g., Engineering 21) or consent of instructor.

4 units, Spr (Street) TTh 8 and WF 12

206. 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

207. Open Channel Hydraulics and Sedimentation Problems — Uniform, gradually-varied, and rapidly-varied flow in channels; hydraulic jump; channel transitions. Erosion,
transport and deposition of sediment. Regimen of rivers, design of stable channels, reservoir sedimentation. Environmental effects of watershed management and engineering control works. Prerequisite: 107 or equivalent.

4 units, Spr (Franzini) MWF 9 and W 2:15–4:05

209. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)

214A. Experimental Stress Analysis — (Enroll in Applied Mechanics 205A.)

214B. Experimental Stress Analysis — (Enroll in Applied Mechanics 205B.)

214C. Advanced Work in Experimental Mechanics—(Enroll in Applied Mechanics 205C.)

216. Mechanical Properties of Materials—Elastic, inelastic behavior of structural materials; yield criteria; material damping; viscoelastic behavior; creep; rheological models. Effects of internal structure on properties. Prerequisite: 114 or equivalent.

3 units, Spr (Richards) TTh 11:00–12:15

220. Philosophy of Planning—An introduction to planning with emphasis on why plan, what is a plan, the role of the planner, attitudes of planners as they affect planning, and the ideal planning process.

3 units, Aut (Linsley) MWF 2:15

221. Social Aspects of Public Works — The urban community as a functional, spatial and social system. Emphasizes the community context (pluralism, decision making, citizen involvement); the social impacts (neighborhood level to regional, manifest and latent); the methods of identifying impacts (federal, state and local data resources, survey research techniques) of public works.

3 units, Spr (Dotson) TTh 11 and F 3

222. Water Resources Planning — Integration of technical, economic, political and social factors in decisions relating to water resources management. Prerequisites: 220 and 160 or 268.

3 units, Spr (Linsley) MWF 11

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 (Roggeveen) 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 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 (Staff) TTh 7:30–8:50 a.m.

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 2:15 to 4:05 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

231. Highway Planning — A study of the decision process in highway planning as influenced by engineering, economic, political, and social problems. Prerequisites: 223 and 226, Engineering 161 or Industrial Engineering 229 or consent of instructor.

3 units, Spr (Oglesby) MWF 9

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: 230.

3 units, Spr (Roggeveen) MWF 1:15

233. 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 W 1:15–2:05

236. 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, Spr (Shah) TTh 10 and T 2:15–4:05

238. Transportation Problems — Individual investigation. Prerequisite: 130, 230, or equivalent and consent of instructor.

2 or more units, Aut, Win, Spr (Oglesby or 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.

2 units, Aut (Oglesby) TTh 1:15–2:05

241. Concrete Construction — Economy and procedures in plant and equipment selection, form design, and field operations. Special techniques in forming and handling concrete. Prerequisite: graduate standing.

3 units, Spr (Fondahl) MW 11 and one evening by arrangement

242. 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 and T 10

243. Construction Administration — Business and management aspects of construction: licensing, bonding, insurance, financing, labor relations, legal problems, and cost control. Prerequisites: 143, 144, and 145.

4 units, Aut (Fondahl) MW 11 and one evening by arrangement

244. 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 9
Spr (Fondahl) MWF 10

245. 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: 145.

4 units, Win (Parker) TThF 1:15; one evening by arrangement

246A. Heavy Construction Estimates—Estimating and bidding construction work, with emphasis on procedures adapted to large engineering projects. Prerequisites: 144, 145 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

246B. 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

247. Problems in Land Development—Study of the interrelationships between marketing research, land development, engineering feasibility studies and financial planning as it involves land acquisitions and land development up to the time of construction. Enrollment limited to 15. Prerequisites: graduate standing and consent of the instructor.

2 units, Spr (Medearis) M 7:30–8:50 a.m.

248. 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 (Oglesby) MT or W 3:05–5:15

249. Construction Problems — Analysis of individually selected problem in construction techniques, equipment, or management, followed by preparation of oral and written report. Students are expected to consult specialists from construction industry as well as make use of University facilities. Prerequisites: 240, 241, and 243.

3 units, Spr (Fondahl) by arrangement

250. Introduction to Urban Planning — Same as 150, with additional assignments for students who desire graduate credit.

251. Selected Topics in Urban Planning I—A discussion of various aspects of urban planning. Specific topics will be announced. Prerequisite: 250.

3 units, Win (Dotson) TTh 10; M 1:15


3 units, Spr (Dotson) MWF 9

253. Environmental and Urban Design Studio—Student selected design projects in the areas of urban design, environmental engineering, water resources and transportation; studies to investigate the visual aesthetic impacts of projects on the environment.

3 units, Spr (Staff) WTh 2:15–4:05

254. 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

256. 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 (Linsley) MWF 9; lab. W 2:15–4:05

257. Advanced Hydrology — Application of hydrologic simulation and stochastic methods in hydrology. Review of significant current literature in hydrology with emphasis on new developments. Prerequisite: 256 or a previous hydrology course.

4 units, Win (Linsley) MWF 9; 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.

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 (Kruger) W 4:15–6:05

270. Water Quality in Water Resource Development — Effects of organic, nutrient, and thermal pollution on the ecology and chemical 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 desalination, 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

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 — Application of chemical principles 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.

3 units, Aut (Leckie) TTh 9 plus F 11

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.

1 unit, 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.

3 units, Win (Young) TTh 10; lab. T 1:15–4:05 or W 1:05–4:05

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.

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 radioactive 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.

2 units, Win (P. Kruger) TTh 9

3 units, Spr (P. Kruger) MWF 9

277. Explosive Construction Engineering — The use of explosives for civil engineering applications. The science of chemical and nuclear explosions, the technology of explosion-produced configurations. Charge emplacement. The mechanical effects from ground shock and air blast and the environmental effects from the explosion products. Survey of current and potential applications in civil construction, water resources, and industry.

3 units, Spr (P. Kruger) MWF 11


1 unit, Spr (Leckie, Young) W 4:15-6:05

281A. Matrix Analysis of Structures — Analysis of statically and kinematically indeterminate structures by the flexibility and stiffness methods; energy and work principles; deflection of structures. Prerequisites: mechanics of materials and elementary matrix algebra.

3 units, Aut (Gere) MWF 10

281B. Computer Programming for Structural Analysis and Design — Continuation of 281A: Emphasis on the stiffness method of analysis, including programming for a digital computer; analysis of large frameworks by band-matrix and substructures techniques; automated design of framed structures. Prerequisite: 281A or equivalent.

3 units, Win (Weaver) MWF 11

281C. Finite-Element Method of Structural Analysis — Continuation of 281A,B: Theory of finite elements applied to problems in continuum mechanics: plates in plane stress, plain strain, or bending; axi-symmetric and three-dimensional solids; shells; linear and nonlinear analysis, including programming for a digital computer. Prerequisite: 281B or equivalent.

3 units, Spr (Weaver) MWF 11

282A. Earthquake Engineering I — Elementary engineering seismology; theories of earthquake mechanisms, seismic waves, size of earthquakes and frequency of occurrence; study of ground spectrum; tsunamis. Study of past major earthquakes; slides and motion pictures will be used. Effects of these occurrences on technical, social, economic, and psychological factors. Prerequisite: open to seniors and graduate students in Engineering and Geology.

3 units, Win (Shah) MWF 10

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 instructors.

3 units, Spr (Shah) MWF 10


2 units, Aut (Krawinkelr) M 11, T 2:15-4:05 (Given 1974-75)


3 units, Aut (Krawinkelr) TTh 8, W 2:15-4:05


3 units, Win (Krawinkelr) TTh 8, W 2:15-4:05


3 units, Spr (Krawinkelr) TTh 8, W 2:15-4:05
289. Structures, Materials and Soils Seminar—Discussions on topics in these fields including reports on current research at Stanford.

1 unit, Aut (Weaver) W 4:15-5:15
Win (Gere) W 4:15-5:15
Spr (Staff) 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 (Staff) 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 (Staff) MWF 8

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 (Staff) TTh 10; 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 (Staff) by arrangement, given 1974–75


2 units, Aut, Spr (Staff) by arrangement given 1974–75

295. Harbor Structures—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


3 units, Win (Gere) MTh 2:15–4:05

296B. Structural Dynamics II — Vibration and dynamic response of complex structures using matrix methods. Linear and nonlinear analysis, including programming for a digital computer. Prerequisites: 281B and 296A or equivalent.

3 units, Spr (Weaver) MWF 9

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) TTh 11:00–12:15, given 1974–75

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, Aut (Gere) MWF 9

299. Independent Study in Civil Engineering — Directed study for graduate students on subject of mutual interest to student and staff member. Student must find 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

400. **Thesis**—Dissertation for degree of Doctor of Philosophy. Aut, Win, Spr (Staff) by arrangement

**ELECTRICAL ENGINEERING**


*Chairman:* John G. Linvill

*Associate Chairmen:* Ralph J. Smith, James B. Angell

*Assistant Chairman:* Frank S. Greene


*Lecturers:* Otis L. Frost, Frank S. Greene, Victor H. Grinnich, Frank Herman, Marcian E. Hoff


*Senior Research Engineers:* John P. Katsurakis, William R. Kincheloe

**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. 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, 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 adviser 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, electromechanics, 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, completion of a language requirement, and sponsorship by two faculty members.

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 the language requirement (see...
below) and after securing agreement by two faculty members to serve as dissertation advisors, 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) a written foreign language examination, or an approved foreign language course, or an approved 9-unit sequence of course work outside of electrical engineering and related subjects; (4) an approved program of courses in electrical engineering and allied subjects; (5) an oral examination near the completion of the doctoral program; (6) 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, Edward S. Davidson, Chairman, Gene H. Golub, and Edward J. McCluskey, Chairman.

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.381, E.E.382, and C.S.311; (b) E.E.381, E.E.382, 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; C.S.300.

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.

FELLOWSHIPS, SCHOLARSHIPS, AND ASSISTANTSHIPS

The Department each year awards a number of fellowships and assistantships that are available to graduate students. Inquiries concerning these awards should be addressed to Associate Chairman, Admissions, Electrical Engineering Department.

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**

- Radiation and Refraction of Radio Waves by Ionized Media
- 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**
- Linear, Digital, and Optoelectronic Integrated Circuits
- Imaging Arrays
- Large Scale Integration
- Micropower Electronics
- Sensor Fabrication
- 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

**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:

- 0–99 first or second year
- 100–199 third or fourth year
- 200–299 mezzanine courses for advanced undergraduates or graduates
- 300–399 first graduate year
- 400–499 second or third graduate year
- 700–799 special summer courses

**COURSES FOR UNDERGRADUATE STUDENTS**

Attention is called to courses listed under "Engineering" starting on page 87 that may be of special interest to Electrical Engineering undergraduates.

101. Circuits I—Analysis of simple circuit models, with a view to discovering their fundamental characteristics as transmission networks. Forced and natural components of response, natural frequencies, the complex-frequency plane, resonance; transfer functions and the roles of their poles and zeros. The use of digital computers in circuit analysis. Impulse response: its calculation and its use in obtaining response to other excitations; the superposition (convolution) integral. Definition and use of transfer functions. Prerequisites: Engineering 41, Mathematics 44, ability to use digital computation facilities, or consent of instructor.

3 units, Aut (Tuttle) MWF10
Win (Manning) MWF 8

102. Circuits II—Use of transfer functions (continued), the Laplace transformation, development and application of Fourier series. Sampling and bandwidth concepts. The sin-
usoidal steady state: electric power systems, introduction to frequency dependence, impedance matching, transformers. Circuit theorems and analytical techniques. Prerequisite: 101 (or, by consent, Engineering 104 plus supplementary reading).

3 units, Win (Tuttle) MWF 10
Spr (Manning) MWF 8


3 units, Aut (Harris) MWF 9
Spr (Tuttle) MWF 10

111, 112, 113. Electronics — Basic electronic devices and circuits and an introduction to their applications in electronic systems. Physical principles of charge motion in semiconductors, leading to the operating principles and terminal characteristics of both discrete semiconductor devices and integrated circuits. Development of various modeling techniques which are useful in electronic circuit theory (piecewise-linear, graphical, and analytical). Applications of discrete electronic devices and integrated circuits in 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 (Staff) MWF 11

112. 3 units, Win (Gibbons) MWF 8
Spr (Staff) 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 (——) Th 1:15 and 3-hour lab. weekly by arrangement

122. 2 units, Aut, Spr (——) T 1:15 and 3-hour lab. weekly by arrangement

126A. 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. Supplements lectures in 278N, and 279. Prerequisites: 113, 122, and 142 (142 may be taken concurrently).

3 units, Win (Kino) TTh 9 and 3-hour lab. weekly by arrangement

139. Design Project (Measurements) — A laboratory course in which individuals or small teams design, build, and test special circuits or simple systems. Projects are selected to emphasize the measurement aspects. Possible topics include measurements of: time, frequency, bandwidth, distortion, noise, and noise factor. A typical system would be an acoustic radar or a non-moving electronic anemometer. Ideally, two students form a team and propose a project. Some laboratory experience at the level of E.E.122 or some practical experience is prerequisite.

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: Engineering 41.

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.

3 units, Win (Waterman) MWF 8
Spr (Quate) MWF 9

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. Prerequisite: Computer Science 105 or 106 or equivalent (same content as Computer Science 111).

3 units, Aut (Staff) MWF 1:15
Win (Baskett) MWF 10
Spr (Staff) MWF 10


3 units, Aut (Staff) MWF 9
Win (——) 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 (Greene) Th 11
200B. 0 units, Win (Greene, Staff)
200C. 0 units, Spr (Greene, Staff)
201A,B,C. Seminar — Weekly discussion of special topics of current interest in electrical engineering. Speakers from faculty and from outside the University. Normally taken by graduate students each quarter for 3 quarters.

201A. 1 unit, Aut (Greene) Th 11
201B. 1 unit, Win (Greene, Staff)
201C. 1 unit, Spr (Greene, Staff)

202. Medical Electronics — This course is an introduction to physiology for engineers, with discussions of problems unique to biomedical instrumentation. Various medical, electrical, and chemical transducer systems and the accompanying electronics are briefly considered. Prerequisite: familiarity with electrical instrumentation techniques.

3 units, Aut (Thompson) W 3:15—5:05 plus one hour by arrangement

206. Models, Men, and Machines — (Enroll in Engineering-Economic Systems 223.)

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 9:25—10:40

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


3 units, Aut (Angell) MWF 8
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 (Linvill) TTh 9:25-10:40
Aut (Dutton) MWF 1:15
Win (Staff) MWF 9
Sum (Staff) MTWTh 1:15

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
Win (Linvill) TTh 9:25-10:40

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 (Spicer) MWF 1:15

231. Introduction to Lasers—An introductory survey of laser devices and applications (no quantum mechanics background required). Laboratory and classroom demonstrations. Prerequisites: electromagnetic theory at a level similar to 142, and preferably an introductory undergraduate course in atomic or modern physics.

3 units, Aut (Siegman) TTh 9-10

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

233A,B,C. Laser and Quantum Electronics Laboratory—Opportunity for individual unsupervised student laboratory projects in lasers, optics, atomic resonance, parametric devices. Recommended: 231 or 232 (may be concurrent).

Any quarter (Siegman) by arrangement

238. Electric and Magnetic Properties of Solids—The electric and magnetic properties of solids from a fundamental point of view, with the necessary elementary concepts of quantum mechanics. Free electron theory, introduction to band theory, dielectric and ferroelectric materials, magnetic materials, ferromagnetism, and superconductivity. Emphasis on physical understanding. Prerequisites: Physics 57 and preferably 111 or Engineering 50.

3 units, Win (Siegman) TTh 9-10

239A,B. Solid-State Physics — (Enroll in Applied Physics 239, 240.)


3 units, Aut (Staff) MWF 10


3 units, Win (Staff) MWF 9

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 (Hellman) TTh 11:00–12:15
(Williamson) MWF 2:15

Win (Buneman) MWF 2:15
Spr (Bracewell) 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; and data reduction and utilization. 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 2:15–3:30

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, Aut (Tuttle) MWF 8


3 units, Win (Tuttle) MWF 9

274. The Computer as a Laboratory Instrument—Computer-system architecture and design philosophy described in lectures, and weekly laboratory experiments demonstrate basic principles of real-time measurement, control, and computation. Role of small computer as dedicated system component in data acquisition, control, automated testing, real-time transforms, and signal processing is developed by “hands-on” experiments. Limited enrollment. Prerequisite: 181 or equivalent programming experience.

3 units, Aut, Win, Spr (Widrow, Staff)
TTh 10 and 3-hour lab. by arrangement


278N. Introduction to Statistical Signal Processing—(Formerly 276F.) 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) MWF 1:15
Win (Gray) TTh 2:15–3:30

279. Information Transmission and Modulation—(Formerly 278F.) Signals and circuits for information transmission in electronic systems; analog and digital modulation and demodulation, frequency conversion, multiplexing, and noise; spectrum, envelope, and instantaneous frequency relations; information measure, channel capacity, and comparison of systems from an information-theory standpoint. Prerequisite: 278N.

3 units, Spr (Gray) TTh 2:15–3:30

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 blood-pressure 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*


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: 363 or Mathematics 113.

3 units, Aut (Staff) MWF 2:15

286A,B. Systems Programming—Structure of assemblers, linkage editors, loaders, macro facilities, interpreters, compilers, debugging systems and text editors. Introduction to operating systems. Same content as Computer Science 140A,B. Prerequisite: 181 or equivalent.

286A. 3 units, Win (Cerf) TTh 9:30-10:45
286B. 3 units, Spr (Cerf) TTh 9:30-10:45

288. Computer Systems Laboratory—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. Areas of particular interest are logic subsystem design, interfacing, systems programming, and operating systems. Students are encouraged to suggest and define their own topics, and normally work on one project for the entire academic quarter. Computer facilities including a PDP-11 computer are available. A written report is required. Limited enrollment. Prerequisite: previous or concurrent registration in any one of the following: 286B, 382, 386, Computer Science 144A,B, or Computer Science 240B.

3 units, Spr (Bredt) F 1:15 and by arrangement

292. Special Seminars—Each year special seminars are given on topics of current interest. See the Time Schedule and bulletins in the Department Office for detailed announcements.

**Courses for Graduate Students**

300. Topics and Methods in Solid State Research—Discussion of technical topics in solid state electronics and related mental processes and thinking tools.

*Aut (Shockley) by arrangement*

310. Integrated Circuits Technology and Design Seminar—In-depth treatment of technology and circuit design problems. Content will roughly parallel topics of interest from E.E.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, oxide masking, diffusion, and thin film deposition. Laboratory portion is limited in enrollment. Prerequisite: 113.

2 to 3 units, Aut (Staff), Spr (Meindl)

313. Digital Integrated Circuits—Analysis and Design—Device technology and modeling constraints important to digital integrated circuit design. Comparison of MOS and BJT technologies and device configurations. Design problems relating to power, speed, size, and functional complexity in logic and memory circuits. Standard and special purpose circuit configurations and technologies. Topics may include: Standard and Schottky Clamped TTL, ECL, p-channel vs. n-channel MOS, C-MOS, V-groove vs. Iso-planar, multiphase logic. Prerequisite: 216.

3 units, Win (Dutton)

314. Linear Integrated Circuits—Analysis and Design—Device technology and modeling constraints important to linear integrated circuit design. The unique capabilities and fundamental constraints of device configurations appropriate for linear IC's. Circuit
configurations that illustrate state-of-the-art linear design. Topics may include: high performance op-amps (fast slew rate, high input impedance), linear multipliers, multiple medium performance amplifiers, phase-locked loops, band-pass and oscillator circuits. Prerequisite: 216.

3 units, Spr (Dutton)

315. Solid State Circuits Laboratory—Experimental projects on design of high-performance circuits or small systems using transistors, integrated circuits, and other modern solid state devices or on device measurement and evaluation, with emphasis on relationships between observed characteristics and underlying physical mechanisms. Applications to medical electronics are emphasized. Limited enrollment. Prerequisite: previous or concurrent registration in any one of the following: 214, 216, 221A,B, 316.

3 units, Aut, Win, Spr, Sum (Meindl)

316. Transistor Electronics — Quantitative analysis of the limits of performance of transistors and solid state diodes in discrete and integrated applications for tuned, video, low-noise and low-drift amplifiers, parametric amplifiers, and nonlinear switching and regenerative circuits; based on the device models developed in 216. Prerequisite: 216. Recommended: 214.

3 units, Spr (Angell)

320. Solid State Seminar—Discussion by faculty, students, and guest specialists of research topics and current literature in solid state physics.

1 unit, Aut, Win, Spr, Sum (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)

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)

325. Acoustic Seminar — Research seminar on acoustic waves. Topics include acoustic surface waves, microwave acoustics, medical applications, materials testing, imaging techniques, biological applications, seismic studies, and other current research in this field.

1 unit, Aut, Win, Spr (Kino, Auld)

326A. Wave Phenomena in Active Media I—(Enroll in Applied Physics 250.)

326B. Wave Phenomena in Active Media II—(Enroll in Applied Physics 251.)

327A. Descriptive Theory of Semiconductors—“Electron-in-box” extended to crystals. Review wave-packet, continuity equation, etc.: example, expectation-value force equals mass times acceleration of expectation-value center-of-probability replaces Newton’s $F = ma$ Second Law. Energy bands and gaps inevitable for one-dimensional periodic potentials both for periodic (loop) and for work-function boundary conditions. Stress on physical interpretation of mathematics: example, constant “Wronskian” means divergenceless probability current. Pedagogical aim: student can prove theorems on energy bands and effective mass from Schrödinger equation and standard differential equations. Prerequisites: 322A, 322B (may be concurrent), or equivalent.

3 units, Win (Shockley)

327B. Descriptive Theory of Semiconductors—Application of energy band theory to behavior of electrons and holes in semiconductors including Brillouin zones and introduction to Fermi level and detailed balance
applied to Shockley-Read recombination theory. Other topics dependent on student interests. Prerequisite: 327A or equivalent.

3 units, Spr (Shockley)


3 units, 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: 328 or Physics 172, or Materials Science and Engineering 181.

3 units, Win, Spr, Sum (Pearson)

332. Optical Properties of Solids — Basic theory with emphasis on the relationship between electronic structure and optical properties of solids. Representative semiconductors, insulators, and metals will be discussed. Impurities and defects in solids. Photoemission. Luminescence. Applications. Prerequisite: 322A or equivalent.

3 units, Win (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, Harris, Byer)

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 1974–75

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: 244 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 (Staff) alternate years, given 1973–74


3 units, Spr (Goodman) alternate years, given 1974–75

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—(Formerly 443)
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 1973–74

352. Wave Propagation in the Ionosphere and Magnetosphere—(Formerly 443) Magnetoionic theory from a modern point of view; applications including ray tracing, dispersion (e.g. whistlers), absorption, boundary effects. Interpretation of experimental observations and use of radio waves as diagnostic tools. Introduction to wave-particle interactions. Prerequisite: 243 or equivalent.

3 units, Spr (Helliwell) alternate years, given 1974–75


3 units, Aut (Bracewell) alternate years, given 1974–75

354. Theory and Application of Radio Wave Scattering—(Formerly 448) 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 1973–74

356. Introduction to Plasma Physics—(Formerly 354) 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 1973–74

358A. Solid State Physics Laboratory — (Enroll in Applied Physics 354.)

358B. Quantum Electronics Laboratory — (Enroll in Applied Physics 358.)

358C. Superconductivity and Low Temperature Physics Laboratory — (Enroll in Applied Physics 356.)

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, Kailath)

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: 103 or Engr. 104.

4 units, Aut (Kailath, Staff)

Spr (Padulo)

Sum (Staff)

364S. Multivariable System Theory—Structural properties—controllability, observability, canonical forms. Applications to pole-shifting, decoupling, system realization and identification. The course will be a sequel to
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E.E.363 where similar problems are studied for scalar systems.

1 to 3 units, Spr (Kailath)

366F. Optimal Trajectories and Control Logic—(Enroll in Aeronautics and Astronautics 278A.)

367F. 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 advanced topics and research areas in information systems: selected topics such as computational and statistical complexity, rate distortion theory, algebraic systems theory, simultaneous communications, etc.

1 unit, Aut (Padulo)
1 unit, Win (Gill)
1 unit, Spr (Cover)

376. Information Theory — Information sources. The measure of entropy, information, and mutual information properties of codes; coding information sources; Huffman coding. 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 (Staff)


3 units, Win (Kailath)

379. Communication Channels — Fundamental principles of communication engineering; 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: 278N 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

381. Switching Theory and Logic Design—Analysis and synthesis of digital circuits with emphasis on basic design techniques and use of integrated circuit gates and flip-flops; codes for representing information and correcting errors; Boolean algebra; simplification of switching functions; sequential circuit analysis; effects of delays; counters, adders, iterative networks.

3 units, Aut (Peterson) MWF 9 and (McCluskey) MWF 11
Win (Staff) MWF 11
Sum (Staff) MTWTh 11

382. Digital System Organization and Switching Theory — Sequential circuit synthesis. Digital integrated circuit families. Memory systems, and arithmetic units. System organization and control, microprogramming. Input-output. Project in detailed design of a system such as minicomputer, desk calculator, etc. Prerequisite: 381. Corequisite: 181.

3 units, Win (McCluskey) MWF 11;
Win (Peterson) MWF 1:15
Spr (Greene) MWF 10
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, Sum
(McCluskey) Th 1:15–5:05

385B. Parallel Computing Seminar — Student-faculty discussions of research problems in the areas of computer operating systems, scheduling, resource allocation, measurement, performance evaluation, parallel computer organizations, control of parallel operations, high-level languages for parallel computation, and parallel program schemata. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr, Sum (Bredt)
M 1:15–5:05

385C. Computer Architecture Seminar — Student-faculty discussions on advanced topics and research problems in new computer organizations, parallel computers, and efficient algorithms for scheduling, compiling, and program optimization.

1 to 4 units, Aut, Win, Spr, Sum (Stone) by arrangement

385D. Computer Systems Analysis Seminar — Student-faculty discussions on measuring, modeling, and analyzing the performance of computer systems and computer system components.

385E. 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)

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 content 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 — Information representation; Huffman and alphabetic encodings. Theory and implementation of codes for detection and correction of independent and burst errors. Recurrent codes. Synchronization; comma-free codes, codes with special correlation properties, convolutional encoding, and sequential decoding. Prerequisite: 284 preferred; 376 or 379 acceptable.

3 units, Spr (Gill)

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 detailed announcements.

395. Electrical Engineering Instruction: Practice Teaching — Open to a very limited number of Electrical Engineering students who plan to make teaching their career.

(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 + indicates satisfactory work; no letter grade is assigned.

By arrangement

412. Advanced Integrated Circuit Laboratory — Experimental projects and seminars on integrated circuit fabrication using epi-
taxial, 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.

3 units, Aut, Win, 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

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 device. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr


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

430. Band Structure and Photoemission Seminar—Subjects of current research interest will be selected from the literature and discussed. The more advanced students will assume responsibility for presenting the material for discussion.

1 unit, Aut, Win, Spr (Spicer, Staff)

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 1974–75

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

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

450. Radioscience Laboratory—Experimental, observational, and theoretical problems of the ionosphere, magnetosphere, troposphere, and radio and radar astronomy. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr

430. Band Structure and Photoemission Seminar—Subjects of current research interest will be selected from the literature and discussed. The more advanced students will assume responsibility for presenting the material for discussion.

1 unit, Aut, Win, Spr (Spicer, Staff)

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 1974–75

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

438A. Group Theory and Symmetry—(Enroll in Applied Physics 270.)

438B. Solid-State Theory—(Enroll in Applied Physics 339.)

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3 units, Aut, Win, Spr

450. Radioscience Laboratory—Experimental, observational, and theoretical problems of the ionosphere, magnetosphere, troposphere, and radio and radar astronomy. Prerequisite: consent of instructor.

3 units, Aut, Win, Spr

430. Band Structure and Photoemission Seminar—Subjects of current research interest will be selected from the literature and discussed. The more advanced students will assume responsibility for presenting the material for discussion.

1 unit, Aut, Win, Spr (Spicer, Staff)
451. The Laboratory Plasma — (Enroll in Engineering 211.)

452. Experimental Plasma Physics Laboratory—(Enroll in Engineering 215.)

455. Seminar in Astrophysics — (Enroll in Applied Physics 363.)

456A. Solar Terrestrial Relations—(Enroll in Applied Physics 360.)

457. Computer Simulation of Continuous Media—A survey of the algorithms, tricks, approximations, economics, 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 (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, by arrangement

477. Statistical Complexity — (Enroll in Statistics 363.)

479. Topics in Statistical System Theory—Study of related problems in statistical communication, stochastic control, statistical data processing, network and system realization and identification, stability theory. Exact choice of topics will vary from year to year. Prerequisite: 278N or consent of instructor. Recommended: 378.

3 units, Spr (Staff)

482. Advanced Computer Organization —(Enroll in Computer Science 311.)

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 382 or equivalent.

3 units, Spr (Staff) alternate years, given 1973-74

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 362, Philosophy 162, or Computer Science 156.

3 units, Spr (Staff) alternate years, given 1974-75

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 Baskett
Section 2 Bredt
Section 3 Cerf
Section 4 McCluskey
Section 5 Peterson
Section 6 Stone
SCHOOL OF ENGINEERING

man, Ronald A. Howard, William K. Linn- vill, David G. Luenberger

Associate Professors: Richard D. Smallwood. Acting: John T. McAlister, Jr.


Lecturers: Nicolaos V. Arvanitidis, Hewitt D. Crane, James E. Matheson, George R. Murray, 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 coursework 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 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.

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
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. 151), (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-making 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 six 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.

The student’s internship work in the field is mainly directed toward the successful 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 70 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 primar-
ily 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.

**Decision Analysis** (Howard, Matheson, Murray, Smallwood)

Decision analysis is a logical procedure for balancing the many factors that influence a decision, including economic, technical, and social factors. It is the only procedure known that can simultaneously consider 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 under the Stanford program (which includes activities at the university, Stanford Research Institute, Xerox Palo Alto Research Center, and KMB Health Systems, Inc.). Government applications which have been treated include optimal expansion through nuclear plants of the electrical power system of Mexico, planning unmanned space exploration, and determining whether hurricanes threatening the United States should be seeded with silver iodide crystals. Theoretical research is being done in the areas of 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 major program in educational policy analysis has been conducted as a part of a research program centered at SRI which has involved EES faculty and students working with social scientists and educators under the direction of Professor Harman.

An interdisciplinary research program in telecommunications has been conducted by Professor Dunn in cooperation with faculty and students from several departments and schools. This work has dealt with policy issues in relation to cable television, broadcast television, and computer communications.

A third policy research program is one in national growth policy 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.

**Health Systems** (Murray, 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 the planning and evaluation of alternative programs or policies in several health care problem areas including the planning and development of a university medical center, the analysis of health care delivery programs in Appalachia, the development of nurse staffing policies, and the analysis of alternative regional health care programs in a developing country. This latter work has led to a current research project which is developing analytic tools for regional health care planning. We are collaborating in this research with the local regional health planning authority, the Bay Area Comprehensive Health Planning Council. Another current research project deals with a joint project with the Stanford University School of Medicine, the formulation, evaluating, and testing of alternative heart disease prevention programs. In addition, of general research interest is the development of an analytic
structure for the study of clinical decision-making.

**Telecommunications Systems** (Dunn, Linvill)

Developments in computers and communication technology over the last decade and the synthesis of these two technologies in teleprocessing and two-way cable television systems have created a wide range of opportunities for society. A long-term interdisciplinary study of the technology, costs, markets, and social effects of these systems has just been initiated under Professor Dunn. The study is centered in EES, but it will bring together faculty and students from the economics, communication, and electrical engineering departments as well as EES. This study follows a similar inter-disciplinary study that is now being completed which concentrated on cable television. A regular EES course (given jointly with the Department of Communication) on Telecommunication Systems and Public Policy developed out of this research program. The course and the research utilize 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) economies of scale in computer communication networks; (2) the effects of pricing policy on congestion in such networks; (3) the effects of financial policy on the ability of regulated industries to meet rising or fluctuating demand; and (4) international standards and agreements and their effects on domestic systems.

Professor Linvill is working at the interface between telecommunications and the society. Recently he completed an exploratory study jointly with Battelle Memorial Institute and Intasa, Inc. on the use of telecommunications to deliver health, education, and welfare services. 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.

**Urban Models, Analysis, and Planning** (Luenberger, Sweeney)

EES research in urban modeling has been focused in two areas: the development of housing market models and the development of land use planning methodologies. The first component involves modeling of supply and demand forces and the resultant adjustment dynamics of the system that determines how housing is supplied and used in urban areas. Based on these models, the short-run and long-run effects of public policy measures such as subsidy programs, code enforcement, tax law changes, and public housing programs are being examined in order to guide such programs better. The second component of our research, conducted both at the University and at Intasa, Inc. is aimed at the development of quantitative tools that can assist in the land use planning process. Attention is being directed to questions of zoning, infrastructure development, and tax incentives as they relate to the major issues of urban growth. Several specific planning projects have been addressed using the newly developed methodology.

**Optimization** (Luenberger, Bertsekas, Oren)

Research in the field of optimization is motivated by the need for improved methodology that can be used for the analysis and computational solution of decision or policy problems arising in a variety of disciplines. Efforts are directed both at the interpretation and the extension of the scope of the existing abstract theory and at the development of analytical and computational techniques motivated from specific application areas. In the area of stochastic optimization our efforts are directed toward the unification and extension of the scope of dynamic programming techniques, as well as their use in specific applied areas. In the area of deterministic optimization we are primarily occupied with two more or less independent subjects: the theory of necessary conditions, and the invention of numerical algorithms for solving practical problems. Most recently we have been largely devoted to establishing a strong link between these two areas, in order to make the theory more useful and the practice more systematic. From this effort has emerged the development of local convergence analysis as a tool for analyzing and comparing algorithms. We have discovered that the convergence properties of a large number of what were apparently unrelated algorithms all depend, in fact, on the same basic properties of the problem being solved. Analysis of these algorithms can therefore be carried out within a common framework related to the conventional theory.
of necessary conditions. This relationship has led to both development of new effective algorithms and discovery of serious deficiencies in known algorithms.

**FINANCIAL ASSISTANCE AND ADMISSION**

Most students in the EES Ph.D. program have found that, after completing their first year, 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 to $1500 per month during the period of their internships. The critical period financially for most students has been the first year of graduate work which requires a financial commitment of about $5000 to cover tuition and expenses. Several alternatives are open to EES students who wish assistance in financing their first year.

A few fellowships 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. A student who has completed the first year of course work and the internship has usually been able to obtain financial support through employment as a research assistant or a teaching assistant.

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: 249, 250, 202, 203, 204, 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 for a student to obtain a minor in his 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) Introductory System Analysis:
         201A*, B*, C
      2) Probabilistic Models for Problems of Uncertainty: 221*, 251A*, B*
   b) Optimization

2. Economics and Decision Analysis: 210, 211, 212A*, B*, 231*

3. Applications and Research
   1) Models, Men, and Machines: 223
   2) Decision Analysis Practice: 236
   3) Public Policy Analysis: 211, 249, 280
   4) 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


3 units, Aut, Win, Spr (W. Linvill, Oren) TTh 8:00–9:15

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

251A,B. Dynamic Probabilistic Models — Emphasizes the extension and further application of basic system concepts to modeling of processes exhibiting both dynamic and uncertain behavior. Application of linear system theory to the study of finite- and infinite-state, discrete- and continuous-time, stationary and non-stationary, Markov and semi-Markov processes. Optimization of probabilistic systems over short and long time periods by means of dynamic programming. A concurrent presentation of examples in the areas of system reliability, marketing, health systems, automatic control, maintenance and replacement policies, search procedures, inventory control, and other operating problems of systems. Prerequisite: 221 or equivalent.

3 units, Win, Spr (Sondik) TTh 9:30–10:45

SYSTEM ANALYSIS: OPTIMIZATION

242. Introduction to Optimization — Overview of optimization field. Basic notions related to convexity. An introduction to linear programming including: basic properties, simplex method, duality, dual simplex method, reduction of linear programs to minimal form. Special computing techniques and their economic interpretations. Applications.

3 units, Win (Luenberger) MW 1:50–3:05

3 units, Spr (Luenberger) MW 1:50-3:05

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 (Bertsekas) TTh 1:50-3:05

263B. System Optimization — Linear operators; inverses; adjoints, pseudo-inverses. Minimization of functionals; calculus of variations, Fenchel duality. Constrained optimization: Lagrange multipliers, Kuhn-Tucker theorem, duality, optimal control theory. Iterative techniques of optimization. Prerequisite: 263A.

3 units, Win (Bertsekas) TTh 1:50-3:05

ECONOMICS AND DECISION ANALYSIS

210. Introduction to Microeconomics — A self-contained presentation of the basic tools of microeconomics for graduate students having an analytical background typical of 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 (Sweeney) 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.

3 units, Win, Spr (Sweeney) MW 9:30-10:45

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

APPLICATIONS AND RESEARCH

223. Models, Men, and Machines — Those systems that require a quantitative analysis of the human component in the system. Em-
phasis on quantitative modeling of this human component, especially human decision-making. Specific system areas considered include: manual control, monitoring, decision-making, automated instruction, and medical diagnosis. Discussion of the importance of this area to future systems. Presentation augmented by classroom experiments. Prerequisite: 221 or consent of instructor.

3 units, Aut (Smallwood) TTh 9:30–10:45

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

249. Urban Economic Analyses—(Enroll in Economics 249.)

280. Telecommunications Systems and Public Policy—(Same as Communication 280.) Fundamentals of telecommunication technology and costs. 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, and computer-based teleprocessing systems.

3 units, Spr (Dunn, Parker) 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 1972–73 the following 3-unit seminars were held: Social Systems Analysis (Luenberger); Technology and Public Policy (McAlister); Bayesian and Inferential Statistics (Sondik); and Optimization under Uncertainty and Dynamic Programming (Bertsekas).

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) M 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: W. Grant Ireson

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.

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

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.

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 four 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.
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.

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 $4,650 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 series of lectures and discussion sessions dealing with the nature of industrial engineering problems, tools used in solving problems, employment opportunities, history and development of underlying principles of I.E., legislation affecting work of industrial engineers. Students will read a carefully selected list of articles and selections from certain books prior to each lecture-discussion session. Members of I.E. faculty will present the lectures dealing with their special areas of interest. For freshmen and sophomores to aid in curriculum selection.

No credit, Spr (Staff) M 12

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 8:00-9:50
Win (Jucker) TTh 10:00-11:50

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, Winn (——) MWF 11

133. Industrial Accounting — Principles of financial and cost accounting, design of accounting systems, techniques of analysis and cost control, impact of taxes. Interpretation and use of accounting information for decision making is stressed through case discussions. (Students who have taken or are taking another University course in elementary accounting should not enroll.)

4 units, Aut, Winn (——) MWF 8 and one hour by arrangement
Sum (——) MTWThF 8

140. Introduction to Computer Utilization — An introduction to effective use of computers in industry. The design concepts utilized in various higher level compiler languages will be compared. FORTRAN will be introduced through examples of engineering and business data processing applications. Intended primarily for graduate students with no prior computer programming experience. 241, 242, 243 may follow this course.

4 units, Aut, Winn (——) MWF 2:15

141. Utilization of Computers — Background necessary for use of computers in industrial engineering and management problems. An in-depth study of a higher level compiler language. Introduction to interactive use of computers. Extensive use of available facilities dealing with the time-sharing environment. Prerequisite: Computer Science 106 or equivalent. (Must have programmed in a macro language such as FORTRAN or ALGOL.) Not for students who have taken 140 for credit.

3 units, Winn (——) MWF 8
Spr (——) MWF 8

152. Introduction to Operations Research I — (Enroll in Operations Research 152.)


160. Analysis of Production Systems — 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 plant location, production-inventory systems, scheduling of job shop, line balancing for continuous production processes, and aggregate planning of work force, production, and inventory under fluctuating demand. Graduate students enroll in 260. Prerequisites: 141, 153, Engineering 161, and Statistics 110 or 116.

3 units, Aut (Carlson) MWF 8
Winn (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, Winn (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.

I 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, Winn (Jucker) MWF 10

COURSES PRIMARILY FOR GRADUATE STUDENTS

208. Biotechnology — 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 mak-
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

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; lab. Th 1:15-4:05, alternate years, given 1974-75

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. Prerequisite: graduate standing.

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.

3 units, Win, Spr (Oakford) TTh 3:15-4:30

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 develops further sophistication in financial decision making within an indus-
trial 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: 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 retention 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

235A,B. Program Management—A study of the managerial support and integration necessary to accomplish the conception, design, and implementation of large, complex, technical programs. Emphasis on organization and management for R&D, economic analysis of benefits and costs of system under study, and techniques of planning and reporting status of progress of the system study. In conjunction with E 235A,B projects will be undertaken by student teams in the analysis and design of a major engineering system. (See E 235A,B).

3 units, Win, Spr (—) T 1:15-3:05, Th 1:15 and one hour by arrangement

240. Advanced Utilization of Computers—To enhance the student's ability to utilize digital computers, the material in this course will be chosen from such topics as job control language, assembly language, timesharing, organization and use of files, sort/merge operations, data structures, information retrieval, and cost considerations. Prerequisite: 141 or Computer Science 106 or equivalent.

3 units, Aut (Ludwig) MWF 11

241. Computing Techniques for Deterministic Models—Application of computer techniques to the solution of deterministically-formulated engineering and systems problems. Topics will include: approximation, search, constrained optimization by numerical methods, and simulation. Prerequisite: 240 or consent of instructor.

3 units, Win (——) MWF 1:15


3 units, Spr (——) MWF 11

243. Computation Laboratory—Application of digital computers to problems related 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, Spr (Daetz) by arrangement


260. Analysis of Production Systems—for graduate students. Lectures same as 160. Prerequisites: same as 160.

3 units, Aut (Carlson) MWF 8
Win (Carlson) MWF 9

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, production 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

264. Advanced Analysis of Production Systems—Advanced topics in production plan-
ning 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

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 by student teams acting as consultants to the appropriate hospital supervisors and professional staff. Problems such as hospital information systems, patient room assignments, admission procedures, central supply distribution, and service delivery will be studied.

3 units, Win (Thompson) TTh 11 and one hour by arrangement

281. Individual Study in Biotechnology — 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 Seminar I—Introduction to model construction for development situations. Presentation will be mainly from a systems analysis point of view, although review of some popular models in the economics literature will be included. Discussion of means and ends of development. Prerequisites: graduate standing, at least one prior course in economics or engineering economy, good working repertoire of mathematical skills and elementary understanding of mathematical modeling.

3 units, Win (——) MWF 2:15

293B. Development Planning Seminar 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) MWF 2:15


Aut, Win, Spr (Staff) by arrangement


Aut, Win, Spr (Staff) by arrangement

341. Interactive Computer Graphics—Comparative study of hardware and software for interactive computer graphics. Special emphasis will be placed on currently available systems. Applications of graph theory to engineering analysis and design problems. Two- and three-dimensional projection problems will be solved using the AGT-30 graphics system. Enrollment limited to engineering students. Prerequisite: 240 and Computer Science 111.

3 units, Win (Brastow) TTh 9, and one hour by arrangement

351. Dynamic Programming and Stochastic Control — (Enroll in Operations Research 351.)


358. Queueing Theory — (Enroll in Operations Research 358.)

360. Models for Production Planning—Intended for students interested in doing research in the area of modeling and constructing algorithms for solving models of components of production systems. Topics will include scheduling, capacity expansion, inventory systems, and areas of interest from current literature. Prerequisite: 264 or consent of instructor.

3 units, Aut (Carlson) MWF 11, alternate years, given 1974-75

MATERIALS SCIENCE and ENGINEERING

Emeriti: Welton J. Crook, O. Cutler Shepard (Professors)

Chairman: John C. Shyne


Associate Professors: Craig R. Barrett, Clay-
SCHOOL OF ENGINEERING

Consulting: Farid Abrah
Assistant Professors: David M. Barnett. Vis-
iting: Richard A. Wallace
Lecturer: Claus G. Goetzel, Egon Loebner

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 W. Bartlett, Norman A. Parlee, George A. Parks, and Paul Kruger.

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 coursework and to obtain training in research. Graduate programs lead to the degrees of Master of Science, Engineer, and Doctor of Philosophy.

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 Mater-
MATERIALS SCIENCE AND ENGINEERING

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 and 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 required.

2. Mechanics of Materials

This program is designed for those students who wish to obtain a working knowledge of Materials Science and Engineering Mechanics. This program is normally viewed as a terminal M.S. program although transfer into the Ph.D. program may be possible in some cases. The course requirements for this program are listed below.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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<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 185</td>
<td>Mechanical Behavior of Solids</td>
<td>3</td>
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<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>6</td>
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<tr>
<td>MS&amp;E 244</td>
<td>Failure Analysis</td>
<td>3</td>
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<tr>
<td>A.M. 202A,B</td>
<td>Theory of Elasticity</td>
<td>6</td>
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<tr>
<td>A.M. 205</td>
<td>Experimental Stress Analysis</td>
<td>3</td>
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<tr>
<td>A.M. 250</td>
<td>Math. Methods (or equivalent)</td>
<td>3</td>
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<tr>
<td>A.M. 251</td>
<td>Math. Methods (or equivalent)</td>
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<td>Total</td>
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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. Knowledge of at least one foreign language must be demonstrated before a student is admitted to candidacy for the Ph.D. degree.

4. 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 203, 204, 206, 209, 222, 233, 240, 246.

c) A minimum of 18 units of course work taken outside the department (excluding courses in the Department of Physical Education and including no more than 4 units of English in the case of foreign students).

5. Maintain a grade point average of 3.0 for all course work taken as a graduate student at Stanford.

6. 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.)

106. Extractive Process Metallurgy — (Enroll in Applied Earth Sciences 105.)

120. Industrial Report—Report covering at least two consecutive months of industrial experience related to Materials Science.

1 unit, any quarter (Staff) by arrangement

140. Independent Study — Independent study in Materials Science under supervision of a faculty member. Prerequisites: junior or senior standing in science or engineering with high scholarship and approval of Materials Science Faculty.

2 to 3 units, any quarter (Shyne) and by arrangement

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. Designed for undergraduates and students in the Mechanics of Materials option.

4 units, Aut (Staff) given 1974–75

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.

5 units, Aut (Tiller, Shyne) MTWTh 10; lab. by arrangement

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) MTWF 9

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 (Tiller) MWF 10


3 units, Win (Barrett) MWF 9

188. Electrical, Optical, and Magnetic Properties of Materials — A broad course with phenomenological orientation covering thermal, dielectric, ferroelectric, dia-, para-, and ferromagnetic, electrical, optical and superconducting properties in pure and imperfect crystal and polycrystalline solids. Prerequisite: Engineering 50.

3 units, Win (Bube) TTh 9

188L. Electrical, Optical, and Magnetic Properties Laboratory — The basic laboratory involves six experiments: (1) electrical
properties of p-n and n-p-n junctions, (2) optical absorption in solids, (3) Hall effect, (4) temperature dependence of electrical conductivity, (5) temperature dependence of saturation magnetization, and (6) plotting of B-H loop for various magnetic materials.

2 units, Win (Staff) by arrangement

190. Polymer Science — Relationships of structure and composition of polymers to their physical properties. Polymerization, copolymerization, degradation, diffusional transport properties, glass transition behavior, and polymer crystallinity are discussed. Illustrative polymer problems and their solutions are presented. Prerequisite: Engineering 50 or equivalent.

3 units, Aut (Wallace) TTh 11

191. Engineering Properties of Polymers—The course studies the mechanical, electrical, and thermal behavior of polymer materials as related to their structural variables. Amorphous and crystalline polymers in stress-strain, creep, stress-relaxation, and dynamic tests is discussed. The electrical behavior plus the thermal properties and the degradation behavior of polymeric materials will be treated. The emphasis is on describing and solving relevant problems in polymeric materials. Prerequisite: Engineering 50 or equivalent.

3 units, Win (Wallace) TTh 11

192. Biomaterials—A study of the properties and functions of materials in the body environment. Structure and function of membrane processes, and ion transport will be treated. Blood surface interactions, medical prosthesis of plastics, and applications of polymers to the artificial kidney and heart will be treated. Prerequisites: 190 and 191.

3 units, Spr (Wallace) TTh 11

200. Special Problems.

Any quarter (Staff) by arrangement

201. Principles and Methods of Crystal Growth—Broad look at the important phenomena involved in the growth and perfection of crystalline solids from melt, solution, vapor, electrodeposition, etc. Discussion of the merits of the various preparation methods.

3 units lec.; 2 units lab. Spr (Tiller)
TTh 2:15–4:30

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, etc. 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 (Shyne), Spr (Bube)

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 toward non-materials science majors. Prerequisite: graduate standing in Engineering or Science.

3 units, Aut (Sherby) TTh 11:00–12:15


3 units, Aut (Staff) MWF 8

207. Metal Refining and the Nature of Liquid Metals — (Enroll in Applied Earth Sciences 207.)

208. Radioactivation Analysis — (Enroll in Engineering 177.)

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, variation, 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 131.

3 units, Spr (Barnett) MWF 9, given 1974–75

212. Seminar on 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 (Goetzell) TTh 10:30–12:00

215. Mechanical Properties Laboratory—Application of the principles of Materials Science through laboratory experience. Integration of the experimental techniques for materials preparation, mechanical property measurement, and structure analysis. Experimental determinations of structure-property relations in elastic properties, yielding, fracture, creep, fatigue, and other selected mechanical properties.

3 units, Win (Nix, Staff) by arrangement, alternate years, given 1974–75

220. Phase Transformations in Solids—Thermodynamic, kinetic, and crystallographic aspects of phase transformations in metals and alloys, with particular attention to martensitic transformations. Prerequisite: 182.

3 units, Spr (Shyne) TTh 11, alternate years, given 1973–74

222. Statistical Thermodynamics—Systematic development of the methods of statistical mechanics with application to problems in Materials Science. Prerequisite: 181.

3 units, Win (Pound) MWF 10

223. Advanced Seminar on Statistical Thermodynamics—A discussion of the Grand Canonical Ensemble approach to the statistical mechanics of statistical fluctuations and to the statistical mechanics of irreversible processes. Applications to the description of material systems and processes. Prerequisite: 222.

3 units, Aut (Pound) MWF 11, given 1974–75

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.

3 units, Win (Bates) TTh 10:00–11:30

225. Surfaces and Interfaces—(Enroll in Applied Earth Sciences 225.)

226. Corrosion and Electrometallurgy—Development of electrochemical principles with application to corrosion, electrolytic processes, and galvanic cells. Prerequisites: elementary thermodynamics.

3 units, Win (Stevenson) MWF 10, alternate years, given 1974–75

230. Materials Science Colloquium.

1 unit, Aut (Staff) M 4:15
Win (Staff) M 4:15
Spr (Staff) M 4:15
Sum (Staff) M 4:15

232. Point Defects in Crystals—Structure of point defects. Defect equilibria; influence of temperature, chemical and electrical potentials, interface association. Solid-state electrochemical transducer effects; structural control, sensors, batteries, other applications.

3 units, Aut (Huggins) MWF 9

233. 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: 204 or Electrical Engineering 322A.

3 units, Spr (Bates) MWF 1:15

234. 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 level and Fermi level analysis of semiconductors. Prerequisite: 233 or Electrical Engineering 322B.

3 units, Aut (Bube) MWF 1:15, alternate years, given 1973–74

235. Photoelectronic Properties of Solids—Seminar on selected topics in photoelectronic properties of solids, including photoco-
ductivity, luminescence, photovoltaic effects, and methods of photoelectronic analysis of ordered and disordered materials. Prerequisite: 233 or Electrical Engineering 322B.

3 units, Aut (Bube) MWF 1:15, alternate years, given 1974–75

236. Advanced X-ray Diffraction — X-ray diffraction from perfect crystals, use of Fourier analysis in diffraction, particle size line broadening, strain measurements, effect of stacking faults, diffuse scattering, low angle scattering, diffraction from noncrystalline materials. Prerequisite: 180.

3 units, Win (Bienvennstock) TTh 9

237. 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: 180.

3 units, Aut (Barnett) MWF 10


3 units, Spr (Nix) MWF 11


3 units, Spr (Pound) MWF 11


3 units, Spr (Barrett) lec. TTh 10; lab. by arrangement, given 1973–74

244. Failure Analysis — A study of techniques and methods used in the analysis of failures in the field of materials sciences. Topics covered include optical and electron fractography, electron microprobe, X-ray techniques, non-destructive testing methods and selected case studies from the areas of mechanical properties and solid state electronics.

3 units, Spr (Barrett) lec. TTh 10; lab. by arrangement, alternate years, given 1974–75

245. Advanced Mechanical Properties of Solids—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; strain hardening in single and polycrystals; effects of recovery on plastic flow; special subjects such as the mechanical properties of composite materials and shock phenomena in crystalline solids. Prerequisite: 237.

3 units, Win (Nix) MWF 8, alternate years, given 1974–75

246. Crystalline Anisotropy — Seminar on the application of tensor notation to the description and analysis of the properties of crystalline materials.

2 units, Spr (Shyne) TTh 9, alternate years, given 1974–75

248. Photoelectronic Materials and Devices — (Enroll in Electrical Engineering 392B.)

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 257.)

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. Prerequisite: 181 or equivalent.

3 units, Aut (Tiller) TTh 2:15, alternate years, given 1974–75

3 units, Win (Pound) TTh 1:15–2:45, given 1974–75

266. The Science of Crystallization I—Analysis of the factors involved in predicting distribution coefficients for solutes between two phases. Analysis of solute redistribution during and after a phase transformation under both equilibrium and non-equilibrium conditions. Consideration of diffusion in only one or both phases, applied electric field, shape of new phase, time dependence of transformation velocity, dendritic interface, multi-phase interface, fluid motion, and layer edge effects. Prerequisites: 201 or 240, and Mathematics 131.

3 units, Aut (Tiller) TTh 3:15–4:30, alternate years, given 1974–75

267. The Science of Crystallization II—Quantitative determination of growth rate, shape, and perfection of crystals. Stability of planar, cylindrical, and spherical crystals; dendritic growth; spherulite formation; eutectic and eutectoid growth; volume change effects; interface attachment kinetic dominated growth forms. Prerequisite: 266.

3 units, Win (Tiller) TTh 3:15–4:30, alternate years, given 1974–75

283. Irreversible Thermodynamics—This course deals with the statistical mechanical foundations of fluctuation theory and irreversible thermodynamics. Prerequisites: 181 and 222.

3 units, Spr (Pound) TTh 3:45–5:00

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 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 11

300. Research.

Any quarter (Staff) by arrangement

339. Seminar in Advanced Mechanical Metallurgy.

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

340. Advanced 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

342. Solid-State Electrochemistry Seminar—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, Win, Spr (Staff) by arrangement

352. Photoelectronic Seminar.

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


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

356. Seminar on Stress Corrosion—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 surface polarization in 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 (Titter) TTh 2:15–3:30
MECHANICAL ENGINEERING

Emeriti: Henry O. Fuchs, Boynton M. Green, Lydik S. Jacobsen
Chairman: William C. Reynolds
Associate Chairman: Thomas J. Connolly
Division Directors: James L. Adams (Design), Robert J. Moffat (Thermosciences)
Laboratory Directors: James L. Adams (Design), Robert H. Eustis (High Temperature Gasdynamics), Robert J. Moffat (Thermosciences)
Associate Professors: Joel H. Ferziger, Robert J. Mittelstadt
Assistant Professors: John R. Manning, Robert L. Piziali. Acting: William L. Verplanck
Lecturers: Frank R. Arnold, Carl G. A. Rosen
Design Division Affiliated Faculty: William J. Bowman (Art), Matthew S. Kahn (Art), Bruce B. Lusignan (Systems Design), David A. Thompson (Biotechnology and Computer Graphics)

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 two divisions, Thermosciences and Design, each of which maintains its own laboratories, shops, and offices. The Thermosciences Division offers courses and specialized work in the areas of applied thermodynamics, energy systems, nuclear energy, pollution control, fluid mechanics, and heat transfer. The Design Division emphasizes the design process, and is specifically concerned with systems design, mechanical analysis and design, automatic control, and optimization. The Design Division also offers an undergraduate program in architecture and advises undergraduates interested in Urban Design, and offers a program in Product Design (jointly with the Art Department).

It should be noted that this Department does not offer a comprehensive program in engineering mechanics. However, students in the Department have ample opportunity to do course work in the Department of Applied Mechanics and other departments with concentrations in other areas related to the broad discipline that is mechanical engineering.

FACILITIES

Both Divisions of the Department maintain modern laboratories which are used for both undergraduate and graduate instruction and graduate research work.
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 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. 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 gasdynamic lasers. 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 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.

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 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.

**PROGRAMS OF STUDY**

**BACHELOR OF ARTS—ARCHITECTURE PROGRAM**

This course of study enables the student to acquire a broad educational background while receiving basic training in architecture. The range of courses includes humanities, fine arts, social sciences, mathematics, sciences, engineering, and architecture. Specific requirements are available from the Design Division. This program is suitable as preprofessional training for students going on to graduate study in Architecture at other institutions.

**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 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.

**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 grad-
uate 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 4 below) in the M.S. degree program. 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, outlined below, is designed to assure some minimum of breadth with an opportunity for modest depth in one or two areas. However, a high degree of specialization can only be attained by continuing toward the degrees of Engineer or Doctor of Philosophy, or by including more than 45 units in the M.S. degree 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.

Students who have already fulfilled the mathematics requirement in full or in part, item 1 below, may place the released units in the approved elective category.

The Departmental requirements which must be met for the degree of Master of Science are:

1. 6 units of mathematics from Applied Mechanics 250, 251, 252 (or 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.)

2. 18 units of graduate level courses (200 series) in the Department of Mechanical Engineering (including a maximum of 3 units in Applied Mechanics or Physics), of which not more than 12 units shall be in any one Division. Mechanical Engineering 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, 174, 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 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 201A,B,C, 206, 242A, 242B, 247, Applied Mechanics 205, Aeronautics and Astronautics 131.

b) In Engineering Synthesis, a minimum of 3 units of Mechanical Engineering 291, 292 (Engineering Synthesis Work) by arrangement with a member of the faculty, or by completion of any one of the following courses: Mechanical Engineering 201A,B,C, 206, 214, 220, 222, 228, 235A,B, 237A, 282. 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 81 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>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>*M.E. 299A, B, C. Master's Project</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>*Art 341D. Master's Project</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Art 261. Graphic and Product Design</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Indus. Engr. 208. Biotechnology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Indus. Engr. 263. The Engineering and Organization of Small Businesses</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Approved electives</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Free electives</td>
<td>5</td>
<td></td>
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</tbody>
</table>

* 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 Stanford 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 86 (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 in-
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. Additionally the student must complete certain minimum course requirements in a fifth optional area, but need not take an examination. 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 quarter 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. It may be taken once before the end of the third quarter of residence, without prejudice in case of failure. Details may be obtained from the Department secretary.

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 Language requirement for the Ph.D. degree, which requires a minimum competence in reading technical material in a second language.

The Department also 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.

It is the policy of the Department that students engaged in faculty-supervised research and special study are obligated to provide the faculty member 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.

**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 assistantship 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.

**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 will be descriptive rather than analytical. The course will include: principles of nuclear power generation; the nuclear fuel cycle; fuel reprocessing and radioactive waste disposal; environmental and radiological considerations; siting of nuclear power plants; reactor safety and nuclear materials safeguards; licensing and intervention procedures. 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

**101. Visual Thinking**—Visual thinking and visual language skill developed and exercised in context of solving design problems. Exercises for the mind’s eye. Quickly executed diagrammatic, orthographic, perspective and three-dimensional sketching. Relation of visual thinking to creative process. Emphasis upon fluent and flexible idea production.

3 units, Aut (McKim, Verplank) lec. and lab.
Sec 1 MW 1:15–3:05
Sec 2 MW 3:15–5:05


3 units, Win (Wilde) MWF 1:15

**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. Engineering organization.

4 units, Win, 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.)

**107. 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 (Piziali) lec. TTh 10; lab. W 2:15–5:05


3 units, Aut (Staff) lec. TTh 10; lab. Th 2:15–3:05

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, 107, and 111.

3 units, Spr (Staff) lec. TTh 10; lab. Th 12:00–2:05

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 (Adams) MW 1:15–4:05

115B. Environmental Design—Experience with design problems involving large numbers of people (e.g., mass transportation). Students work in teams; nature of group activity examined. Final presentation to professional jury. Prerequisite: 115A.

3 units, Spr (Verplank) 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 (Verplank) TTh 12:00–2:05

116B. Advanced Product Design — New product innovation via need-finding. Prerequisite: 116A.

3 units, Win (McKim) 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 (——) MWF 10; lab. one afternoon by arrangement

131B. Thermosciences — Continuation of 131A.

5 units, Win (Moffat) 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, Aut (C. Kruger) MWF 1:15

138. Noise Pollution — An interdisciplinary survey of noise pollution. Physical description of sound; human perception and response; technology of noise control; legal and economic aspects of noise abatement. Prerequisite: senior standing (any allied major). Open to graduate students.

3 units, Spr (Reynolds) MWF 1:15

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 (Staff) TTh 10 plus lab. one afternoon by arrangement


3 units, Win (Piziali) MWF 11

174. Nuclear Science—(Enroll in Engineering 174.)

176. Nuclear Energy—(Enroll in Engineering 176.)

177. Radioactivation Analysis — (Enroll in Engineering 177.)

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) TTh 1:15–2:30

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—Form determinants, basic elements of design. Architecture as a profession. Design projects.

3 units, Aut (Staff) TTh 10–12

140. Independent Study — Individual projects with instructor’s approval.

Aut, Win, Spr (Staff) by arrangement

141. Design Communication — Drafting, graphic vocabulary, conventions, and symbols. Orthographic, axonometric, and perspective projection.

3 units, Win (Staff) T 1:15–5:05

142. Building Technology — Basic concepts in structural design, construction methods, materials, environmental control systems, and building production.

3 units, Spr (Staff) TTh 11

143. Building Design I—Case study projects involving actual architectural problems. Prerequisites: 42, 141, 142.

6 units, Aut (Staff) TTh 1:15–5:05

144. Building Design II — Continuation of 143.

3 units, Win (Staff) Th 1:15–5:05

148. Graphic Contracts — Development of drawings and specifications; professional practice. Prerequisite: 141.

3 units, Spr (Staff) Th 1:15–5:05

149A. Internship I — Work experience and observation in offices of architects and landscape architects. Requires one full day each week in an office.

2 units, Aut (Staff) by arrangement

149B. Internship II.

2 units, Win (Staff) by arrangement
149C. Internship III.
2 units, Spr (Staff) by arrangement

FRESHMAN LEVEL COURSES

The following courses offered by the faculty of the Department are suitable for Freshmen.

Course No. Subject
Engr. 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

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. 102. Optimization and Design
(Enroll in Engineering 102)
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. 174. Nuclear Science
(Enroll in Engineering 174)
M.E. 176. Nuclear Energy
(Enroll in Engineering 176)
M.E. 177. Radioactivation Analysis
(Enroll in Engineering 177)
M.E. 180. Energy and Society
M.E. 206. Control System Analysis and Design
(Enroll in Engineering 206)
M.E. 230A. Heat Transfer
M.E. 235A,B. Engineering Systems Design
M.E. 236. Gasdynamics

COURSES PRIMARILY FOR GRADUATES

ENGINEERING DESIGN

201A,B,C. Engineering Design — An intensive treatment of engineering design. The package consists of project work accompanied by investigations of the design process and the study of material of particular value to the engineer involved in design activity. Projects will be carried through fabrication and testing. Special emphasis will be given to the conceptual and the development processes, information collection and organization, failure mode prediction, legal aspects of design, use of the computer and of mathematical analysis in design, protection of intellectual property, production considerations, interpersonal problems faced by the designer in various professional environments, design aesthetics, and man-machine integration. The course is team-taught and involves all Design Division faculty members. These three courses constitute an integrated series. Prerequisite: graduate standing.

201A. 6 units, Aut (Staff) TTh 1:15-4:05
201B. 6 units, Win (Staff) TTh 2:15-5:05
201C. 6 units, Spr (Staff) MW 1:15-4:05

202. Differential Design of Structured Systems—Use of first and second constrained derivative matrices to couple and optimize components of structured systems such as machines, processes, and structures. Chain rule coupling. Removal of loops. Students are required to do an approved design project of their choice. Lectures concurrent with Engineering 102.

3 units, Aut (Wilde) MWF 11

212. Advanced Optimal Design—Proposed design of existing machines, manufacturing processes, or structures are analyzed by optimization theory to see what, if any, improvements are possible. Prerequisite: previous course in optimization theory.

3 units, Spr (Wilde) Th 1:15-4:05

214. Philosophy of Design—An introduction to the philosophy of comprehensive design. A discussion of the attitudes and viewpoints of the designer and an investigation of the techniques of analysis, synthesis, and evaluation that he uses. Emphasis will be placed on understanding the creative process and the factors that influence it. Limited registration. Prerequisite: graduate standing.

3 units, Spr (Staff) T 2:15-5:05

220. 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, working in teams, 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

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-curve analysis, circle and center-point theory. Prerequisite: 107.

3 units, Spr (Roth) MWF 12

223. 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, Aut, Win, Spr (Roth) by arrangement


3 units, Spr (J. Manning) MWF 9, alternate years, given 1974–75

228. Fluidics—Introduction to fluidic components and systems. Behavior and modeling of bistable and proportional jet devices, vortex amplifiers and sensors, passive elements, transmission lines. System synthesis, coupling effects. Survey of current applications and research.

3 units, Spr (J. Manning) MWF 9, alternate years, given 1973–74

229. Logic in Configuration Design—Rigorous logic and combinatorial optimization applied to engineering design involving combinations of indivisible components. Students are required to do an approved design project of their choice.

3 units, Spr (Wilde) MWF 10


2 units, Win (Fuchs) by arrangement

261. 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) MWF 11

293. Experiential Methods in Design Education — A laboratory for training potential teachers of engineering design to develop creativity in themselves and in their students. Students enrolled will gain experience in using effective teaching methods in various undergraduate and graduate design courses. Limited to post-M.S. students planning to teach engineering design.

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

294. Seminar in Design Research — Design students, faculty, and visitors inform each other of recent technical and aesthetic developments in engineering design. Pass/No Credit.

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

299A,B,C. 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.)

299A. 4 units, Aut (Staff) by arrangement

299B. 4 units, Win (Staff) by arrangement

299C. 4 units, Spr (Staff) by arrangement
THERMOSCIENCES

211A. 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, Win (Mitchner) MWF 2:15

211B. Physical Gas Dynamics—(Enroll in Aeronautics and Astronautics 211B.)

230A. 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.230B or for the M.E.231 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, Aut (London, Moffat) MWF 9

230B. 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. M.E.230A or an equivalent undergraduate level course in heat transfer is required.

3 units, Win (London) TTh 11:00–12:15

231A. Convective Heat Transfer — An advanced convection course aimed at predicting the rate of heat or mass transfer between a solid and a fluid starting from descriptions of the geometry and the flow field. Differential and integral equations are developed which describe the transfer of momentum, energy, and specie within a moving fluid. Exact solutions are discussed for some laminar problems (fully developed tube flow; similarity flows). Approximate solutions to turbulent heat transfer are developed using mixing-length theory, experimental results, and superposition. Integral methods are developed for approximate solutions to external heat transfer problems. Operational familiarity with the computer is strongly recommended, to the level of the "quick courses" offered on campus. This course should not be taken as a first course in heat transfer.

3 units, Win (Staff) MWF 9

231B. Convective Heat Transfer — An advanced convection course continuing the study begun in 231A. This course will make much use of the computer, using an existing general program as an exploratory trial to study heat transfer behavior. Laminar and turbulent external boundary layer solutions using finite difference solutions to the differential equations. Operational theories of turbulent transport and solutions for arbitrary boundary conditions. Eddy diffusivity models and mixing-length models. Formulation of the mass transfer problem and simultaneous solutions of heat and mass transfer. Operational familiarity with the computer is required, as is M.E.231A, or consent of the instructor.

3 units, Spr (Kays) MWF 8

233A. 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, Win (London) MWF 1:15

233B. Engineering Thermodynamics — A continuation of 233A including a critical review of the fundamental thermodynamic concepts and principles and a study of the current literature of thermodynamics.

3 units, Spr (London) TTh 11:00–12:15

234. Combustion and Pollution—Thermodynamic 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 ox-
ides of nitrogen. Reduction of pollutant emissions by modification of combustion parameters. Application to combustion systems including internal combustion engines, power plants, and gas turbines.

3 units, Aut (C. Kruger) MWF 3:15

236. 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. 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 (Mitchner) MWF 2:15

237A. 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, one hour by arrangement

237B. Thermodynamics of Propulsion Systems—A continuation of 237A 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; one hour by arrangement

238A. Advanced Fluids Engineering — A two-quarter course in continuum fluid mechanics, and engineering design and optimization of internal flow systems, e.g. nozzles, diffusers, turbomachines. Development of the basic mathematical models for the kinematics and dynamics of the fluid continuum. Integral theorems for mass, momentum and energy. Differential equations of motion, Euler's inviscid flow equations and the Bernoulli theorem. Potential flow of an incompressible fluid and introduction to the boundary layer. Dimensional analysis, modeling and analogues, flow visualization. Emphasis on applications to engineering problems by exact and approximate methods. Prerequisite: graduate standing.

3 units, Aut (Johnston) MWF 8

238B. Advanced Fluids Engineering—Continuation of 238A. Exact solutions to Navier-Stokes equations. Low Reynolds number flows. Laminar boundary and free shear layers (wakes and jets). Two-dimensional, incompressible, potential flow. Vorticity, vortex and circulation concepts and theorems. The theory of lift. Introduction to boundary layer transition, turbulence and separation. Applications in fluids engineering. Prerequisite: 238A

3 units, Win (Johnston) MWF 11

239. 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: 238A and 236 or equivalents.

3 units, Aut (London) MWF 9; one hour by arrangement, alternate years, given 1973–74

239B. Hydrodynamic Stability—(Enroll in Chemical Engineering 211.)

240. Research Frontiers in Fluid Mechanics — Group study of selected topics from turbulent shear flow. Topics selected may include three-dimensional boundary layers, separation, boundary layer structure, unsteady turbulent flows. This course will expose the student to the frontiers of research in an area of fluid mechanics, and will help develop a critical attitude towards research in fluid mechanics.

3 units, Spr (Johnston) one afternoon by arrangement, alternate years, given 1973–74

241. Turbulence—Introduction to the basic concepts of turbulence structure, kinematics, dynamics, with emphasis on shear flows and mixing processes. The student will be expected to fill in between major mathematical steps individually outside of class.

3 units, Spr (Reynolds, Johnston) TTh 9, alternate years, given 1974–75

242A. 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 lay-
ers. Advanced laboratory problems in heat
transfer and fluid dynamics. Prerequisite:
graduate standing or consent of instructor.

4 units, Spr (Moffat) MWF 10; one
3-hour lab. by arrangement

242B. 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.
Proposed writing, sources of funding, evaluation
criteria. Budget estimation. Student
teachers 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 instructor.

3 units, Sum (Moffat) MWF 10 plus lab.
or discussion period by arrangement

244. The Physics of High-Temperature
Gases—This is a one-quarter course spe-
cially designed for students with a conven-
tional 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, blackbody radi-
ation, 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 1973–74

247. Experimental Plasma Physics Labora-
tory—(Enroll in Engineering 215.)

251. Introduction to Partially Ionized Gases
—An introduction to the main microscopic
concepts that enter into a description of par-
tially ionized gases, and a discussion of how
the macroscopic properties of gases may be
calculated from a knowledge of the micro-
scopic processes. Some of the topics covered
include cross sections for collisional and radia-
active processes, reaction rates, recombi-
nation, velocity distribution functions, Ruther-
ford scattering, Saha equation, principle of
detailed balancing, transport coefficients of
mixtures, electrical conductivity, plasmas,
the Debye length, plasma frequency,
sheaths.

3 units, Win (Mitchner) MWF 1:15

252. Magnetofluidmechanics—Interaction
of conducting fluids with electric and mag-
netic fields. MHD one-dimensional channel
flow, boundary layers, power generation and
fluid acceleration. Calculations of electrical
conductivity of equilibrium and nonequil-
librium partially ionized gases.

3 units, Spr (C. Kruger) MWF 1:15

253. Kinetic Theory of Partially Ionized
Gases—Collisions between charged par-
ticles. Debye shielding. The Boltzmann and
Fokker-Planck equations. Accurate calcula-
tion of electrical and thermal conductivities
and thermal-diffusion coefficients of par-
tially ionized gases in a magnetic field. Eval-
uation of approximate transport-property
formulas for practical calculations. The effect
of strong electric fields on the electron tem-
perature and on the values of the transport
coefficients; the electron energy equation.
Rate equations for the population of excited
atomic states and the degree of ionization.
Applications to nonequilibrium as a result
of relaxation and radiation escape. Prerequi-
sites: 251 and 211A, or consent of instruc-
tor.

3 units, Spr (C. Kruger) MWF 3:15,
alternate years, given 1974–75

255. Radiation Heat Transfer—Fundament-
al physics of radiation: Stefan-Boltz-
mann law, black body radiation, Planck dis-
tribution. Interaction of radiation with solid
bodies: nature of processes, definition of
fundamental quantities, relation of radia-
tion properties to electrical properties. Radi-
ative interchange among solid surfaces:
black bodies, configuration factors, grey
bodies, real materials. Radiative properties
of gases and radiative transfer through gases:
isothermal gases, radiative equilibrium, op-
tically thin and optically thick gases.

3 units, Spr (Ferziger) MWF 1

260A. Mathematical Methods in the Therm-
osciences—Selected advanced material in
mathematics applicable to the thermosci-
ences. Topics may include integral equa-
tions, vector and tensor calculus, calculus of
variations, asymptotic methods. Applications
to various engineering problems including
mechanics, fluid mechanics, and heat trans-
fer. Prerequisites: Applied Mechanics 250,
251 or equivalent. Computer programming capability desirable.

3 units, Aut (Ferziger) MWF 9


3 units, Win (Ferziger) MWF 9

270. 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 9

271A. 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; criticality calculations for bare homogeneous reactors.

3 units, Aut (Sher) MWF 10

271B. Nuclear Reactor Theory—Continuation of 271A. 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: 271A and concurrent registration in Mathematics 131 or Applied Mechanics 251.

3 units, Win (Sher) MWF 10

271C. 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: 271B.

3 units, Spr (Sher) MWF 10

272. 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, stellarator, Tokamak. Concepts of fusion reactors and fusion-electric generators. Prerequisite: consent of instructor.

3 units, Spr (Staff) by arrangement; given 1974–75

282. 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: 271A or consent of instructor.

3 units, Spr (Connolly) TTh 11:00–12:15

298. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)

DIRECTED STUDY

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 faculty sponsor.

1 to 15 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 15 units, any quarter (Staff) by arrangement


2 to 15 units, any quarter (Staff) by arrangement


2 to 15 units, any quarter (Staff) by arrangement

OPERATIONS RESEARCH

Chairman: Gerald J. Lieberman

Professors: Richard W. Cottle, George B. Dantzig, Frederick S. Hillier, Donald L.

Associate Professor: B. Curtis Eaves
Assistant Professors: Václav Chvátal, Patricia A. Jacobs
Affiliated Faculty:

Professors: Gene H. Golub, Ronald W. Howard, Samuel Karlin, David G. Luenberger, Ingram Olkin, Douglass J. Wilde, Robert B. Wilson
Associate Professors: Charles P. Bonini, J. Michael Harrison, Evan Porteus

OFFERINGS AND FACILITIES

Operations Research is a mathematical science concerned with optimal decision making and modeling of deterministic and probabilistic systems. The Department's principal objectives are to provide a comprehensive program of instruction in the basic mathematical foundations of operations research, to acquaint students with the application of these methods to real problems, and to train research workers in operations research.

Introductory courses are offered for both undergraduate and graduate students from other departments. Operations Research 152 and 153, open only to undergraduates, is a two quarter introductory sequence which covers the basic concepts of operations research, and includes material on both deterministic and probabilistic models. Operations Research 252 is a similar type introductory course for graduate students. Its purpose is to acquaint students from other disciplines with the techniques of operations research which may be useful to their field. Operations Research 240 is a first course in linear programming, and the sequence 240, 250, 251 forms a basic one-year course in operations research, aimed at students who desire a mathematical science professional career in business, government, or industry.

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, Economics, or Chemical Engineering.

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 and remote-access computer terminal.

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>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. 219</td>
<td>Elementary Statistical Inference</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 220</td>
<td>Statistical Inference</td>
<td>3</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>Comp. Sci. 106</td>
<td>Introduction to Computing</td>
<td>3</td>
</tr>
</tbody>
</table>
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, structure and identification of dynamical 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 grading, 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

50. Models and Applications of Operations Research in Society—Analysis of important socio-economic problems by methods of operations research. Problem areas include the
184 SCHOOL OF ENGINEERING

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 10:00

150. Models and Applications of Operations Research in Society—Lectures same as 50, but a term paper is required.

3 units, Win (Hillier) MWF 10:00

152. Introduction to Operations Research I—Introduction to deterministic models in operations research. Linear, nonlinear, 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. (Graduate students enroll in 252.) Prerequisite: Mathematics 43.

3 units, Win (Cottle) 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. Game theory, minimax theorem. 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: 152 and Statistics 40 or 110 or 116 or Mathematics 123.

3 units, Spr (Jacobs) TTh 4:15-5:30


240. Linear Programming—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 (Cottle) TTh 1:15-2:30

241. Economics of Industry—Optimization of investment decisions; plant size, location and time-phasing; equipment replacement; capital budgeting; pricing and investment policies for a multi-product public enterprise; relation between economies-of-scale and oligopoly problems; inter-industry analysis; public goods—pollution and congestion.

3 units, given 1974-75


3 units, Win (——) TTh 9:00-11:00

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 (Eaves) TTh 4:15-5:30

251. Stochastic Models in Operations Research—Formulation, solution, and analysis of stochastic models in operations research, including those of queueing theory, inventory theory, Markov processes, simulation, reliability theory. Prerequisites: 250 and Statistics 116 and 218 (concurrently) or Mathematics 124 (concurrently).

3 units, Spr (Iglehart) TTh 4:15-5:30

257. Simulation—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 (Shedler) TTh 2:45-4:00

264. Advanced Analysis of Production Systems—(Enroll in Industrial Engineering 264.)

290A,B. Seminar in Applications of 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 unit, Win (Shedler) W 1:15–3:05
290B. 3 units, Spr (Shedler) W 1:15–3:05
290. 3 units, Sum (—) MW 3:15–5:00

299. Independent Study — Intensive study of literature of special topics.

Any quarter (Staff) by arrangement

314A,B. Matrix Analysis and Inequalities—
(Same as Statistics 314A,B.) 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 consent of instructor.

314A. 3 units, given 1974-75
314B. 3 units, given 1974-75

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 bimatrix game problems via linear complementarity theory and its pivotal methods. Prerequisites: 340A and Mathematics 115 or consent of instructor.

3 units, Win (Cottle) TTh 1:15–2:30


3 units, Spr (Eaves) 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 1974–75

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, given 1974–75

Pseudobolean methods. Diophantine equations. Weighted matroid intersection algorithms. Prerequisite: 202 or 240.

3 units, Spr (Wilde) MWF 11


3 units, Spr (Veinott) TTh 9–11


3 units, Aut (Lieberman) TTh 1:15–2:30

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 (Veinott) 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 11:00–12:15

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, Aut (Iglehart) TTh 2:45–4:00

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, Spr (Cottle) by arrangement

371. Seminar in Combinatorial Analysis and Integer Programming—Advanced topics. Prerequisite: 341.

3 units, given 1974–75

372. Seminar in Nonlinear Programming—Advanced topics. Prerequisite: 340C.

3 units, given 1974–75

375. Seminar in Network Theory—Advanced topics. Prerequisite: 345.

3 units, given 1974–75


3 units, given 1974–75

377. Seminar in Game Theory—Advanced topics.

3 units, Aut (Eaves) by arrangement

381. Seminar in Dynamic Programming—Advanced topics. Prerequisites: 351 and Mathematics 205A.

3 units, Win (Veinott) by arrangement

384. Seminar in Applications of Point Processes in Computer System Evaluation—Prerequisite: 358.

3 units, Aut (Shedler) by arrangement

385. Seminar in Reliability Theory—Advanced topics. Prerequisite: 355.

3 units, Win (Lieberman) by arrangement

386. Seminar in Inventory Theory—Advanced topics.

3 units, given 1974–75
387. Seminar in Probabilistic Models—Advanced topics. Prerequisites: 359 and Mathematics 230A.

3 units, Aut (Jacobs) by arrangement

388. Seminar in Queueing Theory—Optimal design and control of queueing systems. Prerequisite: 358.

3 units, Spr (Hillier) by arrangement

389. Seminar in Applied Probability—Advanced topics. Prerequisite: 360 or consent of instructor.

3 units, Spr (Iglehart) TTh 2:15-3:30

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.) Selected topics drawn from the literature.

4 units, Aut (Wilson) TTh 4:10-5:45
SCHOOL of HUMANITIES and SCIENCES

Dean: To be named

Associate Deans: Calvin F. Quate, Arnice Streit

Assistant Dean: Sydney G. Burkhart


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, Mathematics, Music, Philosophy, Physics, Political Science, Psychology, Religious Studies, Slavic Languages and Literatures, Sociology, Spanish and Portuguese, and Statistics, and of the Committee on Linguistics.

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 following. 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: St. Clair Drake, Chairman, Ronald Alexander, Francesca Cancian, N. Gregson Davis, Barbara Hatton, Kennell Jackson, Barbara Joyce Ross, Al Young; Student Representatives: Glenn Jordan, Jon Sylvester

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 Chairman of the Committee in Charge. 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. 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.

CORE COURSES

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).

COURSES OFFERED BY DEPARTMENTS

ANTHROPOLOGY

104. Race and Culture Contact in the Caribbean.
109. Peoples of Africa.

110. Urbanization in African Societies.
111. Belief Systems of Sub-Saharan Africa.

COMPARATIVE LITERATURE


ENGLISH

61. (161.) Forms of Afro-American Literature.
160. The Minority Voice in Contemporary Literature.

FOOD RESEARCH INSTITUTE

133, 134. Economic Development Problems of Third World Economies with Colonial Heritage I and II.
160. Trade and Development Problems of Tropical Africa.

FRENCH

295. Littérature africaine d'expression française: roman et poésie.

HISTORY

147. Kingdoms of Africa: Society and History.
147B. Modern African History.
Given 1973–74
148A. The History of West Africa.
Given 1973–74
157A. Black Community and Leadership, 1739–1877.
157B. Black Community and Leadership, 1877–Present.
182. Latin America and the African.
249H. Senior Honors: Research in African History.
348B. Graduate Core Colloquium: The Interpretation of African History.
447B. Graduate Seminar: Field Work in African History.

POLITICAL SCIENCE

223. Seminar in Comparative Politics: Latin America.
277. Seminar in Comparative Politics: Africa.
SCHOOL OF HUMANITIES AND SCIENCES

**PSYCHOLOGY**

235A. Seminar in African Psychology I.
235B. Seminar in African Psychology II.
235C. Seminar in African Psychology III.

**COLLATERAL COURSES**

(To be selected from Departmental listings within a single discipline by the student in consultation with the adviser.)

**SERVICE COURSES**

The Program also administers three courses for the Black Students Volunteer Service Center:

African and Afro-American Studies: 130A, B, C. Toward Relevant Counseling—A laboratory course designed to train Stanford students in skills and attitudes needed to counsel Black students in elementary, junior, and high schools. Combines seminar with tutoring and counseling in public schools.

130A. 3 to 5 units, Aut (Staff) T 7:00–10:00. Field-work by arrangement
130B. 3 to 5 units, Win (Staff) T 7:00–10:00. Field-work by arrangement
130C. 3 to 5 units, Spr (Staff) T 7:00–10:00. Field-work by arrangement

133A, B, C. Cultural Awareness and Sociological Perspectives—Combination of seminar and field-work designed to provide participation in community situations and to develop analytical skills needed for working with teachers and students concerned with education of Black children and youth. Instruction in preparation of field-reports, and material for use in curriculum, K-12.

133A. 3 to 5 units, Aut (Staff) T 7:00–10:00. Field-work by arrangement
133B. 3 to 5 units, Win (Staff) T 7:00–10:00. Field-work by arrangement
133C. 3 to 5 units, Spr (Staff) T 7:00–10:00. Field-work by arrangement

136A, B, C. Urban Educational Experiences—Reading, discussion, and participant-observation related to the problems of providing meaningful and adequate education for residents of Black communities. Emphasis upon gaining an understanding of the role of public schools and of institutions providing alternative education in the process of Black community development.

136A. 3 to 5 units, Aut (Staff) T 7:00–10:00. Field-work by arrangement
136B. 3 to 5 units, Win (Staff) T 7:00–10:00. Field-work by arrangement
136C. 3 to 5 units, Spr (Staff) T 7:00–10:00. Field-work by arrangement

**ANTHROPOLOGY**

Chairman: Joseph H. Greenberg


Associate Professors: Harumi Befu, A. Richard Diebold, Jr., Arthur P. Wolf

Assistant Professors: George F. Collier, Jane A. Collier, M. Bridgett O'Laughlin, Michelle Z. Rosaldo, Renato I. Rosaldo, Jr., Ezra B. W. Zubrow. Acting: Harriet Whitehead

Lecturers: Peggy J. Golde, Suzanne Chevalier-Skolnikoff (winter quarter, 1974), John C. Cordell (spring quarter, 1974), C. Stevan Harrell (spring quarter, 1974), Louise S. Spindler

**OFFERINGS AND FACILITIES**

The courses offered by the Department of Anthropology are designed (1) to provide undergraduate students with instruction in this discipline which deals with man from the broadest 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 anthropology.

**PROGRAMS OF STUDY**

**BACHELOR OF ARTS**

There are three different undergraduate programs leading to the Bachelor of Arts de-
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 adviser with whom the student will plan a program of courses which satisfies the requirements for the major and meets the needs and interests of the student. The Department maintains a file for each student who declares for the major, which documents progress toward fulfilling the 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. (1) This requirement may be met by successful completion of any of the following courses (or newly offered equivalents): Chinese 23, 25; French 22, 26, 82–86; German 51, 82–86; Hausa 333-A; Italian 22, 82–86; Japanese 23, 25; Portuguese 22, 35; Russian 52; Spanish 22, 29, 52, 53; Swahili 335-A; Yoruba 343-A. (2) The language requirement may also be met by certification in writing from the department involved that the student has demonstrated a reading proficiency equivalent to the level attained in the courses listed above and, in some instances, by presentation of superior S.A.T., G.R.E., or comparable foreign language placement scores.

To transfer from another major into Anthropology after the beginning of his or her junior year, the student must have a grade of B or better in all letter-graded courses previously completed which are to count toward the Anthropology degree requirements.

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 1. To obtain a balanced view of the field, students are required to take at least one course in each of the following topics: (a) Archaeology and Physical Anthropology — 5, 170–179, 270–279; (b) Ethnographic area—100–119, 200–219; (c) Socio-cultural Theory — 120–159, 220–259; (d) Linguistics—3, 160–169, 260–269. Undergraduate majors are encouraged to seek admission to 100- and 200-level seminars but students who wish to take a particular course are advised to plan ahead to be sure of having fulfilled required prerequisites. Undergraduates may also take part in field work on local archaeological sites (Anthropology 180), obtain training in museum methods by doing directed research relating to the Stanford anthropological collections (Anthropology 182), or apply to 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 an average of B or better in all letter-graded course work done at the University 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, one letter of recommendation and a short paper. In the fall quarter of the following year the successful applicants will be required to take Anthropology 199. The honors thesis must be presented to the student's honors adviser 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 195.

**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, students must declare for this program no later than the beginning of the winter quarter of their 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 1. The remaining 20 units must be selected in consultation with the adviser 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 Interdepartmental Major Program.

ADVANCED DEGREES

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.

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 to the Educational Testing Service, Box 955, Princeton, New Jersey 08540, for possible arrangements, or notify the Department.

The Department of Anthropology 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 degree. Ordinarily the Department will not admit students who wish to work only toward the Master of Arts 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 Master of Arts 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 Master of Arts as described in the preceding section.

DOCTOR OF PHILOSOPHY

The Doctor of Philosophy degree is earned by fulfilling the following requirements:

1. Pass during the first year, at an acceptable graduate level, four of the five 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 taken as the University Oral.
7. Prepare a dissertation proposal to be approved by the student's dissertation committee before undertaking field-work.
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.

INTRODUCTORY COURSES

1. Cultural Anthropology — An introduction to social and cultural anthropology, in-
cluding 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
Spr (G. and L. Spindler) MTWThF 1:15


5 units, Aut (Ferguson, Greenberg, Huntington, Staff) 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) MWT 11

UNDERGRADUATE AND GRADUATE COURSES

100. Indian and Peasant Cultures of Latin America—Current economic, political, and demographic trends, especially modernization and marginality, will be included.

5 units, Spr (Cordell) MTWTh 3:15

102. Natives of North America — History, cultural background, and contemporary situation of major tribes and groups in North America. Lecture and seminar format. (Graduate students enroll in 202.)

5 units, Aut (Barnett) MW 2:15-4:05

103. Peoples of Mesoamerica — Survey of 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, (G. Collier) given 1975-76

104. Race and Culture Contact in the Caribbean — 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 10

105. 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.

10 units (G. Collier, R. Rosaldo) given 1974-75

109. Peoples of Africa—An introduction to the ethnography, languages and prehistory of sub-Saharan Africa; special attention will be given to the analysis of problems in the African literature which have led to theoretical advances within social anthropology.

5 units, Aut (O'Laughlin) MWF 9

110. Urbanization in African Societies — Seminar on 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 1974-75

112. 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, Spr (Wolf) MTWTh 2:15

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 (M. and R. Rosaldo) given 1974-75

116. Japanese Society and Culture—Racial, cultural, social characteristics, and background. Relationships between Japanese and other peoples of East Asia. Opportunities to read on special areas. Prerequisite: 1 or consent of instructor.

5 units, Win (Befu) MWF 11
120. **Primitive Curers** — Seminar primarily for anthropology majors and anthropology graduates, centering on the nature, recruitment, and performance of such ritual specialists as shamans and "medicine men," as well as bone-setters and midwives when these involve possession of supernatural powers. Participants will discuss and prepare individual (or cooperative) term papers. Limited enrollment. Prerequisite: consent of instructor. (Graduate students enroll in 220.)

5 units, Aut (Paul) W 2:15-5:05

121. **Cultural Evolution** — Examination of the 19th and 20th century evolutionary theories. General and specific evolution. Cultural adaptation as an evolutionary process. Prerequisite: 1 or consent of instructor.  

5 units (Befu) given 1974-75

122. **Social Movements** — Seminar on Cultural Process — Typology of social movements. Consideration of such social problems as origins, recruitment to membership, organization, and group-environment interaction. Attention paid to competing theories (e.g., collective behavior, revitalization, relative deprivation, cognitive dissonance, stress-strain relations). Relation to peasant and national movements. Examples drawn principally from North America, Latin America, Africa and Europe. Prerequisite: consent of instructor. (Graduate students enroll in 222.)

5 units, Spr (Siegel) W 3:15-6:05

125. **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 1974-75

126. **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. Prerequisite: 1 or consent of instructor.

5 units, Spr (Paul) MWF 11

127. **Applied Anthropology** — A course focusing on the interplay between anthropological theory, methods, and findings; and the instigation, study, ethics, and findings of planned culture change and action programs. Consideration of domestic and overseas programs of technological change, community and national development, and urban migration and relocation. Students will be encouraged to study or participate in action programs. Prerequisite: 1 or consent of instructor.

5 units (Barnett) given 1974-75

129. **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, Win (Frake) T 10:00-11:50

130. **Social Stratification** — Seminar on 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 230.)

5 units, Aut (Cancian) TTh 1:30-3:05

131. **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, Win (Siegel) MWF 10

133. **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 (Frake) MWF 9

136. **Comparative Urbanism** — (Same as Sociology 136.) 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, Spr (Drake) MWF 2:15

138. **Women in Cross-Cultural Perspective** — A lecture course on various traditional anthropological concerns as these are illuminated by a study of the position and behavior
of women. Topics will include: the place of women in kinship, political, economic, and ritual systems. Limited enrollment. Prerequisite: consent of instructors.
5 units, Aut (J. Collier, M. Rosaldo) MW 2:15-4:05

140. Conversion and World View Reorganization—(Same as Modern Thought and Literature 240.) Seminar on the nature of altered states of consciousness, mind-manipulative techniques, and the way in which these are articulated into particular views of the world and the individual. Material from primitive and modern societies will be considered. Limited enrollment. Prerequisite: consent of instructor. (Graduate students enroll in 240.)
5 units, Aut (H. Whitehead) TTh 3:15-5:05

141. Marginal Religions in America—(Same as Modern Thought and Literature 241.) Seminar, examining the alternate and "underground" religious traditions in America, the sorts of groups that embody them, and their relationship to the mainstream culture. Prerequisite: consent of instructor.
5 units, Spr (Whitehead) TTh 2:15

142. Symbolic Anthropology — (Same as Modern Thought and Literature 242.) 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, Spr (Whitehead) MWF 9

143. Anthropological Approaches to Religion—An examination of various approaches to the interpretation of non-Western religious beliefs and practices, with an emphasis on recent developments in structural anthropology.
5 units (Staff) given 1974-75

144. Mythology and Folklore—Anthropological contributions to understanding these fields of human activity; comparisons with Western literature.
5 units, Aut (Gerow) MWF 11

145. Political Anthropology — Review of 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, Spr (J. Collier) MWF 11

146. Anthropology of Law — Theories of law, social control and conflict resolution set in ethnographic perspective. Prerequisite: consent of instructor.
5 units, Win (J. Collier) to be arranged

150. 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 250.)
5 units, Spr (O'Laughlin) MWF 9

151. Economic Anthropology — The economic organization of tribal and peasant peoples; special attention to systems of social and economic stratification and problems of economic change in peasant societies.
5 units, Win (Cancian) MWF 9

152. Anthropology and Demography — A seminar 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 pre-modern Western European cases. Limited enrollment. Prerequisite: consent of instructor.
5 units, Win (Wolf) Th 9:00-11:50

154. Cultural Ecology — This course discusses systems of cultural adaptations of human societies to their environments. It considers ecological approaches to archaeological and ethnographic studies, as well as evaluating different theoretical interpretations of the relationship between cultural and ecological systems. Prerequisite: 1 or consent of instructor.
5 units, Win (Zubrow) MWF 10

155. Psychological Anthropology—Adaptations in different cultural settings. The problem of what is "normal" and "abnormal" in human behavior. Relationship of socialization and cultural transmission to development of personality. Psychology of social and religious movements, and of culture change, with attention to the impact of urbanization,
sex differences, and the problem of consciousness. Prerequisite: 1 or Psychology 1.

5 units, Win (G. and L. Spindler)

MWF 1:15

158. Personality in Culture—Anthropological contributions to psychological and psychiatric theories of personality formation. Cross-cultural comparative studies leading to hypotheses about cultural determinants of personality structure. Cross-cultural perspective on the notion of “normal” vs. “abnormal” adjustment. Prerequisite: 1 or Psychology 1, or consent of instructor.

5 units, Spr (Diebold) MWF 2:15

161A. Linguistic Field Methods I—(Same as Linguistics 175A.) 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. (Graduate students enroll in 261A.)

5 units, Win (Diebold) T 3:15-6:05

161B. Linguistic Field Methods II—(Same as Linguistics 175B.) 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. (Graduate students enroll in 261B.)

5 units, Spr (Diebold) T 3:15-6:05

163. 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 in 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 263.)

5 units, Aut (M. Rosaldo) TTh 10:20-11:50

164. 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.

5 units, Spr (Gerow) MWF 10
173. Development of Civilization—Seminar course considering the archaeological evidence for the development of civilization. Limited enrollment. Prerequisite: consent of instructor.

5 units, Aut (Zubrow) MWF 9

174. Prehistoric Peoples and Cultures 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 environments. Such problems as dietary analysis, skeletal analysis and grave-lot analysis will be viewed with the space-time continuum of 7000 years. Relationships with adjoining culture areas (Great Basin, Northwest Coast, Southwest) and with the present-day Indians of California will be explored. Enrollment limited to about 15 students with previous archaeological coursework or experience, or consent of the instructor.

5 units (Gerow) to be arranged

175. Evolution of Primate Behavior — Introduction to evolutionary theory, including such concepts as population, variation, genetics, the forces of evolution and adaptation, and the process of speciation. Brief survey of the fossil record. Classification, distribution, and general behavioral adaptations of the major groups of contemporary primates. Primate dispersal patterns and their relevance to the evolution of human behavior.

5 units, Win (Skolnikoff) TTh 1:15-3:05

177. Medical Anthropology—Seminar, analyzing theories of disease and therapy in selected societies, the relation of medical beliefs to other areas of culture, and similar problems of medical anthropological interest. Limited enrollment. Prerequisite: graduate standing or consent of instructor.

5 units, Win (Golde) TTh 10:00-11:50

179. Advanced Medical Anthropology — Seminar devoted to examination in depth of selected research problems requiring medical and behavioral science collaboration. Prerequisite: 177 or consent of instructor. (Graduate students enroll in 279.)

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

180. Archaeological Field Methods—Studies, excavations of local archaeological sites, and related work in the Department archaeological laboratory. Prerequisite: 5 or consent of instructor.

4 units, Spr (Zubrow) by arrangement

181. Time Perspective in Anthropological Studies — (Same as Modern Thought and Literature 246.) Seminar for graduate and undergraduate students on anthropological approaches to the study of historical processes in pre-industrial societies; readings on theory and on the integration of linguistic, archaeological and ethnohistorical materials; case-studies of diachronic re-analysis of selected ethnographies. Prerequisite: consent of instructor. (Graduate students enroll in 281.)

5 units, Win (O’Laughlin) MW 3:15-5:05

182. 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) by arrangement

183. Selected Problems in Anthropological Theory — (Same as Modern Thought and Literature 247.) Advanced undergraduate seminar in anthropological theory; introduction to seminal controversies and opposed traditions in the analysis of society and culture. Lecture and discussion. Prerequisite: two or three courses in anthropology or sociology and consent of instructor.

5 units, Spr (O’Laughlin) TTh 10-11:50

184. Design of Field Research—A seminar on basic issues in research design, with special attention to problems of preparing dissertation proposals and applications for research grants. Limited enrollment. Prerequisite: consent of instructor. (Graduate students enroll in 284.)

5 units, Win (Cancian) T1:15-3:05

185A,B. Statistical Methods — Introduction to theory and use of parametric and non-parametric statistics with special emphasis on applications in anthropology. Open to Departmental majors in their senior year and to anthropology graduate students. Continuous enrollment through autumn and winter quarters required for credit.

10 units (G. Collier) given 1974-75

186. Anthropological Research Methods with Implications for Education—(Same as Education 254.) This course is intended for students whose research plans call for substantial employment of anthropological re-
search 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 coordinations 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. Where appropriate, students will be encouraged to collect their own field data locally, or to carry out analyses of available live data. Open to all graduate students, and to juniors and seniors with consent of instructor. (Graduate students enroll in 286.)

3 to 5 units, Win (Textor) by arrangement

187. Data Analysis—Training in computer applications and other formal methods of data analysis in anthropology. Limited enrollment. Prerequisite: consent of instructor.

5 units (G. Collier) given 1974–75

188. 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. Students will be expected to carry out a project in a suitable Chicano community in the greater Bay Area. Enrollment limited. Prerequisite: consent of instructor.

5 units (R. Rosaldo) given 1974–75

190. 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

192. Seminar on Selected Topics in Anthropology — Normally open to anthropology majors.

5 units (——) given 1974–75

195. Honors Program — Directed independent study and honors thesis work for students admitted to this program.

Any quarter (Staff) by arrangement

199. Seminar for Honors Candidates—Presentation of recent research by anthropology faculty and others. The seminar will indicate the range of on-going research and will discuss problems of formulation, method, and reporting. Required of anthropology honors candidates; others admitted only with consent of instructor.

5 units, Aut (Befu) TTh 3:15–4:30

COURSES FOR GRADUATES AND ADVANCED UNDERGRADUATES


203. Mesoamerican Social Organization — Problems in the social organization of Mesoamerica with an emphasis on inter-ethnic relations. Prerequisite: Anthropology 103 or 105.

5 units, Spr (G. Collier) TTh 1:15–3:05

220. Primitive Curers—See 120.

222. Social Movements—See 122.

228. 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, team research, and other experiential techniques will complement a discussion group format.

5 units, Spr (Textor) TTh 2:15–4:05

230. Social Stratification—See 130.

233. Social Organization — Examination of theories and findings in the area of culturally defined interpersonal relations, focusing on kinship and local group organization. Prerequisite: consent of instructor.

5 units, Win (Befu) T 9:00–11:50

235. Kinship and Social Behavior—Analysis of kinship terminologies; relations among terminological systems, social behavior, and social structure; kinship as a principle of social grouping, marriage regulation, and role behavior; examination of the technical vocabulary of kinship studies; training in data elicitation, analysis, and interpretation. Prerequisite: graduate standing or consent of instructor.

5 units, Spr (Frake) MW 4:15–6:05
240. Conversion and World View Reorganization—See 140.

243. Primitive Religion—(Same as Modern Thought and Literature 243.) 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 beliefs, worship, rites of passage, magic, shamanism, and dreaming. Prerequisite: consent of instructor.

5 units, Aut (R. Rosaldo) TTh 9:00–10:20

245. Political Anthropology—Anthropological approaches to the study of political systems and political processes with an emphasis on local group dynamics. Prerequisite: consent of instructors.

5 units (G. and J. Collier) given 1974–75


255. 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. Spindler) MW 3:15–5:05

256. 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.

261A. Linguistic Field Methods I—See 161A.

261B. Linguistic Field Methods II—See 161B.

263. Language and Social Interaction—See 163.

265. Seminar in Historical Linguistics: Linguistic Change—(Same as Linguistics 310.) Survey of types of linguistic change and problems of generalization and explanation in the light of diachronic universals and of contemporary linguistic theory. Prerequisites: 214 and 230, or consent of instructor.

5 units (Greenberg) given 1974–75

268. Ethnographic Semantics—(Same as Linguistics 350.) 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, Aut (Frake) W 3:15–5:05

271. Archaeological Anthropology—The relationship of archaeology to the discipline of anthropology as a whole is discussed, emphasizing both theoretical concepts and critical data for modern anthropologists. This course is designed to examine the assumption base, the theories, methods, and data of "paleo-anthropology." This course is designed for the anthropology student who is interested in what archaeology has to offer and for the student who is interested in contemporary archaeological thinking whether or not he has decided to specialize in archaeology.

5 units, Spr (Zubrow) Th 3:15–6:05


276. 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, Spr (Barnett) T 4:15–6:05

279. Advanced Medical Anthropology—See 179.


283. 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) by arrangement

284. Design of Field Research—See 184.

286. Anthropological Research Methods with Implications for Education—See 186.

288. 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)

290A. History of Anthropological Theory—A historical treatment of the chief theoretical trends in anthropology up to approximately 1930.
5 units, Aut (Greenberg) MWThF 11

290B. The Historical Background of Contemporary Anthropological Theory—A critical treatment of contemporary anthropological theory and its historical background.
5 units, Win (Greenberg) MWThF 2:15

300. Directed Project Work — Special research projects undertaken for course credit.
Any quarter (Staff) by arrangement

301. Department Colloquium — Meetings throughout the school year for the presentation and discussion of current research interests of the faculty, dissertation writers, and visiting scholars. Open to all graduate students and Anthropology majors. To be taken for credit only by first-year graduate students.
1 unit, Aut, Win, Spr (Staff) F 3:30–5:00

302. Directed Individual Study — Provides opportunities for advanced students to explore special areas of interest.
Any quarter (Staff) by arrangement

308. Teaching Apprenticeship—Supervised experience as assistant in one undergraduate course.
5 units, any quarter (Staff) by arrangement

Any quarter (Staff) by arrangement

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 adviser as fitting into the student’s program.

COURSES OFFERED OVERSEAS

1. General Anthropology—(Taught at Stanford in France).
4 units, Sum (Befu)

113. Analysis of Folk Society in France—(Taught at Stanford in France).
4 units, Sum (Befu)

123. Culture and Behavior — (Taught at Stanford in France).
4 units, Spr (Befu)

128. Folk Society — (Taught at Stanford in France).
4 units, Spr (Befu)

151. Economic Anthropology — (Taught at Stanford in Italy).
4 units, Sum (Cancian)

300. Anthropological Field Work—(Taught at Stanford in Italy).
4 units, Spr (Cancian)

APPLIED PHYSICS

Chairman: Hubert Heffner


Associate Professors: Vahe Petrosian, Mitchell Weissbluth

Assistant Professor: Robert L. Byer

Lecturer: Robert M. White

Senior Research Associates: Bertram A. Auld, H. John Shaw, John M. Wilcox

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, 1974. 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, 202, 203, Applied Physics 354, 356s, 358, Electrical Engineering 329A,B, or Engineering 215), 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 his candidacy for the Ph.D. degree is accepted. 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, 202, 203, Applied Physics 354, 356s, 358, Electrical Engineering 329A,B, or Engineering 215). 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.

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."

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. Applications for fellowships, scholarships, and assistantships are made to the Office of Financial Aid and must be completed by January 15, 1974.

COURSES

15. The Nature of the Universe — This course is intended to familiarize undergradu-
ates, 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 11

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 (Doniach) TTh 11:00-12:15

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, Tchebyshev 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, 234. 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 Schrödinger 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: Physics 131 or Electrical Engineering 322B.

232. 3 units, Aut (Weissbluth) MWF 11

233. 3 units, Win (Weissbluth) MWF 11

234. 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 (Heffner) MWF 11

239. Solid State Physics I—The emphasis is on important general concepts of solid state physics and the application of these ideas to specific problems. The concepts will include periodic structures and the reciprocal lattice, wave propagation in periodic structures, Brillouin zones, and dispersion relations. The problems will include X-ray diffraction, lattice vibrations, thermal properties and the band theory of solids, and magnetism.

3 units, Win (Staff), MWF 1:15

240. Solid State Physics II—This course will cover areas of interest in solid state physics, rather than unifying concepts. These areas will include magnetic and mechanical properties of solids, together with resonance effects, superconductivity, and surface properties. Applied Physics 239 is not a prerequisite.

3 units, Spr (Staff), MWF 1:15

250. Wave Phenomena in Active Media I—Theory of wave interactions in various active media. Space charge waves in electron beams, plasmas and semiconductors. Instability criteria for growing waves. Applications to various types of devices such as the klystron, the Gunn amplifier and the small signal theory of the avalanche diode. Domain theory of the Gunn oscillator, and the LSA mode. The Read diode, and other types of IMPATT oscillators. Prerequisites: Physics 111 and 122, or Electrical Engineering 244 or the equivalent.

3 units, Aut (Chodorow) TTh 9:00-10:15
251. Wave Phenomena in Active Media II
— Interactions of coupled systems. The traveling wave tube, the backward wave tube, and the acousto-electric amplifier. Normal mode theory and coupled mode theory. Parametric interactions. The Manley-Rowe relations. The principles of various types of oscillators, amplifiers and frequency conversion devices. Illustrative applications from various types of nonlinear media such as varactor diode, harmonic generators and amplifiers, the scattering of light by sound waves in dielectric materials, interactions between sound waves, between light waves, and nonlinear interactions in plasmas. Prerequisite: 250.

3 units, Win (Chodorow) TTh 9:00-10:15


3 units, Spr (Auld), alternate years, given 1973-74


3 units, Spr (Auld), alternate years, given 1974-75

261. 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: Physics 121 and 131, or consent of instructor.

3 units, Spr (Petrosian) MWF 1:15


3 units, Aut (Harrison) MWF 10

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 (Harrison) given 1974-75

340. 3 units, Spr (Harrison) MWF 10

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 semiconducting and acoustic properties and solid state spectroscopy. Experiments include X-ray and crystal symmetry, phase transition measurements, heat capacity at low temperatures, acoustic properties, bulk semiconductor measurements and spectroscopy.

3 units (4 unit option), Aut (Byer) MW 9, lab. by arrangement

356S. Superconductivity and Low Temperature Physics Laboratory—Combined lecture and laboratory course which discusses im-
important concepts in superconductivity 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.

3 units (4 unit option), Sum (Byer) MW 9, lab. by arrangement

358. Quantum Electronics Laboratory — Combined lecture and laboratory course which discusses laser devices and their applications in experiments. The lasers studied include HeNe, Argon ion, Nd:YAG, Ruby and CO₂. The topics discussed include properties of lasers, laser amplifiers, gaussian beams, anisotropic crystals, second harmonic and parametric generation, Raman and Brillouin scattering, and acousto-optic processes. Experiments are performed with the above lasers in selected areas. Prerequisites: Electrical Engineering 231 and 232 or consent of instructor.

3 units (4 unit option), Spr (Byer) MW 9, 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 244, or equivalent.

3 units, Aut (Sturrock) MWF 9, alternate years, given 1974-75

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 244, or equivalent. (Physics 131 desirable.)

3 units, Win (Sturrock) MWF 9, alternate years, given 1974-75

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, Aut (Petrosian) MWF 11, alternate years, given 1974-75

363. Seminar in Astrophysics—Limited enrollment. Study of the principles and techniques of scientific research with application to current problems of astrophysics. Students are required to take an active role, preparing and presenting reviews and working out specific research problems. Topics to be selected but may include: astrophysical plasmas; solar activity; pulsars and neutron stars; quasars and activity in galactic nuclei; experimental tests of general relativity and gravitational waves.

3 units, Win (Sturrock) by arrangement


3 units, Aut (Sturrock), MWF 9, alternate years, given 1973-74

365. Introduction to General Relativity and Cosmology — Review of special relativity, followed by basic material of general relativity with selected applications, including gravitational collapse, gravitational radiation and cosmology. Prerequisite: Physics 221 or equivalent. (Concurrent enrollment acceptable.)

3 units, Aut (Petrosian), alternate years, given 1974-75

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. Pre-

3 units, Win (Petrosian), alternate years, given 1973–74


3 units, Spr (Sturrock) MWF 9, alternate years, given 1973–74

367. Theory of Phase Transitions and Critical Phenomena — Modern statistical mechanical treatments of phase transitions and critical phenomena. After an introduction to statistical mechanics, the following topics will be treated: ferromagnetism, alloy order-disorder transitions, condensation and melting. Prerequisites: Physics 171 or Materials Science 222, plus an introduction to quantum mechanics.

3 units, Aut (Bienstock) alternate years, given 1974–75

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) W 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) TTh 11:00–12:15

390A. Solid-State Physics Seminar — Discussion of research problems and current literature in solid-state physics is offered by faculty, students and outside specialists.

1 unit, Aut, Win, Spr (Geballe, Staff) Th 4:15

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: Ray N. Faulkner (Professor); Daniel M. Mendelowitz (Professor); Victor M. Arnautoff (Assistant Professor)

Chairman: Lorenz Eitner

Professors: Elliot W. Eisner, Lorenz Eitner, Albert Elsen, Matthew S. Kahn, Frank Lobdell, Dwight C. Miller, Nathan Oliveira, Michael Sullivan

Associate Professors: Keith Boyle, Kurt W. Forster, Suzanne Lewis, Richard Randell, Isabelle Raubitschek

Assistant Professors: William Bowman, John-David P. LaPlante, Paul Turner. Visiting: Per-Olow Leijon, Kirk Varnedoe

Lecturers: Art History—Studio—Leo Holub, James N. Johnson, Robert Parker. Visiting: Alfred Frankenstein

Principal Adviser to Undergraduate Studio Majors: Keith Boyle

Principal Adviser to Undergraduate Art History Majors: Isabelle Raubitschek

Director of Graduate Studies in Art History: Suzanne Lewis

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,
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 adviser 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.

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 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 expected 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 in conjunction with the written examination.
5. Demonstration to the faculty, by course work 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 candi-
date 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 major field. (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 advisers 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—At least 15 units must be taken 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 adviser and as chairman of his or her dissertation committee. The final draft of the dissertation must be in the adviser'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.

**PRACTICE OF ART (STUDIO)**

**Bachelor of Arts**

The major program in the studio area must total 65 units:

**Studio requirements:**
- Art 40, 50, 60

**Art History requirements for studio major:**
- Art 1 (to be taken in the freshman or sophomore year).
- Two additional courses at the 100 level.

Students are urged to take a sequential series in art history (e.g., Art 120A, B, C.)

The above requirements are part of the total of 65 units. A major in studio may take a total of 15 units pass/no credit in either art history or studio courses.

Students are required to formulate their program in careful consultation with their advisers. The freshman and sophomore years should be considered as a time to investigate various studio courses, not to specialize. Following this investigation, a flexible program expressing the concerns of the student should evolve. Such a program might place stress on one or more of four areas: drawing/painting, sculpture, printmaking, or design. The validity of a major in the studio area should reflect the artistic individuality of the student.

For students wishing to concentrate in visual design, the following courses are required (in addition to Art 40, 50, 60, and three courses in art history) as part of the 65-unit total:

1. Art 160, 161, 162 (Intermediate Design)
2. Art 166, 167, 168 (Intermediate Design)
3. Art 140, 145, 150 (Intermediate Fine Arts)
4. Art 261, 262, 263 (Advanced Design)

**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 hopes to achieve a balance between independent concentration, 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 includes a distribution of work between the following areas:

- **Master's Project and Graduate Design Seminar**
- **Advanced Design Course**
- **Advanced Art Course**
- **Advanced 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.
5. Applications and portfolios for the studio program must be submitted by February 1. 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. Painting, sculpture, lithography, and photography students must participate in a weekly seminar in which their work is criticized and discussed in detail.
2. Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.
3. 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 creden-
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 (Varnedoe)

5. Survey I—Main currents in the history of Western art from prehistoric time, Egypt, Greece, and Rome, to the end of the Middle Ages.
   4 units, Win (Varnedoe)

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) alternate years, given 1974-75

103. Greek Architecture—From its origins to the Hellenistic Age, with emphasis on the Classical period.
   4 units, Spr (Raubitschek)

104. Byzantine Art—Art and architecture of the Eastern Empire from the foundation of Constantinople in 330 A.D. to the Turkish Conquest in 1453.
   4 units, Aut (Lewis) given 1974-75

105A. Medieval Art I—Aspects of iconography and style in the art of the Early Middle Ages in the Latin West, from the Early Christian period through the Dark Ages to the end of the Carolingian Renaissance.
   4 units, Aut (Lewis)

105B. Medieval Art II—Art of the Romanesque period in Western Europe, from the late 10th century developments in Mozarabic Spain, Saxon England, and Ottonian Germany through the 12th century, with emphasis on style and iconography in sculpture and manuscript illustration of Romanesque France.
   4 units, Win (Lewis)

105C. Medieval Art III—Art of the Gothic period in Western Europe from the mid-12th century through the International Style, with emphasis on iconography and style in sculpture, painting, and manuscript illustration.
   4 units, Spr (Lewis)

   4 units, Aut (Lewis)

109A,B. Renaissance Society and Culture—(Same as Humanities and History 109A,B.)
   5 units, Win, Spr (Forster, Spitz, Ryan) given 1974-75

110A. Renaissance Art I—Italian architecture, sculpture, and painting of the four-
teenth century. Emphasis on Tuscan art, major fresco cycles, Giotto, the Lorenzetti, and developments in Milan.

4 units, Aut (Forster)

110B. Renaissance Art II — Italian architecture, sculpture, and painting of the fifteenth century. Concentration on civic programs of the early Renaissance in Florence: Donatello, Ghiberti, Brunelleschi; on princely patronage in Urbino (Piero della Francesca), Mantua (Mantegna), Milan (Leonardo); on papal projects, and the new basis of artistic practice (Alberti, Leonardo).

4 units, Win (Forster)

110C. Renaissance Art III—Italian art and architecture from Leonardo and Michelangelo to Titian and Palladio. Focus on coherent programs of patronage in papal Rome, Medici Florence, Venice, Mantua, and on the changing function of art.

4 units, Win (Forster) given 1974-75

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, Aut (Forster) given 1974-75

115A. Northern Renaissance Art I—Art in German-speaking countries during the Reformation: painting, sculpture, and printmaking from Schongauer and Pacher to Dürer, Grünewald, and Holbein.

4 units, Aut (Forster)

115B. Painting in the Low Countries and France During the Seventeenth Century—Rubens, Rembrandt, Vermeer, and Poussin.

4 units, Win (Forster)

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)

120B. Modern Art II — Romanticism and Naturalism. Main currents in European art in the time of the Napoleonic Wars, the Res-
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, Aut (Sullivan) given 1974–75

126B. Introduction to Chinese Painting.
   4 units (Sullivan) given 1974–75

126C. The Art of Japan.
   4 units, Win (Sullivan)
   alternate years

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, Aut (Frankenstein)

130B. Art in Twentieth Century America—Major developments and personalities in painting in twentieth century America.
   4 units, Win (Frankenstein)

155. Picasso — Picasso’s work in painting, sculpture, drawing, and prints.
   4 units, Spr (Elsen) given 1974–75

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, Aut, Win (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, Spr (Turner)

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

200A, B. Studies in Ancient Art.
   4 units, Aut, Win (Raubitschek)

200C. Studies in Ancient Art.
   4 units, Spr (Raubitschek) given 1974–75

203. Studies in Greek Architecture.
   4 units, Spr (Raubitschek)

204. Studies in Byzantine Art.
   4 units, Aut (Lewis) given 1974–75

   4 units, Aut, Win, Spr (Lewis)

206. Seminar in Medieval Art.
   4 units, Spr (Lewis)

207. Studies in Medieval Architecture.
   4 units, Aut (Lewis)

208. Seminar in Medieval Architecture.
   4 units, Win (Lewis) given 1974–75

   4 units, Aut, Win, Spr (Forster)

211A. Studies in Northern Renaissance Art.
   4 units, Aut (Forster) given 1974–75

212. Studies in Renaissance Architecture from Brunelleschi to Palladio.
   4 units, Win (Forster) given 1974–75

214A. Seminar in Renaissance Art—Art and society in Renaissance Italy.
   4 units, Aut (Forster)

   4 units, Win, Spr (Forster)

   4 units, Aut, Win (Miller)

216A. Seminar on the Carracci Family and Painting in Bologna of Their Period.
   4 units, Win (Miller)

216B. Seminar on Painting in Bologna of the Post-Carracci Period.
   4 units, Spr (Miller)

217. Seminar in European Art and Architecture During the Eighteenth Century.
   4 units, Aut (Miller)

   4 units, Aut, Win, Spr (Eitner, Varnedoe)

221. Seminar in Nineteenth Century Art.
   4 units, Spr (Eitner) given 1974–75
221A. Studies in Modern Painting from 1900–1920.  
4 units, Spr (Elsen) alternate years

4 units, Win (Elsen) given 1974–75

4 units, Spr (Elsen) given 1974–75

223A, B. Studies in Modern Sculpture.  
4 units, Win, Spr (Elsen) alternate years

4 units, Aut, Win, Spr (LaPlante)

226A. Studies in Chinese Art.  
4 units, Aut (Sullivan) given 1974–75

226B. Studies in Chinese Painting.  
4 units, Win (Sullivan) given 1974–75

226C. Studies in the Art of Japan.  
4 units (Sullivan) given 1974–75

226E. Studies of Meeting of Eastern and Western Art.  
4 units, Aut (Sullivan)

4 units, Aut (Sullivan) given 1974–75

227B. Seminar in Far Eastern Art.  
4 units, Aut (Sullivan)

227C. Seminar in Far Eastern Art.  
4 units, Spr (Sullivan) given 1974–75

228A. Seminar in Japanese Architecture and Gardens.  
4 units, Aut (LaPlante)

228B. Seminar in Hindu and Buddhist Iconography: India, China, and Japan.  
4 units, Win (LaPlante)

228C. Seminar in Indian and Central Asian Sculpture.  
4 units, Spr (LaPlante)

230A, B. Studies in Nineteenth and Twentieth Century Painting in America.  
4 units, Aut, Win (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. Sessions on research methods and bibliography in the major areas of art history will be given by specialists in each field, as well as an introduction to basic art reference materials by the art librarian.  
4 units, Win (Staff)

4 units, Aut (Finch)

238. Pro-seminar: Introduction to Art History and the Art World—A course in historiography, methods of research, and careers of art history. Recommended for majors.  
4 units, Spr (Elsen, Staff) given 1974–75

239. Colloquium: The Artist from Antiquity to the Present—Extensive readings and discussion of important developments in the history of the artist's profession. Primarily for art history majors. Recommended prerequisites: Art 1 or Art 5 and 10.  
4 units, Aut (Elsen) given 1974–75

Any quarter (Staff) by arrangement

255. Studies on Picasso.  
4 units, Spr (Elsen) given 1974–75

275A, B. Studies in Modern Architecture I, II.  
4 units, Aut, Win (Turner)

4 units, Spr (Turner)

277. Seminar in the Technology in the Nineteenth Century—Selected topics relating to the impact of new technology on architecture in the nineteenth century.  
4 units, Aut (Turner)

278. Seminar in Twentieth Century Architectural Theory — Readings and individual projects relating to theory and criticism in twentieth century architecture and urbanism.  
4 units, Win (Turner)

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.

INTERDEPARTMENTAL COURSE
Renaissance Society and Culture—See Humanities 109A,B or History 109A,B (Art History Credit Given)

INTERDEPARTMENTAL SEMINAR
The Nature of the Humanities—See Humanities 192. Fine Arts and the Humanities.

COURSES IN PRACTICE OF ART (STUDIO)

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 (Staff)

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 (Bowman, Kahn)

70. Basic Photography—Basic laboratory problems in developing and printing.
3 units, Aut, Win, Spr (Holub, Parker)

INTERMEDIATE COURSES
140. Drawing I—Intermediate drawing. Object drawing, memory drawing, figure drawing. Stress is placed on varied media and composition. Prerequisite: 40 or equivalent. May be repeated for credit.
4 units, Aut, Win, Spr (Boyle)

141. Drawing II—Advanced drawing. Life drawing and composition. Prerequisite: 140 or equivalent, or consent of instructor. May be repeated for credit.
3 units, Aut, Win, Spr (Oliveira)

142. Drawing III—Advanced drawing. Emphasizes work from the model, still life, and imagination as necessary to the student's development. Prerequisite: 140 or equivalent. May be repeated for credit.
3 or more units, Aut, Win, Spr (Lobdell)

143. Painting I—Introduction to painting procedure. Still life, landscape, and figure studies in oil and varied media. Prerequisite: 40 or equivalent. May be repeated for credit.
3 units, Aut, Win, Spr (Staff)

146. Painting II—Extended problems in pictorial organization and content, with stress on oil painting. Prerequisite: 145 or equivalent. 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.
3 or more units, Aut, Win, Spr (Lobdell)

148. Lithography—Introduction to lithography. Prerequisite: 140 or equivalent. May be repeated for credit.
3 units, Aut, Win, Spr (Oliveira)

150. Sculpture I—Introduction to wood-carving and wood construction. Prerequisite: 50.
3 units, Aut, Win, Spr (Oliveira)

151. Sculpture II—Introduction to sculpture in metal. Gas and arc welding are principal techniques used. Prerequisite: 150.
3 units, Aut, Win, Spr (Randell)

160. 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 (Kahn, Bowman)

161. Design II—Graphic design media and processes, including illustration with ink and paint, pasteup techniques, typography, and experience in offset lithographic printing. Project work will emphasize graphic communication through functional images and symbols. Prerequisite: 60.
3 units, Win (Bowman)

162. Design III—Product design media and processes, with emphasis on wood construction. Creative projects in areas of physical utility; visual expression through structures
which perform a functional role. Prerequisite: 60.

3 units, Spr (Bowman)

166. Silkscreen Process — 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) given 1974-75

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)

168. Design Synthesis — Mature semi-elective problems in composite and multi-media design areas. Prerequisite: any two design courses above 160.

4 or more units, Spr (Kahn) alternate years, given 1974-75

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)


3 units, Aut, Spr (Randell)


Any quarter (Kahn, Staff) by arrangement

261. Advanced Design I—Continuation of 161; graphic design practice. Prerequisite: 161. May be repeated for credit.

3 or more units, Aut, Win, Spr (Bowman)

262. Advanced Design II—Continuation of 162; product design practice. Prerequisite: 162. May be repeated for credit.

3 or more units, Aut, Win, Spr (Bowman)

263. Advanced Design III—Visual design research; emphasis on invention. Prerequisite: 261 or 262. May be repeated for credit.

3 or more units, Aut, Win, Spr (Bowman)

269. Advanced Creative Studies Seminar—Intensive emphasis in areas of personal specialization, with comparative analysis.

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 COURSE

Philosophy of Design—See Mechanical Engineering 214.

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.)

COURSES OFFERED OVERSEAS

111A. Northern Renaissance Art I—(Taught at Stanford in Germany.)
4 units, Sum (Forster)

120. English Painting from Hogarth to Turner—(Taught at Stanford in Britain.)
4 units, Spr (Eitner)

121. Colloquium: English Eccentrics in Art—(Taught at Stanford in Britain.)
4 units, Spr (Eitner)

213. Dürer and Grünewald—(Taught at Stanford in Germany.)
3 units, Sum (Forster)

ASIAN LANGUAGES

Emeriti: S. Wing Chan, Frederic Spiegelberg (Professors)
Chairman: James J. Y. Liu
Professors: Albert E. Dien, James J. Y. Liu, David S. Nivison (on leave 1973–74), Makoto Ueda
Associate Professors: William A. Lyell, John C. Y. Wang
Assistant Professors: Kung-yi Kao, Susan K. Matisonoff. Acting: Winston B. Davis, Phillip T. Harries
Lecturers: Yin Chuang, Hiroyasu Kubota, Kimie Nebrug, Hiroshi Sakamoto, Dorothy Shou, Hei-Tak Wu
Curator-Librarian, East Asian Collection, Hoover Institution: John T. Ma

OFFERINGS

The Department of Asian Languages offers courses in the languages and literatures of China and Japan. The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, and Doctor of Philosophy. 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: 103, 131, 132, 133, and two other courses at the 100 level (Philosophy 120: Ancient Chinese Philosophy may be included among the courses fulfilling the latter requirement).
2. Concentration in Japanese: 103, 136, 137, 138, and two other courses at the 100 level.

These requirements are in addition to the University’s basic requirement for the Bachelor’s degree.

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. However, the Department is pre-
pared to sponsor students with no previous knowledge of an Asian language as non-matriculated graduate students for one year.

**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.

Well prepared students are encouraged, when appropriate, to spend their first graduate year at either the Taipei or the Tokyo center (see below). It is usually possible for them to do so without losing time in their progress toward the A.M., since advanced courses taken at the centers may exempt them from certain A.M. requirements. Thus, provided that a graduate student's preparation is the equal of the Department's A.B. requirements, he or she should normally be able, after spending a year at the overseas center, to return to Stanford and complete his or her A.M. by the end of the following year. Students interested in doing this must consult the Graduate Adviser.

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 Adviser in consultation with the student's individual adviser. 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 Adviser in consultation with the student's individual adviser. 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**—A student who has been admitted to graduate study in the Department must meet the following requirements before being certified for admission to candidacy.

1. He or she must complete all the requirements for the Master of Arts degree in this Department or equivalent work at another university.

2. He or she must demonstrate a reading knowledge of French or German within a year after completing the A.M. degree.

3. He or she must complete two seminars at the 300 level. These seminars must be in different subjects.

4. 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 Japa-
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 by completing Chinese 103.

5. He or she must pass comprehensive written examinations in four fields. One of these will emphasize comparative or methodological approach to a discipline. The remaining three fields are to be chosen, with the approval of the Graduate Adviser in consultation with the student's individual adviser, 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 adviser. 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 four 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, 215, Japanese 5, 25, 105, and 215 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) W 3; one discussion section by arrangement

108. Asian Culture and Traditions—An attempt to give students a cultural perspective with which to view many of the major philosophical, artistic, and institutional expressions of the East Asian way of life. Special emphasis will be placed on the traditional conceptualizations of the natural world, history, the role and nature of man, the ideal order of society, and the role of art.

4 units, Spr (Staff) MWF 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) MWF 10

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 (Wang) MWF 10

133. Modern Chinese Literature in Translation—Readings in representative twentieth-century works of fiction, drama, and poetry in translation.

4 units, Spr (Lyell) MWF 10
136. Early Japanese Literature in Translation—An introduction to the major works of prose and poetry from the Nara through the Kamakura periods (c. 750-1330).
   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 (Nivison) given 1974-75

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

   4 units (Wang) given 1974-75

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

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
   2. 5 units, Win (Kao, Shou, Staff) Section 1 MTWThF 9
   3. 5 units, Spr (Kao, Shou, Staff) Section 1 MTWThF 9

5. Intensive First-Year Modern Chinese—Equivalent to 1, 2, and 3 combined.
   15 units, Sum (——) MTWThF 8-12

21, 22, 23. Second-Year Modern Chinese—Further study in grammar, reading, conversation, composition. Prerequisite: 3 or equivalent.
   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 (——) MTWThF 8-12

41, 42, 43. Intensive Modern Chinese—Intensive study in grammar, reading, conversation, and composition, the equivalent of first-year and second-year Modern Chinese combined. The successful completion of this course will qualify the student to take 101.
   10 units, Aut (Chuang, Shou) MTWThF 9 and 1:15
   42. 10 units, Win (Chuang, Shou) MTWThF 9 and 1:15
43. 10 units, Spr (Chuang, Shou)  
   MTWThF 9 and 1:15

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—Conversational and grammar.  
   81. 5 units, Aut (Wu) by arrangement  
   82. 5 units, Win (Wu) by arrangement  
   83. 5 units, Spr (Wu) by arrangement

86, 87, 88. Advanced Cantonese Conversation—Prerequisite: 83 or equivalent.  
   86. 3 units, Aut (Wu) by arrangement  
   87. 3 units, Win (Wu) by arrangement  
   88. 3 units, Spr (Wu) by arrangement

ADVANCED

101, 102, 103. Introduction to Classical Chinese—Reading, syntax, composition. Prerequisite: 23 or equivalent.  
   101. 5 units, Aut (Kao) MTWThF 11  
   102. 5 units, Win (Kao) MTWThF 11  
   103. 5 units, Spr (Kao) MTWThF 11

105. Intensive Introduction to Classical Chinese—Equivalent to 101, 102, 103 combined. Prerequisite: 23 or equivalent.  
   15 units, Sum (——) MTWThF 9-12

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, 202. Proseminar—Research methods in Chinese studies. Prerequisite: 103 or equivalent.
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 1974–75

262. Chinese Poetry—Selected readings in T'ang and Sung Poetry (7th–13th century A.D.), with emphasis on critical analysis. Prerequisite: 223 or consent of instructor.
   4 units, Win (Liu) given 1974–75

263. Chinese Lyrics—Selected readings in lyrics (tz'u) of the T'ang, Five Dynasties, and Sung periods (8th–13th century A.D.), with emphasis on critical analysis. Prerequisite: 262 or consent of instructor.
   4 units, Win (Liu) MWF 11

264. Chinese Drama—Selected readings in dramatic works of the Yuan and Ming periods (13th–17th century A.D.), with emphasis on literary rather than theatrical qualities. Prerequisite: 263 or consent of instructor.
   4 units, Win (Liu) MWF 10

271, 272. Vernacular Chinese Fiction—Prerequisite: 103 or consent of instructor.
   271. 4 units, Aut (Wang) by arrangement
   272. 4 units, Win (Wang) by arrangement

281, 282. Modern Chinese Literature—The first quarter is devoted to the short story and essay and the second quarter to the novel. Prerequisite: 213 or consent of instructor.
   281. 4 units, Aut (Lyell) TTh 1:15
   282. 4 units, Win (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 1974–75

299. Translation.

   A total of 5 units, which may be taken in one or more quarters, Aut, Win, Spr (Staff) by arrangement

351. Seminar in Chinese Traditional Historiography—May be repeated for credit.
   5 units, Spr (Dien) T 2:15–4:05

361. Seminar in Chinese Literary Criticism—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 (Liu) M 2:15–4:05

371. Seminar in Chinese Fiction—May be repeated for credit.
   5 units, Spr (Wang) given 1974–75

399. Dissertation.
   (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 2:15
   2. 5 units, Win (Sakamoto, Nebrig)
      Section 1 MTWThF 9
      Section 2 MTWThF 2:15
   3. 5 units, Spr (Sakamoto, Nebrig)
      Section 1 MTWThF 9
      Section 2 MTWThF 2:15

5. Intensive First-Year Modern Japanese—Equivalent to 1, 2, and 3 combined.
   15 units, Sum (——) 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 (——) 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

41, 42, 43. Intensive Modern Japanese—Intensive study in grammar, reading, conversation, and composition, the equivalent of first-year and second-year Modern Japanese combined. The successful completion of this course will qualify the student to take 101.
41. 10 units, Aut (Sakamoto, Nebrig)  
   MTWThF 11 and 1:15
42. 10 units, Win (Sakamoto, Nebrig)  
   MTWThF 11 and 1:15
43. 10 units, Spr (Sakamoto, Nebrig)  
   MTWThF 11 and 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 (——) 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) M 2:15–4:05
   202. 5 units, Win (Harries) M 2:15–4:05

211, 212, 213. Modern Expository Japanese—Scholarly and journalistic writings in Japanese. Prerequisite: 103 or equivalent.

   211. 5 units, Aut (Matisoff) MWF 9
   212. 5 units, Win (Matisoff) MWF 9
   213. 5 units, Spr (Matisoff) MWF 9


   15 units, Sum (——) MTWThF 9–12

246, 247, 248. Introduction to Classical Japanese—The basic principles of the classical literary language; the first quarter is devoted to a study of Heian grammar, while the subsequent quarters deal with later developments in style. 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

256. Readings in Japanese Culture—Reading and discussion of modern Japanese essays on the identity of Japanese culture. Prerequisite: 103 or consent of instructor.

   4 units, Win (Ueda) given 1974–75

258. Major Haiku Poets—Reading and discussion of selected haiku by Bashō, Buson, Issa, and others. May be repeated for credit.

   4 units, Win (Ueda) WF 2:15–4:05

276, 277. Readings in Medieval Prose—Readings from the major prose texts of the Kamakura-Muromachi periods. Prerequisite: 243 or equivalent.

   4 units (Staff) given 1974–75  
   by arrangement

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

295. Modern Intellectuals in Japanese Literature—(Same as 195 with additional work requiring knowledge of modern Japanese.)

   4 units, Win (Ueda) M 2:15–4:05

296. Readings in Modern Japanese Literature—Poetry, prose, and drama after 1868. Prerequisite: 103 or equivalent. May be repeated for credit.

   4 units, Aut (Ueda) WF 2:15–4:05

297. Images of Woman in Modern Japanese Literature—(Same as 197 with additional work requiring knowledge of modern Japanese.)

   4 units, Aut (Ueda) given 1974–75

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, Win (Staff) by arrangement

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) W 2:15-4:05

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, Rolf L. Bolin, Arthur C. Giese, George S. Myers, Cornelis B. van Niel, Joseph F. Oliphant, Willis H. Rich, Ira L. Wiggins (Professors); Roxana S. Ferris (Curator)

**Chairman:** Norman K. Wessells

**Director of Undergraduate Studies:** Richard W. Holm

**Director of Graduate Studies:** Paul B. Green (Aut); Paul R. Ehrlich (Win, Spr)


**Associate Professors:** Harold A. Mooney, John H. Thomas. **By Courtesy:** Olaf E. Björkman, David C. Fork.

**Assistant Professors:** Marcus W. Feldman, Peter A. Getting, H. Craig Heller, Peter K. Hepler, Jonathan Roughgarden, Robert D. Simoni, Frank Stockdale, Ward B. Watt

**Senior Research Associates:** Naomi C. Franklin, Donald H. Perkel, Evelyn Shaw

**Lecturers:** Marcia K. Allen, Charles H. Baxter, Elizabeth M. Center, Patricia A. Sokolove

**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 the new 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, and (3) programs of graduate study and research leading to the degree of Doctor of Philosophy. The Department also administers a graduate program leading to the Ph.D. in Biophysics. Applications are not accepted for the Master’s degree.

The Jasper Ridge Biological Experimental Area near the Stanford Campus provides a 735-acre reserve for ecological and population biology. Research vessels and special laboratory facilities for biological oceanography and 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

COURSE REQUIREMENTS

Candidates for the degree of Bachelor of Science must complete:

(1) **Core Courses**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 1</td>
<td>5</td>
</tr>
<tr>
<td>Biology 21</td>
<td>4</td>
</tr>
<tr>
<td>Biology 22</td>
<td>3</td>
</tr>
<tr>
<td>Biology 23</td>
<td>3</td>
</tr>
<tr>
<td>Biology 24YZ (see note 1)</td>
<td>6</td>
</tr>
</tbody>
</table>

Total........................................................................ 21

(2) **Elective Courses**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
<td>8 8 2</td>
</tr>
</tbody>
</table>

Total Core and Electives............ 40

Note 1. Beginning 1972–73, Biology 24ABC will no longer be offered. Students who have completed only a portion of the 24ABC sequence should consult their advisers about fulfilling this requirement.

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 Undergraduate 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 in a single specialized field from "in-depth" courses, such as 169, 175H, 176H, 178, 198, 199, 199H, 222H, 245, 251, 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 (or 4, 5)
- 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

It is strongly recommended that students intending to do graduate work in Biological Sciences acquire reading ability in an appropriate modern European language.

**TYPICAL SCHEDULE FOR A FOUR-YEAR MINIMUM PROGRAM**

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 31, 33, 35, 36. Introductory Chemistry</td>
<td>4 4 5</td>
</tr>
<tr>
<td>Biology 1. Introductory Biology</td>
<td>4</td>
</tr>
<tr>
<td>Math. 5, 6, 7. Calculus and Probability</td>
<td>3 3 3</td>
</tr>
<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
<td>8 8 2</td>
</tr>
</tbody>
</table>

Totals.......................................................... 15 15 15

**Second Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 21. Principles of Biology</td>
<td>4</td>
</tr>
<tr>
<td>Biology 22. Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biology 23. Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biology 24. Experimental Biology</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 131, 132, 135. Organic &amp; Physical Chemistry</td>
<td>6 3</td>
</tr>
<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
<td>5 6 9</td>
</tr>
</tbody>
</table>

Totals.......................................................... 15 15 15

**Third Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 21, 23. Introductory Physics</td>
<td>4 4</td>
</tr>
<tr>
<td>Writing &amp; Distribution Requirements or Electives</td>
<td>11 11 15</td>
</tr>
</tbody>
</table>

Totals.......................................................... 15 15 15
Fourth Year
Course No. Subject A W Sp
Electives 15 15 15
Totals .................. 15 15 15

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, pre dental, 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.)

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 sec-

tion or may be obtained from the Credential Secretary, School of Education.

MASTER OF ARTS

Students are not normally admitted to the Department for a terminal Master of Arts degree in the Biological Sciences.

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 of the Graduate Record Examination as part of the application. The advanced biology test is recommended but not required.

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. 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 Fi-
nancial 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 Graduate 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 bulletin and to the Department requirements stated below:

Courses required of all Ph.D. candidates—Each student must take at least three units of work 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 adviser or the Director of Graduate Studies.

Teaching Experience and Training are part of the graduate curriculum. Each student assists in teaching at least eight sections during the first and second year. This normally involves two afternoons a week for four quarters and assignments are made in consultation with the student. Biology Fellows with departmental support may be called upon to teach one-fourth time (or less) in their third and fourth year.

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—Before being recommended for admission to candidacy for the degree of Doctor of Philosophy, the prospective candidate will be required to pass a qualifying examination, normally at the beginning of the second year of registration as a graduate student. The qualifying examination is given once a year near the beginning of the autumn quarter. The status of the student remains probationary until this examination is completed, at which time his eligibility to continue work toward the Ph.D. degree is determined on the basis of his or her total academic performance during the first four quarters of graduate study. (Entering students are encouraged to take this examination prescriptively in order to plan first year course work. For entering students, the exam is reviewed but not graded, and cannot be “passed.”)

Language Requirement—A foreign language may be required by the major professor but is not required by the Department.

Dissertation Proposal—Each student will prepare, by the end of his second year in residence, a Dissertation Proposal which will include a definition of the problem, the goals of the particular work, and the proposed methods of procedure. Work should be planned so as to complete the entire Ph.D. program within four years. The proposal will be endorsed by the major professor and circulated to a three-member faculty committee prior to an oral presentation and review.

Application to Candidacy should be made as early as departmental preliminary procedures are completed and not later than the fourth week of the last three quarters of candidacy.

The Dissertation Reading Committee can be appointed at any time between the filing of the application to candidacy and the beginning of the fourth year.

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.

_Minor for the Degree of Doctor of Philosophy_— Candidates for the degree of Doctor of Philosophy in other departments who wish to minor in Biological Sciences may meet this requirement by successfully passing the Departmental Qualifying Examination.

**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 but not required.

   5 units, Spr (Watt, Sokolove) TWTThF 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) F 1:15–3:05,
   (10) F 3:15–5:05

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 1, 2, 3 or 31, 33, 35.

21. 4 units, Aut (Allen, Hanawalt, Simoni, Sokolove) MWF 11
22. 3 units, Win (Heller, Ray) MWF 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: Chemistry 1, 2, 3 or 31, 33, 35, 36.

24Y. 3 units, Win (Allen, Center, Sokolove) labs. and discussion
   (1) T 1:15–3:05, T1:15–5:05;
   (2) T 3:15–5:05, T1:15–5:05;
   (3) T 1:15–5:05, T1:15–3:05;
   (4) T 1:15–5:05, T3:15–5:05
   (5) W 1:15–3:05, F 1:15–5:05;
   (7) W 1:15–5:05, F 1:15–3:05;
   (8) W 1:15–5:05, F 3:15–5:05

24Z. 3 units, Spr (Allen, Center, Sokolove) labs. and discussion
   (1) T 1:15–3:05, T1:15–5:05;
   (2) T 3:15–5:05, T1:15–5:05;
   (3) T 1:15–5:05, T1:15–3:05;
   (4) T 1:15–5:05, T3:15–5:05
   (5) W 1:15–3:05, F 1:15–5:05;
   (7) W 1:15–5:05, F 1:15–3:05;
   (8) W 1:15–5:05, F 3:15–5:05

95. _Practical Plant Biology_—Experience in phenomena and techniques of food crop growth by participation in student organized field garden project accompanied by reading and discussion of pertinent botanical background. Prerequisite: consent of instructor.

   3 units, Spr (Ray) TTh 10 plus 6 hours per week by arrangement

97. _Biology of Subtidal Communities_—Lectures and field trips treating shallow water communities accessible to SCUBA divers. For selected communities it will introduce: (1) physical characteristics of the environment, (2) organismal composition, (3) selected aspects of their life histories and adaptation, (4) interactions between species. Enrollment is limited and by consent of in-
structor. Prerequisites: SCUBA certification, SCUBA equipment, ocean experience, and consent of instructor.

3 units, Aut (Baxter) WF 3:15–4:30 plus 5 Sunday field trips

UPPER DIVISION COURSES

100H. Marine Algae—See Hopkins Marine Station.

102. Invertebrate Biology—The phylogeny, classification, morphology, physiology, and ecology of invertebrates. Lectures, laboratory, and field trips. Prerequisites: an elementary biology course and consent of instructor.

5 units, Aut (Baxter) MWF 11; lab. TTh 1:15–4:05

104. Comparative Animal Physiology — A consideration of physiological systems in their present diversity which will emphasize generalities based on phylogeny and environmental relationships. Lectures and laboratory. Prerequisites: 22, 24B or 24Y, and consent of instructor.

5 units, Win (Baxter) MWF 10; lab. TTh 1:15–4:05

105. Immunobiology — An introduction to biological and chemical immunology, concerned with the nature of the immune response; the structural features of antibodies and antigens which determine their qualitative behavior and quantitative reactions. The range of immunological phenomena and their application to the solution of biological and chemical problems. The course meets twice a week and consists of lectures and demonstrations. Prerequisites: 21, 22, and 23; Chemistry 1, 2, and 3; and one term of either organic or physical chemistry.

3 units, Aut (Feigen) T 10–11, Th 10–12

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, form and function of the organelles and inclusions of the cell, fine structure of several different plant and animal cell types, and an introduction to cell development. Prerequisite: 21 or Human Biology 2A.

3 units, Win (Hepler) MWF 10

107. Cell Development—A study of those controls, imposed upon energy transfer and genetic activity, which account for the progression of a cell and its organelles through the cell cycle. Variations in this progression, leading to chemical and geometrical changes during the cycle (differentiation), will be covered in systems through the most highly developed unicells (protozoa, fungi, algae). Prerequisites: 21 and 22 or Human Biology 2A and 3A.

3 units, Spr (Feigen) T 10–11, Th 10–12

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

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 (Wessells) 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 (Wessells, Center) labs T 1:15–5:05

111H. Marine Invertebrates—See Hopkins Marine Station.

112H. Marine Invertebrates—See Hopkins Marine Station.

117H. Zooplankton — See Hopkins Marine Station.

118H. Phytoplankton—See Hopkins Marine Station.

119H. Marine Ecology—See Hopkins Marine Station.

120H. Marine Ecology—See Hopkins Marine Station.

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.
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. 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.

Mosses and Ferns—Structure, development, evolutionary relationships of mosses and ferns. Lectures, laboratories, and field trips. Prerequisite: consent of instructor.

Seed Plants—Structure, development, evolutionary relationships of seed plants. Lectures, laboratories, and field trips. Prerequisites: 22 and 23.

Seminar on Replication of Nucleic Acids—Modes of replication and their control in prokaryotic and eukaryotic systems. Critical review of current literature. Pre-requisite: 21 and/or consent of instructor.

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.

Topics in Comparative Animal Physiology—Reading and discussion on selected topics dealing with functional analyses of physiological functions in whole animals. Background through 22 is necessary and any additional experience is helpful.

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, either probability or statistics, and consent of instructor.

Biostatistics—An introduction to the statistical analysis of biological data. Lectures, discussion and student exercises.

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.

Evolutionary Genetics—Application of genetics to study of evolution. Prerequisite: a knowledge of basic genetics.

The Physiological Basis of Behavior—Properties of neurons, synapses, sensory receptors, and muscles; organization of neural networks and reflexes; the analysis of more complex behavior. Prerequisites: 21, 22, 23, or Psychology 107, 108, or 109.


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.

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.
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 1973-74

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, given 1974-75

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: 22 and 23, and consent of instructor.  
10 to 15 units, Spr (Mooney) by arrangement

179. Plant Ecology—Lectures, discussions, and field problems in the environmental relationships of plants. Prerequisites: 22 and 23, or consent of instructor.  
4 units, Win (Mooney) WF 11; Field trips and discussion F 1:15-5:05

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. Prerequisites: 1, 21, 22, and 23, or consent of instructor.  
3 units, Win (Watt) MTh 2:15; lab. T 1:15-5:05; alternate years, given 1973-74

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, given 1973-74

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

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 weeks are devoted to beginning methods in electron microscopy. Two hours of lecture, one three-hour laboratory. Pre-
requisites: 21 and 22; 24A and 24B (or 24Y instead of A and B); high school physics.

3 units, Aut (Green, Hepler) lec. TTh 1:15; lab. T 2:15-5:05 or Th 2:15-5:05

196. Problems in Marine Pollution—Seminars and field studies on various aspects of man's effect on the ecology of shallow coastal areas. The class will involve the reading of original papers and texts in marine pollution in addition to group and independent problems in the field or laboratory. May be taken more than once for credit. Pre-requisite: consent of instructor.

3 units, Aut, Win, Spr (Baxter) by arrangement

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

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 on inheritance in bacteria. Prerequisite: Medical Microbiology 101 or equivalent.

3 units, Win (Stacker) MWF 11:00 alternate years, given 1973-74

208. Advanced Topics in Genetics — Will deal in depth with topics of current interest, emphasizing eukaryotes. The subject matter will vary from year to year, and the course may be repeated for credit. The general theme in 1973-74 will be genetically determined instabilities of genes and chromosomes. Prerequisites: 166, 167 or equivalent, and consent of instructor.

2 units, Aut (Perkins) M 2:15-4:05

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, antibodies, and hormones and cells. Prerequisites: 21, Biochemistry 200 recommended.

3 units, Spr (Simoni) TTh 11-12

213. Viruses — Principles of virus growth, genetics, architecture and assembly. Rel-
tion 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 1974–75

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 (Green, Hepler, Ray) MW 1:15–3:15

222H. Biological Oceanography—See Hopkins Marine Station.

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, Win, Spr (Pittendrigh) by arrangement

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) MW 4:15

249. Cytogenetics—(Same as Genetics 249.) Principles and modern biochemical methods of chromosome analysis. The structure, function, 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 1974–75

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 1973–74

251. Biophysical Measurements—Selected laboratory research problems to provide experience with modern biophysical instruments and experimental techniques, including: spectrophotometry, chromatography and electrophoresis, radioactive tracers, sedimentation, etc. Open to limited number of advanced students, by consent of instructor.

3 or more units, Spr (Hanawalt and Staff) by arrangement


3 units, Spr (Yanofsky) TTh 9–10:30

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) by arrangement

256. Drug Interactions with Biological Systems—A lecture and discussion course for graduate and advanced undergraduate students in the sciences describing selected examples of experimental approaches to the study of interactions of drugs with their biological receptors. Prerequisites: 21 and 24A or 24Y, organic chemistry, or consent of instructor.

3 units, Spr (Schimke) MW 4:15, alternate years, given 1974–75
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 1974-75

258. Physiological Basis of Adaptation — Lectures, readings, 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 1974-75

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

261H. Comparative Biochemistry of Marine Microorganisms — See Hopkins Marine Station.

269H. Ecological Physiology — See Hopkins Marine Station.

278. Mathematical Analysis of Biological Processes — Continuous systems: Formulation and solution of differential equations arising from growth and interaction of populations, mass transfer, reaction kinetics, morphogenesis. Discrete systems: Elements of probability and stochastic processes and linear algebra as applied to population genetics, neural systems, epidemiology. Guest lecturers will present examples from their specialties. Prerequisites: elementary calculus, probability or statistics, and consent of instructor.
3 units, Aut (Feldman, Roughgarden, Perkel) MWF 1:15

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 1973-74

281. Mathematical Population Biology — The course will, in alternate years, respectively deal with theoretical population genetics and with mathematical ecology. Prerequisite: consent of instructor.
3 units, Aut (Feldman) MWF 3:15

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 on some ecological problem. Prerequisites: 23 and consent of instructor.
3 units, Win (Roughgarden) TTh 11, alternate years, given 1973-74

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 1974-75

300. Research.
(Staff) by arrangement

300H. Research — See Hopkins Marine Station.

351. Seminar in Neurobiology — Prerequisite: consent of instructor.
3 units, Aut, Win, Spr (Kennedy, Perkel) M 12-1:15

352. Seminar in Developmental Biology — Literature and research review of selected topics in development. Prerequisite: consent of instructor.
3 units, Aut, Win, Spr (Green, Hepler, Ray, Wessells) 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.

3 units, Aut, Win, Spr (Ray and Staff)
W 3:30–5:00

354. Seminar in Population Biology—Prerequisite: consent of instructor.

3 units, Aut, Win, Spr (Staff)
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, Senior Research Associate, 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 (e.g. as teaching assistant in courses such as Biology 251 or 253).
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. 201. Biological Effects of Radiation.
Biol. 249. Cytogenetics.
Biochem. 200 and 201. Biochemistry Lectures.
Biochem. 213. The Arrangement of Information in Chromosomes.
SCHOOL OF HUMANITIES AND SCIENCES

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 AND OCEANOGRAPHY,
HOPKINS MARINE STATION

Emeriti: Lawrence R. Blinks, Rolf L. Bolin, Arthur C. Giese, Cornelis B. vanNiel (Professors)
Acting Director: Norman K. Wessells
Associate Director: Donald P. Abbott

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 March.

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.

175H. Problems in Marine Biology — Field studies, laboratory, lectures, individual problems in marine biology. Designed primarily for undergraduates. Students will be in residence at the Hopkins Marine Station during the entire quarter. Prerequisites: 22 and 24B or 24Y; and Chemistry 1, 2, and 3; and consent of instructors. By application only.
15 units, Spr (D. Abbott, I. Abbott, Gilmartin, Phillips) MTWThF

199H. Special Problems — Properly qualified undergraduate students may undertake individual work in fields indicated under 300H. Such studies are intended to introduce the serious student to methods of research. Arrangements must be made by consultation or correspondence.

(Staff) by arrangement

300H. Research—Problems involving original work may be undertaken with members of the staff in the following fields:

Marine Zoology — Problems on the functional anatomy, taxonomy, development, and ecology of marine animals.
(D. Abbott)

Biological Oceanography.
(Gilmartin)

Comparative Biochemistry and Immunology—As exemplified in marine animals.
(Phillips)

Marine Ecology, Physiological Ecology.
(Lee)

Marine Algae—Problems involving structure and reproduction, morphology, taxonomy and life histories of marine algae; marine plants as food and shelter for marine animals.
(I. Abbott)

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 Station. Completed applications must be received by March 30.

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.

The regular six-unit laboratory courses are scheduled for three alternate days per week, an average of 24 hours per week being required. It is possible to obtain twelve units in each term, but registration for more than 16 units in the full quarter is not ordinarily advisable, owing to the intensive schedule.

First Term

100H. Marine Algae—Lectures, laboratory, and field work on the various classes of algae. Particular attention will be given to the marine algae of the Pacific Coast. Prerequisite: elementary botany.

6 units (I. Abbott) TThS

111H. Marine Invertebrates—Survey of the lower marine invertebrates, echinoderms, and protochordates. 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

119H. Marine Ecology—Ecological studies of selected marine associations and habitats. Emphasis will be on intertidal ecology. Prerequisites: at least two courses in general biology or zoology. Chemistry and invertebrate zoology are recommended. Preference will be given to students registering for both 119H and 120H.

6 units (——)

199H. Special Problems — (See above, autumn, winter, and spring quarters.)

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 on inshore and some open sea phytoplankton, morphology, and systematics, ecology and sampling techniques. Prerequisite: one year of biological science at the college level.

6 units (——) MWF

120H. Marine Ecology — Continuation of 119H: The class will meet daily during periods of low tides. Students can expect that at times there may be up to six consecutive meetings. Further meetings will be announced to make a total of 15 meetings. Prerequisite: 119H.

6 units (——)

176H. Problems in Biological Oceanography — The course is designed primarily to give students an opportunity to engage in research at sea. Prerequisite: 222H, or consent of instructor.

6 units (Gilmartin)

199H. Special Problems — (See above, autumn, winter, and spring quarters.)

300H. Research—(See above, autumn, winter, and spring quarters.)

Courses Offered Overseas

181. Darwin and His Influence on Germanic Intellectual Thought—(Taught at Stanford in Germany)

3 units, Aut (J. H. Thomas)

182. General Ecology—(Taught at Stanford in Germany)

4 units, Aut (J. H. Thomas)

Chemistry

Emeriti: Frederick O. Koenig, Philip A. Leighton, J. Murray Luck, J. Pearce Mitchell, Carl R. Noller (Professors)

Chairman: Henry Taube
Vice Chairman: Douglas A. Skoog

* The curriculum leading to the B.S. degree in Chemical Engineering is described elsewhere in this bulletin.

**Associate Professor:** Robert Pecora

**Assistant Professors:** Hans C. Andersen, Bruce S. Hudson, Leonard M. Stephenson, Frank A. Weinhold

**Lecturers:** Karen P. Long, Suzanne Hudson

**Affiliated Faculty:** Paul Kruger (Civil Engineering)

**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.

Students who have taken the College Board Advanced Placement Examination in Chemistry and receive a composite score of 4 will be excused from Chemistry 31 or from Chemistry 4. Those receiving composite scores of 5 may be excused from Chemistry 5 on the recommendation of the Committee on Undergraduate Study.

**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, 133, 134, 137, 171, 173, 174, 175, 176. For Class of 1975 and earlier the requirements may be fulfilled by Chemistry 1, 2, 3 (or 4, 5) 113, 116, 121, 122, 123, 124, 125, 137, 171, 173, 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 51-58 provided they also complete Biology 1, 21, 22, 23. Students interested in attending overseas campuses should consult their advisors 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, 143, 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 136, 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 ap-
proved 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  
(Class of 1975 and earlier)**

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<th>Year</th>
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<td><strong>First Year</strong></td>
<td>Chem. 1, 2,3</td>
<td>General Chemistry</td>
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<td>Writing Requirement</td>
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<td>German 1, 2,3, First-Year German</td>
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<td>Math. 10, 11, 21, Analytic Geometry and Calculus</td>
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<tr>
<td><strong>Second Year</strong></td>
<td>Chem. 121, 123, 125</td>
<td>Organic Chemistry</td>
<td>4</td>
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<td>Chem. 122, 124</td>
<td>Organic Laboratory</td>
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<td>Math. 22, 23, Analytic Geometry and Calculus</td>
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<td>Physics 51, 53, 54. Mechanics, Sound, Electricity</td>
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<td>Electives (see Note 1)</td>
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<td><strong>Third Year</strong></td>
<td>Chem. 113</td>
<td>Quantitative Analysis</td>
<td>4</td>
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<td>Chem. 116</td>
<td>Instrumental Analysis</td>
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<td>Chem. 171, 173, 175</td>
<td>Physical Chemistry</td>
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<td>Chem. 176</td>
<td>Physical Chemistry Laboratory</td>
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<td>Physics 55, 56, 57, 58</td>
<td>Light and Heat, Atomic Physics</td>
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<tr>
<td><strong>Fourth Year</strong></td>
<td>Chem. 137</td>
<td>Inorganic Chemistry</td>
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<td>Electives (see Note 1)</td>
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**TYPICAL SCHEDULE FOR FOUR-YEAR PROGRAM  
(Class of 1976 and later)**

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<tr>
<th>Year</th>
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<td><strong>First Year</strong></td>
<td>Chem. 31</td>
<td>Chemical Principles</td>
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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 104; Math 44, 106, 113, 130, 131, 132; Physics 110, 111, 132; Stat. 40, 110, 116; Geol. 1; Engr. 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, 278.
SCHOOL OF HUMANITIES AND SCIENCES

TEACHING CREDENTIALS

The requirements for certification to teach chemistry in the secondary schools and junior 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 21, 22, 1973, 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 lan-
guage 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 subject. 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 three units of Chemistry 227; (3) take Chemistry 271 (or be exempted therefrom by passing a special examination administered by the professor in charge of this course); (4) take Chemistry 233 in the second year (3 units); (5) 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 and William H. and Myrtle B. Sloan Scholarship are granted only to graduate students. The William H. Nichols Scholarships, David L. and Lavinia E. Sloan Memorial Scholarship and John Maxson Stillman Scholarship are open to graduates and undergraduates; the Robert M. and Katherine F. Loeser Scholarship and the Frank Card Scholarship are 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

4. General Chemistry—A course emphasizing the quantitative and physical aspects of general chemistry. Primarily for engineering and science majors. Properties of solutions; chemical equilibrium; electrolyte solutions; galvanic cells; oxidation-reduction systems; chemical thermodynamics.

Some prior knowledge of physics is assumed; e.g. the laws of motion, the properties of gases; some knowledge of elementary chemistry is assumed; e.g. stoichiometry, simple chemical formulas. Good knowledge of algebra is desirable and concurrent enrollment in calculus recommended.

4 units, Aut (Hutchinson) lec. TTh 8; lab. T or Th 2:15-5:05

5. General Chemistry — Continuation of Chemistry 4. Chemical kinetics and reaction mechanisms; atomic structure; molecular structure and bonding; molecular spectra; introduction to organic chemistry.

4 units, Win (Hutchinson) lec. TTh 8; lab. T or Th 2:15-5:05

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.

4 units, Aut (Andersen, Staff, Pecora, Weinhold) lec. (1 and 2) MWF 8, (3) MWF 9, (4) MWF 10; one recitation by arrangement

33. Structure and Reactivity — Organic chemistry, functional groups, hydrocarbons, oxygenated compounds, chemical equilibria. Prerequisite: 4 or 31.

4 units, Win (Brauman, Collman, Eastman, Stephenson) lecture and recitation sections same as 31

35. Functional Groups and Stereochemistry—Organic Chemistry, carbonyl compounds, bifunctional molecules, stereochemistry, carbohydrates, nitrogen, sulfur, and phosphorus compounds, amino acids and proteins, kinetics. Prerequisite: 33 or 5.

3 units, Spr (Brauman, Eastman, Stephenson) lecture sections same as 31

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.

2 units, Spr (Hodgson) lec. M or W or F 1:15; lab. M, T, W, Th or F 2:15-5:05

130. Biosocial Aspects of Birth Control—(Same as Human Biology 150.) 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 course will deal with a critical evaluation of the logistic aspects of practical human fertility control. Groups of 5 to 8 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 selection of students admitted to this class will be based in part on the desire to create a multi-disciplinary student group 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, etc.) who will focus on specific logistic aspects of a common topic in the birth control field. Limited to 40 students. Pre-registration during fall quarter essential. Prerequisite: At least junior standing and completion of pre-registration questionnaire available from Human Biology Office.

5 units, Win (Djerassi) MW 2:15-4:05

131. Chemical Synthesis and Properties—Polymers, heterocyclic compounds, natural products, dyes, purines, pyrimidines, DNA, RNA. Prerequisite: 35.

3 units, Aut (van Tamelen, Bonner, Staff) Lec. (1) MWF 11, (2) TTh 11-12:15, (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
CHEMISTRY

enrollment in 131. Chemistry majors and prospective majors should register for 132B.

3 units, Aut (Staff) lec. (1) TTh 9; (Staff) 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) TTh 1:15; lab. MW 1:15-4:05 or TTh 2:15-5:05 or TTh 9-12


3 units, Win (Bonner) MWF 11, given 1973-74 for the first time

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 (Loring, Skoog) lec. (1) TTh, 10, lab. TTh 1:15-4:05 lec. (2) TTh 11, lab. MW 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: 131 and calculus.

3 units, Win (Andersen, Pecora, S. Hudson) lec. (1) MWF 11, lec. (2) TTh 11-12:15, lec. (3) MWF 12


3 units, Spr (Bonner) by arrangement, given 1973-74

137. Inorganic Chemistry—Intended for undergraduates. Survey of the chemistry of transition metal compounds. Bonding, structures, and reactivities of transition metal complexes. Prerequisite: 171 or 131.

3 units, Spr (Taube) MWF 10

143. Nuclear Science—(Same as Engineering 174.) Properties of the atomic nucleus; elements of quantum mechanics; nuclear structure, stability, and energetics; modes, kinetics, and statistics of radioactive decay; alpha, beta, gamma, and neutron radiations; nuclear reactions; fission and fusion; interaction of radiation with matter; radiation detection and spectroscopy; radioactivation analysis; radiation chemistry; applications in chemistry and engineering. Prerequisite: Physics 57 or equivalent.

3 units, Aut (P. Kruger) TTh 11-12:15

171. Physical Chemistry—Chemical thermodynamics: fundamental principles, Gibbsian equations, equilibrium conditions, phase rule, systematic deduction of equations, gases, solutions. Prerequisites: 3 or 5, 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 (S. Hudson) 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 (B. Hudson) 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 (——) lec. TTh 10; lab. T 1:15-4:05 or W 1:15-4:05

3 units, Spr (——) MWF 11

176. Physical Chemistry Laboratory—(Continuation of Chemistry 174.) Prerequisites: 174 and previous or concurrent enrollment in 175.

3 units, Spr (——) 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: 125 and 175.

3 units, Aut (Hodgson) MWF 9

223. Advanced Organic Chemistry — Continuation of 221: Applications of physical methods, notably mass spectrometry and optical rotatory dispersion, to organic chemical problems; synthetic reactions in the steroid field, and degradative organic chemistry with illustrations from the field of natural products. Prerequisite: 221 or consent of instructor.

3 units, Win (Djerassi) M 8-10, W 9

225. Advanced Organic Chemistry — Continuation of 223: Organic reactions, new synthetic methods, conformational analysis, and exercises in the syntheses of complex molecules. Prerequisite: 223 or consent of instructor.

3 units, Spr (——) MWF 9

227. Selected Topics in Organic Chemistry — May be repeated for credit. Possible topics include synthetic organic chemistry, photochemistry, inorganic-organic chemistry, bio-organic chemistry, reaction mechanisms, physical-organic chemistry. Prerequisite: 225 or consent of instructor.

3 units, Aut, Win, 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) F 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 (Johnson, Mosher, Stephenson) by arrangement

251. Advanced Inorganic Chemistry—The chemistry of complex ions. Prerequisite: one year of physical chemistry.

3 units, Aut (——) TTh 11

253. Advanced Inorganic Chemistry — Solution of ions; substitution and electron transfer reactions, emphasizing the principles of kinetics and other approaches to defining reaction mechanisms. Prerequisite: one year of physical chemistry.

3 units, Spr (——) TTh 11


3 units, Win (Collman) TTh 11; one hour 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 (——) 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 (Weinhold) 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 (Flory) MWF 11

277. Selected Topics in Physical Chemistry—May be repeated for credit. Possible topics include X-ray crystallography, 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, Win, Spr (Staff) MWF 10

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 1973–74

289. Biophysical Chemistry—(Continuation of Chemistry 287.)

3 units, Win (McConnell) MWF 9, alternate years, given 1973–74

291. Biophysical Chemistry—(Continuation of Chemistry 289.)

3 units, Spr (McConnell) MWF 9, alternate years, given 1973–74

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 work is carried on and number of units agreed upon. 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)

Chairman: Mark W. Edwards

Associate Professors: Andrew Devine, Michael Wigodsky

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, 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 Courses (Greek or Latin), 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.

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. Credit towards the Major for Second Year Courses (101, 102, 103) in Greek or Latin will be accepted only with the approval of the Undergraduate Studies Committee.

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. Pro-
grams 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 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 description 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.

ROMA 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 30 constituent colleges and universities including Stanford. It is open to Stanford majors in Classics (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. The requirements for the degree 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 is required.

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 de-
gree. 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)
2. First-Year Greek—Continuation of 1.
   4 units, Win (Foley)
3. First-Year Greek—Continuation of 2.
   4 units, Spr (Foley)
51. First-Year Greek—Accelerated course.
    5 units, Win (Young)
52. First-Year Greek—Continuation of 51.
    5 units, Spr (Young)
101. Second-Year Greek—Reading of Plato, Apology, and other selections.
    4 units, Aut (Raubitschek)
102. Second-Year Greek — Continuation of 101. Homer, Odyssey.
    4 units, Win (—)
103. Second-year Greek — Continuation of 102. Euripides, one play.
    4 units, Spr (Raubitschek)
    2 units, Spr (—) 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. Tragedy — Sophocles, one or more plays.
    3 to 4 units, Aut (Webster)
112. Euripides.
    3 to 4 units, Win (—)
113. Attic Prose.
    3 to 4 units, Spr (—)
151. Euripides.
    3 to 4 units, Aut (Moore)
152. Homer.
    3 to 4 units, Win (Edwards)
153. Aristophanes.
    3 to 4 units, Spr (Foley)
160. Individual Work.
    By arrangement
161. Plato.
    3 to 4 units, Aut (Moore) given 1974–75
162. Aeschylus.
    3 to 4 units, Win (—) given 1974–75
163. Herodotus.
    3 to 4 units, Spr (Raubitschek) given 1974–75

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, Win (Raubitschek)
181, 182, 183. Senior Undergraduate Course in Greek — This course will be offered only when suitable students are available, and usually not in the same year as the Senior Undergraduate Course in Latin, which it resembles in purposes and design. It is open
to undergraduate majors on the recommendation of their advisers and to first year graduate students. It will commonly extend over two or more quarters.

Works of two or more Greek authors will be studied and the student will be introduced to other branches of classical scholarship, such as paleography, epigraphy, and papyrology, the history of the Greek language, etc. The scope of the course will vary from one year to another, and different authors will be studied, to meet the interests and abilities of students who are eligible for it. Possible subjects: Greek epic, tragedy or comedy, The Age of Thucydides or Demosthenes, Plato and his predecessors or Aristotle, Hellenistic poetry.

Aut, Win, Spr, units by arrangement

GRADUATE COURSES

202. Tutorial in Greek Literature.  
2 units, Aut, Win, Spr (Staff)

205. Greek Language and Style.  
2 units, Aut, Win, Spr (Staff)

The above courses are offered every year. Other courses alternate or vary from year to year. In 1972–73 there were courses in the following authors or topics: Hellenistic Poetry, Demosthenes, Pre-Socratic Philosophy, Archaic Greek figured pottery, Plato, Herodotus. The following courses will be offered in 1973–74:

220. Classical Political Theory.  
4 units, Win (Raubitschek)

230. Pindar.  
4 units, Win (Young)

252. Homer.  
4 units, Win (Edwards)

254. Homeric Archaeology.  
4 units, Spr (Webster)

260. Directed Reading.  
By arrangement

270. Greek Prose or Verse Composition.  

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 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 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 (——)

2. First-Year Latin—Continuation of 1.  
4 units, Win (——)

3. First-Year Latin—Continuation of 2.  
4 units, Spr (——)

51. Accelerated Beginners’ Course.  
5 units, Win (Devine)

52. Accelerated Beginners’ Course — Continuation of 51.  
5 units, Spr (Devine)

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 winter or spring quarter by consent of the instructor.

101. Second-Year Latin (Sequel to Latin 3 or 52.)—Latin Poetry. Ovid, Catullus.
   4 units, Aut (Moore)

102. Second-Year Latin (Continuation of 101.)—Reading in Latin prose. Cicero, Sallust.
   4 units, Win (Mellor)

103. Second-Year Latin (Continuation of 102.)—Latin Poetry. Virgil, Aeneid. One or more books will be studied.
   4 units, Spr (Moore)

104. Christian or Mediaeval Latin Authors. Spr, by arrangement

111. Third-Year Latin (Sequel to Latin 103.)—Literature of the Augustan Age. Horace, Odes, a selection.
   4 units, Aut (Foley)

112. Third-Year Latin (Continuation of 111.)—The Augustan Age. Virgil, Eclogues and Georgics.
   4 units, Win (——)

113. Third-Year Latin (Continuation of 112.)—The Augustan Age. Livy and the elegiac poets, a selection.
   4 units, Spr (——)

MORE ADVANCED COURSES

The series 151–153 and 161–163 will be offered in alternate years and may be taken in successive years.

151. Roman Comedy.
   3 to 4 units, Aut (Mellor)

152. Cicero, Oratory.
   3 to 4 units, Spr (Mellor)

   3 to 4 units, Win (Wigodsky)

160. Individual Work.
   By arrangement

161. Tacitus.
   3 to 4 units, Aut (——) given 1974–75

   3 to 4 units, Win (Davis) given 1974–75

163. Lucretius.
   3 to 4 units, Spr (Wigodsky) given 1974–75

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, Win (Wigodsky)

181, 182, 183. Senior Undergraduate Course in Latin—This course will be offered only when suitable students are available, and usually not in the same year as the Senior Undergraduate Course in Greek, which it resembles in purpose and design. It is open to undergraduate majors, on the recommendation of their advisers, and to first-year graduate students. It will commonly extend over two or more quarters.

Works of two or more Latin authors will be studied and the student will be introduced to other branches of classical scholarship, such as paleography, epigraphy, Roman law and the heritage of Greek philosophy, the history of the Latin language, etc. The scope of the course will vary from one year to another, to meet the interests and abilities of students who are eligible for it. Possible subjects: Latin poetry before Virgil, Latin comedy and its debt to Greek, The age of Cicero or Tacitus.
   Aut, Win, Spr, units by arrangement

GRADUATE COURSES

   2 units, Aut, Win, Spr (Staff)

205. Latin Language and Style.
   2 units, Aut, Win, Spr (Staff)
   by arrangement

The above courses are offered every year. Other courses alternate or vary from year to year. In 1972–73 there were courses in the following authors or topics: Ancient Dialects of Italy, Virgil's Aeneid, Roman Elegy, Lucretius, Roman Literary Criticism. The following courses will be offered in 1973–74:

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, Aut (G. Brown)

4 units, Aut (Wigodsky)

223. Vulgar Latin Inscriptions.
4 units, Aut (Devine)

230. The 2nd Century A.D.
4 units, Spr (Mellor)

260. Directed Reading.
By arrangement

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, page 144.

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.

2 to 3 units, Aut (Webster)

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.

2 to 3 units, Aut (Mellor)


2 to 3 units, Win (Raubitschek)

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.

2 to 3 units, Win (Foley)

GENERAL COURSES

Literature

160. Individual Work.
By arrangement

161. The Classical Epic: Homer, Apollonius, Virgil—A study of classical (and other) epics with respect to structure, character, common motifs, and imagery.
3 to 4 units, Win (Edwards)

162. Greek Tragedy: Aeschylus, Sophocles, Euripides—A study of the history, social function, and development of ancient tragedy.
3 to 4 units, Win (Moore)

172. Classical Influences in Modern Literature—Themes from classical myth and his-
ISTORY in selected Renaissance and later writers; parallel readings from ancient literature.
3 to 4 units, Win (Wigodsky) given 1974–75

**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, Spr (Moore)

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 1974–75

173. Classical Political Theory—Ancient political ideas (Plato, Aristotle, Polybius, Cicero) and their impact on modern theory.
3 to 4 units, Win (Raubitschek)

**Ancient History**

These courses are accepted by the History Department for credit toward a major in History.

**INTRODUCTORY COURSES**

102. History of Greece.
4 to 5 units, Aut (Raubitschek)

103. History of Rome.
4 to 5 units, Win (Mellor)

104. The Tradition of Hellenism—From the death of Alexander (323 B.C.) to the fall of Constantinople (1453 A.D.) The rise of the Hellenistic States and the transformation of Hellenic culture, and the absorption of this civilization by the Romans and the Byzantine Empire.
4 to 5 units, Spr (Raubitschek)

**MORE SPECIALIZED COURSES**

113. The Roman Empire in the Second Century—Open to all students, designed as a sequel to 103.
4 units, Aut (Mellor)

See also Religion 120, 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, Aut (---) given 1974–75

261. Individual Work in Greek History.
By arrangement

262. Individual Work in Roman History.
By arrangement

See Latin 230.

**Religion and Mythology**

117. Greek Religion—The origins and development of Greek religious phenomena from Mycenae to Byzantium.
3 to 4 units, Spr (Berg)

163. Greek Mythology.
3 to 4 units, Spr (Young)

**Art and Archaeology**

101. Archaic Greek Sculpture and Painting.
2 to 3 units, Aut (Webster) given 1974–75

102. Classical Greek Sculpture and Painting.
2 to 3 units, Win (Webster) given 1974–75

103. Hellenistic Greek Sculpture and Painting.
2 to 3 units, Spr (Webster) given 1974–75

105. Athenian Everyday Life.
2 to 3 units, Aut (Webster)

106. Art and Monuments of the Romans.
4 units, Spr (Wigodsky)

107. Greek Theatre Production.
2 to 3 units, Win (Webster)

See Greek 254.
See also Art 100 A, B, C, and 103.

**Other Courses**

201. Introduction to Classical Scholarship.
1 unit, Aut, Win, Spr (Staff)

213. Introduction to German Classical Scholarship.
4 units, Spr (Berg) given 1974–75

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, Aut (Devine) by arrangement
3 units, Aut, Win (Devine)

COURSES OFFERED OVERSEAS

163. Comparative Mythology — (Taught at Stanford in Italy)
4 units, Spr (Davis)

185. Ovid and His Influence — (Taught at Stanford in Italy)
4 units, Spr (Davis)

COMMUNICATION

Emeriti: Wilbur Schramm, Clifford F. Weigle (Professors)
Chairman: Lyle M. Nelson
Director, Institute for Communication Research: To be named.
Director, Professional Journalism Fellowship Program: Lyle M. Nelson. Associate Director: Harry N. Press
Assistant Professors: Cedric C. Clark, Donald F. Roberts, Edward J. Sondik. Acting: Don Dodson, Dan G. Drew, Steven Kovacs, Emile McAnany
Senior Lecturer: Ronald Alexander
Lecturers: Julian Blaustein, Jules Dundes, Thomas Martin, John Mayo, Colin Mick, Templeton Peck

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. 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 Humanities Foundation.

ADMISSION

Undergraduate students who have been admitted by the University are accepted as majors provisionally for one quarter. Thereafter, the student's record is reviewed quarterly by the Department. Sophomore students must have completed one course in the Department prior to declaring a major.

The exceptionally well-qualified undergraduate major student wishing to pursue a professional program leading to the A.M. degree after one graduate year may apply for admission during winter quarter of the junior year.

Undergraduate majors must enroll in the Department not later than the start of the second quarter of their junior year; this requirement may be waived for applicants entering the Department not later than the start of the first quarter of their senior year, provided that they have maintained a high academic performance.

Students who wish an undergraduate minor in the Department may arrange for a suitable sequence of preprofessional courses.

Prospective undergraduate students should write the University's Office of Admissions.

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.

PROGRAMS OF STUDY

BACHELOR OF ARTS

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 psy-
chology, 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 the general study of communication and the mass media or in pre-professional study in journalism or 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 adviser.

Requirements for the degree are as follows:

1. A total of at least 30 and not more than 40 units in Communication Department courses, which must include:
   a) Two survey courses, Communication 1 and 142 or 220;
   b) Communication 100–102, 107 or 150, and 175; or 101 and 180 (200 and 223A are recommended but not required and may be used to fulfill this requirement);
   c) Communication electives.

2. A unified program totaling not less than 20 units of advanced courses in another department or interdepartmental major, or an interdisciplinary honors program, or a second major.

3. Undergraduates must maintain a high academic performance in Communication courses in order to receive the departmental recommendation for graduation.

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.

Although the Department offers no courses in such subjects as science reporting, technical writing, or public relations, appropriate programs of study can be arranged for interested students. For example, a prospective science writer could be permitted to substitute a unified program of courses in the physical sciences in lieu of other recommended courses.

Master of Arts

The Master of Arts degree is awarded by the Department in the fields of Journalism and Film and Broadcasting. 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 (45 units, including independent project, plus an internship experience for those who do not have professional experience) normally takes three to five quarters depending on the nature of the 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.

3. Students in Film and Broadcasting, upon completion of academic work, including the independent project, will be required to spend a three-month internship with a professional film or broadcasting organization. (No tuition is charged for the internship period.) While an attempt will be made to tailor each student's program to fit individual needs, normally most Film and Broadcasting students will take 200, 208A,B,C, 215, and 223A. The rest of the curriculum will be worked out in consultation with his or her adviser.

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, 203, 220, two quarters of 225, 249 or Political Science 273, 309, and an internship with a media organization. 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. No particular specialization in undergraduate work is expected of a candidate. A few special programs of study may be arranged for individual candidates, which will take account of the nature of their previous preparation.

DOCTOR OF PHILOSOPHY

The Department offers the Doctor of Philosophy degree in Communication, with programs in Communication Theory and Research, in Public Affairs Communication, and in Information Science. All of these degrees are designed primarily for persons interested in teaching and research careers.

In addition to fulfilling the course and residence requirements for the degree, all Ph.D. candidates are required to:

1. Complete requirements for a Master’s degree in Communication, and complete a first year research project. Holders of the Master’s degree may be excused from this first year research requirement if the faculty feels that the previous research has been sufficient.

2. Pass first year qualifying exams and third year specialization exams.

3. Demonstrate proficiency in tools required in area of specialization. Chosen with the advice of the faculty, tools may include foreign languages, statistics, computer programming, etc.

4. Pass the University oral examination, which may be either a comprehensive examination covering the same areas as the written examination or a defense of the dissertation.

5. Complete pre-dissertation research project (in addition to the Master’s or first-year research requirement) or obtain equivalent research experience sufficient to demonstrate research competence.

6. Have at least one year of work experience in the mass media or another activity relevant to the area of specialization, prior to writing the dissertation.

7. Teach or assist in teaching at least two courses.

8. Complete a dissertation satisfactory to an advisory committee of three or more members and to the University Committee on the Graduate Division.

The following is an example of a standard Ph.D. program in Communication Theory and Research:

1. Communication Theory
   Comm. 211. Theory of Communication
   Plus four other advanced Communication Theory courses (numbers 212 and higher)

2. Methodology
   Comm. 218. Communication Research Methods I
   Comm. 219. Communication Research Methods II
   Computer Science 125. Non-numerical Methods
   Comm. 309. First-Year Research Project
   Comm. 319. Pre-Dissertation Research Project
   Two advanced seminars on Communication Research Methods

3. Statistics
   Psych. 60. Statistical Methods
   Psych. 151. Statistical Methodology
   Psych. 152. Analysis of Data

4. Computer Science
   C.S. 127. Computer Models of Social Behavior
   C.S. 144A,B. Data Structures
   C.S. 224. Models of Thought Processes
   C.S. 225. Artificial Intelligence Research
   C.S. 226. The Representation Problem in Artificial Intelligence
   C.S. 261. Computer Models for Natural Languages

5. Information Science
   Comm. 260. Introduction to Information Science
   Comm. 261. Flow of Information Among Scientists
   Comm. 262. Flow of Scientific & Technical Information to the Public
Comm. 263. Computer Information Systems
Psych. 216. Information Processing Psychology

6. Policy Science
Comm. 280. Telecommunications Systems and Public Policy
E.E.S. 231A,B. Decision Analysis
Econ. 192. Economics of Information

7. Experimental Psychology (at least two of the following: 102, 102A Perception are strongly recommended)
Psych. 103, 103A. Learning Performance
Psych. 104. Special Laboratory Projects
Psych. 106, 106A. Human Memory

8. Psychology (at least two courses in social or developmental psychology, at least one in learning theory, and at least one in personality or motivation). Example courses are:
Psych. 211. Advanced Developmental
Psych. 212. Advanced Social Psychology
Psych. 213. Advanced Personality
Psych. 220. Human Motivation
Psych. 251. Seminar in Personality Theory and Assessment
Psych. 254. Principles of Personality Change I
Psych. 259. Seminar in Cognitive Theories in Social Psychology
Psych. 261. Seminar in Research Methods in Social Psychology
Psych. 262. Special Topics in Memory
Psych. 263. Seminar in Perception
Psych. 264. Seminar in Learning Theory
Psych. 266. Seminars in Developmental Psychology
Psych. 267. Seminar in Person Perception
Psych. 272. Seminar on Topics in Psycholinguistics
Psych. 273. Seminar in Personality Differences and the Prediction of Behavior
Psych. 311. Research Seminar in Developmental Psychology

9. Sociology (at least two graduate level courses in Sociology)
Example courses are:
Sociol. 104. Interpersonal Behavior
Sociol. 217. Problems in Theoretical Analysis
Sociol. 250. Basic Problems in Sociological Theory
Sociol. 253. Theory Construction
Sociol. 276. The Social Psychology of Organizational Settings
Sociol. 289A,B,C. Advanced Research in Organizational Theory I, II, III

The following is an example of the Ph.D program in Public Affairs Communication:

1. Communication Theory
Comm. 211. Theory of Communication

2. Structure and Function of the Mass Media
Comm. 220. Mass Communications in Society
Comm. 225A,B. Problems of the Mass Media (at least three quarters)
Comm. 230. Mass Media and Government
Comm. 249. Mass Media Law
Comm. 250. Mass Culture

3. Methodology and Statistics
Comm. 213. Computer Analysis of Communication Research Data
Comm. 218, 219. Sequence in Research Methods
Comm. 309. First-Year Research Project
Comm. 319. Second-year Research Project
Psych. 60. Statistical Methods, or Stat. 50. Elementary Statistics

4. Political Science, Law, History, Economic:
Law 104. Courts and the Legal Process
Pol.Sci. 173(273). Civil Liberties in the U.S.

And a unified program of five courses in one or two of these fields:

Political Behavior and Politics:
Pol.Sci. 181. Attitude Formation and Voting Behavior
Pol.Sci. 184. Legislative Behavior
Pol.Sci. 387A,B. Research Seminar in American Politics

Political Theory:
Pol.Sci. 152. Political Thought: Modern Ideas and Doctrines
Pol.Sci. 158. Theory, Power, and Social Science

Public Law:
Law 110. The Administrative Process
Pol.Sci. 170 (270). The Supreme Court and the Constitution
United States History:
Hist. 187. Twentieth Century American Intellectual History
Hist. 168, 169. American Social History Graduate Seminars in U.S. History

Economics—History, International and Comparative, Industrial:
Econ. 116. Economic History of the United States
Econ. 118. The Economics of Underdevelopment
Econ. 157. Organization and Social Control of Industry
Econ. 165. International Economics I
Econ. 200. Topics in the History of Economic Thought

Among other relevant possible areas of concentration are: Comparative Politics, International Relations, Public Administration; East Asian, Middle Eastern and Latin American History; Core Theory of Economics. (Students specializing in any area of economics will need to have the equivalent of at least Economics 1, and often 51, 52, and 105 for most advanced courses in that department.)

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 adviser. 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 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 (Roberts, Dodson)
   MWF 10 and Sections T or Th 10

70. 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) by arrangement

123. Communication and Community Psychology I—(Same as Psychology 123.) This course is designed for undergraduates interested in relating theory and action with respect to community involvement activities. Primary emphasis is placed on student initiative in selecting community-related projects which will be the basis of a two-quarter written report. Students will be expected to survey both the theoretical and practical literature dealing with the theory of social organization and community development.
   4 units, Aut (C. Clark, McGee) TTh 10 and by arrangement

124. Communication and Community Psychology II—(Same as Psychology 124.) This is a continuation of 123.
   4 units, Win (C. Clark, McGee) TTh 10 and by arrangement
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. Open to non-majors.

4 units, Aut (Rivers) TTh 11
Win (Drew) by arrangement
Spr (Dodson) TTh 10

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 (Rivers) by arrangement
Win (Drew) by arrangement
Spr (Dodson) 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 (——) MW 2:15–4:05

149. Mass Culture—Theories and case studies of mass culture.

4 units, Spr (Dodson) by arrangement

150. Magazine Writing—Practice in writing magazine articles, with emphasis on marketing manuscripts. Conferences. Prerequisites: 100 and 102.

4 units, Win (Rivers) TTh 11

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: 160 and 102 and junior or graduate standing.

4 units, Spr (Drew) MWF 10
by arrangement


4 units, Win (Dodson) TTh 9

183. Internship Experience—San Francisco area media experience coordinated with Department faculty.

0 units (for graduate students),
1 to 4 units (for undergraduate students),
Aut, Win, Spr, Sum (Staff) by arrangement

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. Prerequisite: Communication 100 and 102.

4 units, Spr (Rivers) TTh 11
Sum (Staff) by arrangement

225A. Problems of the Mass Media—Visiting lecturer series. Prerequisite: any other Communication course. May be repeated for credit.

1 unit, Aut (Rivers, Nelson) T 4:15–5:15

225B. Problems of the Mass Media — Continuation of 225A. Prerequisite: 225A. May be repeated for credit.

1 unit, Win (Rivers, Nelson) T 4:15–5:15


4 units, Win (Rivers) TTh 1:00

FILM AND BROADCASTING

101. Film Aesthetics—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;
evening 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 de
velopment of American broadcasting and its
contemporary problems.
4 units, Aut (Dundes) MWF 11

180. Broadcasting and Film Criticism —
The techniques and role of criticism based
upon the objectives and potential of these
media. For advanced students. Prerequisites:
141 or 142 and consent of instructor.
4 units, Spr (Kovacs) MWF 11

189. Uses of Ethnographic Film — Critical
examination of the problems of validity and
reliability involved in reporting and inter-
preting aspects of a culture using essentially
non-verbal forms. Evaluation of the uses of
ethnographic films as research reports, as re-
search instruments and as instructional ma-
terials. Students will prepare a series of written
exercises and a term paper. Prerequisite:
Anthropology 1 and consent of instructor.
4 to 5 units, Spr (Staff) MW 10; lab. Th 7:30–10:00 p.m.

200. Visual and Aural Communication
Techniques — An investigation of the tech-
niques of cinematography and sound from
the standpoint of the communication of
ideas. Students will produce short film and
sound assignments. No previous knowledge
of the media is required. This course is a
prerequisite for all further production work
in film. To be taken concurrently with 223A.
Prerequisite: consent of instructor. (Open
only to graduate students in autumn quar-
ter.)
5 units, Aut, Win, Spr (Alexander)
MW 1:15–3:05

205A. Television Production I — Production
and direction of news and documentary tele-
vision programs. Prerequisites: 200, 223A or
consent of instructor.
4 units, Sum (——)

206A. Film Production I — An intermediate
course in which students produce their own
short films. Prerequisites: 200 and consent
of instructor.
5 units, Win (Alexander) TTh 10–12

206B. Film Production II — Primarily for
graduate students producing film projects
for a degree. Admission by recommendation
of instructor only. Prerequisites: graduate
standing, 206A.
5 units, Spr (Alexander) Th 1:15–4:05

208A. Seminar in Film and Broadcasting I
— Limited to Film and Broadcasting A.M.
students.
1 to 2 units, Aut (Staff) by
arrangement

208B. Seminar in Film and Broadcasting II
— Limited to Film and Broadcasting A.M.
students.
1 to 2 units, Win (Staff) by
arrangement

208C. Seminar in Film and Broadcasting III
— Limited to Film and Broadcasting A.M.
students.
1 to 2 units, Spr (Staff) by
arrangement

209A,B,C. Seminar in Film Studies—Each
quarter during the academic year a different
aspect of film history, criticism, aesthetics,
and institutional development will be ex-
amined in detail. Admission to the seminar
is by consent of the instructor. Topics for
the academic year 1973–74 are as follows:

209A. The Russian Revolutionary Cine-
ma — An examination of the works and
theories of Eisenstein, Pudovkin, Dov-
zenko, Kuleshov, and Dziga-Vertov.
3 to 5 units, Aut (Kovacs)
by arrangement

209B. Third World Cinema — Film pro-
duction in the emerging nations of Africa,
Asia, and Latin America will be studied
within the context of social, political, and
institutional development.
3 to 5 units, Win (Kovacs)
by arrangement

209C. (To be announced)
3 to 5 units, Spr (Kovacs)
by arrangement

216. The Broadcast Editorial—Analyses of
radio and television editorials. Students will
research, write, deliver and direct their own
editorials.
3 units, Aut (Dundes) MW 2:15–4:05

223A. Writing for Film and Broadcasting I
— Techniques of research and writing for the
visual media. To be taken concurrently with
200. Open to graduates, autumn; undergrad-
uates, winter and spring.
4 units, Aut (graduate students only),
Win, Spr (Blaustein) TTh 1:15–3:15

223B. Writing for Broadcasting and Film II
— Structure and style in the construction of
factual film and television scripts. To be
SCHOOL OF HUMANITIES AND SCIENCES

260

223A. Documentary Film — Seminar in dramatized documentary and fictional forms of film and television scripts. To be taken concurrently with 206B. Prerequisite: consent of instructor.
4 units, Spr (Blaustein) TTh 10–12

223C. Writing for Film and Broadcasting III — Seminar in dramatized documentary and fictional forms of film and television scripts. To be taken concurrently with 206B. Prerequisite: consent of instructor.
4 units, Spr (Blaustein) TTh 10–12

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

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 and consent of the instructor.
4 units, Spr (Dundes) by arrangement

Summer Film and Broadcasting Institute
(See the 1974 Summer Session Bulletin, available in February, 1974.)

COURSES FOR GRADUATES

3 units, Aut (Drew, Maccoby) Spr (——) by arrangement

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 (Roberts) TTh 3:15–5:05

212. Persuasive Communication — An advanced seminar on ongoing theory and research in attitude change. Designed for Ph.D. students in Communication. Prerequisites: 211 or consent of instructor.
4 units, Spr (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, Win (Parker) MW 3:15–5:05

4 units, Spr (W. Paisley) MW 3:15–5:05

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 (Staff) by arrangement

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

232. Developmental Communication II — Continuation of 231.
4 units, Win (——) by arrangement

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
241. The New Journalism—Analysis of the “New Journalism” with individual practice in writing. Prerequisite: A.M. candidates with professional writing experience.
   4 units, Aut (Dodson) MW 1:15–3:05

242. Broadcast Communication—See 142.

250. Mass Culture—Theories and case studies of mass culture. Communication graduate students only.
   4 units, Spr (Dodson) by arrangement

251. Teaching Seminar—Discussions of effective teaching methods led by Stanford teachers from several departments. Prerequisite: graduate standing.
   1 unit, Aut (Rivers) T 12–1

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 (Rivers) T 12–1

253. Writing Tutorials—Individual instruction in writing for seniors and graduate students undertaking long articles and books. Communication seniors and graduate students only. Prerequisite: consent of instructor.
   3 units, Aut (Rivers) by arrangement

256. Communication in Economic and Social Development—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 (——) T 4:15–6:05

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 (Martin) by arrangement

261. Flow of Information Among Scientists—Overview of the information systems of science. Systemic analysis of “horizontal” and “vertical” information transfer. Review of studies of information processing by scientists, technologists, physicians, etc.
   3 units, Win (W. Paisley) M 1:15–3:05

   3 units, Spr (W. Paisley) M 1:15–3:05

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

264. Applications of Information Science in Health—Applications of information science and quantitative analysis techniques to health-related areas including medical decision-making, health information systems, regional health planning, and clinical research.
   3 units, Win (Sondik) 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

275. Advanced Data Analysis—Continua-
tion of analysis topics covered in 219: Students may choose individual analysis projects.

4 units, Aut (W. Paisley) M 1:15–3:05

280. Telecommunications Systems and Public Policy—(Same as Engineering-Economic Systems 280.) Fundamentals of telecommunications system technology and costs. 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)

MW 11:00-12:15

299. Advanced Individual Work—Graduate majors may supplement certain courses with individual projects of distinctly advanced order.

1 to 8 units, any quarter (Staff) by arrangement

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

COMPARATIVE LITERATURE

Committee in Charge: David G. Halliburton, Acting Chairman; Joaquim F. Coelho, Joseph Harris, Herbert Lindenberger (spring quarter, 1974), James J. Y. Liu, Charles R. Lyons, Kurt Mueller-Vollmer.

Professors: Jean Franco (Spanish and Comparative Literature), Herbert Lindenberger (Comparative Literature and English), Charles R. Lyons (Drama and Comparative Literature), N. Scott Momaday (English and Comparative Literature), Makoto Ueda (Japanese and Comparative Literature)

Associate Professor: David G. Halliburton (English and Comparative Literature)

Assistant Professors: N. Gregson Davis (on leave fall and winter, 1973–74) (Classics and Comparative Literature), Josué Harari (French and Comparative Literature).

Acting: 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 drawn from 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 ma-
or, 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 (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.

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 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 foreign literatures.

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.

**Foreign Study**—Students are urged, whenever it can be conveniently arranged, to spend two quarters at one of the Stanford programs in foreign countries.

**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 examination 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 exploration 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 third quarter of the second year for students who enter with a year of graduate work). Students 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 knowledge 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 discussions of the period. Students must demonstrate a grasp of how to discuss and define 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 literature, have the option of dividing the period sections into two wholly separate periods. 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 Examination, which will also include a short section on the student's plans for the dissertation.

**Qualifying Procedures**—The qualification procedures for students in Comparative Literature 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 students 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 examination 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 aspects of their academic work. As soon as the
student has completed the qualifying procedures, 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 Committee 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 Literature for entrance to the minor after they have completed their first quarter of graduate work at Stanford. Requirements are as follows:

1. A knowledge of at least two foreign languages, one of them sufficient for the student to qualify for graduate-level courses in that language, the second sufficient for the student to read a major author in the original.

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 students in the Asian Languages, students must choose a second literature outside the department of their major literature.

This minor is designed for students working toward the Ph.D. in the various foreign language departments. Students working toward the Ph.D. in English are directed to the program in English and Comparative Literature described among the English offerings.

COURSES

Courses primarily of a comparative nature are listed below:

30. The Novel—(Same as 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, Aut (Pifer)

40. Drama—(Same as English 40.) Principal dramatic forms; development of dramatic art, masterpieces of the theater from various periods, countries.

5 units, Win (L’Heureux)

50. Poetry—(Same as English 50.) An introduction, through the study of language, figures of speech, metrics, critical theory, and careful reading of poems.

5 units, Win (Rebholz)

Spr (Stone)

61, 62, 63. Western Thought and Literature (Same as Humanities Special Programs 61, 62, 63.) An introduction to fundamental ideas of the past; lectures, discussions, reading of selected masterpieces.

61. The World of Pagan Antiquity.

5 units, Aut (Edwards, Staff)


5 units, Win (Ryan, Staff)

63. From the Enlightenment to the Present — Blake, Kierkegaard, Dostoevsky, Kafka, Virginia Woolf, Sartre, Ellison.

5 units, Spr (Ruotolo, Staff)

109. The Don Juan Legend in Literature and Music — (Same as French and Italian 109.) Reading and discussion of Don Juan versions by Tirso de Molina, Molière, Mozart, Grabbe, Musset, Zorrilla, Montherlant, Frisch, and interpretations by Stendhal, E. T. A. Hoffmann, and Kierkegaard.

3 units, Aut (Weinstein)


4 units, Aut (Harari)

114. Myth and Violence in Literature — (Same as French and Italian 114 and Modern Thought and Literature 174.)

4 units (Harari), given alternate years

116. The Fate of Modern Fiction—(Same as French and Italian 116.)

4 units (Harari), given alternate years

117. “Literary” Criticism and Structural Analysis—(Same as French and Italian 117 and Modern Thought and Literature 171.)
A critical appraisal of structuralist and post-structuralist thought: Barthes, Deleuze, Derrida, Foucault, Girard, Levi-Strauss and others.

4 units, Spr (Harari)

118A, B. Russian Intellectual History — (Same as History 118A, B, Slavic Languages and Literatures 118A, B, and Modern Thought and Literature 231A, B.) Study of major trends and documents in the history of Russian thought from the late eighteenth century to the First World War. Readings (in translation) will be drawn from literature, criticism, memoirs and correspondence, political and social theory, philosophy and history. Enrollment limited to 30, permission of instructors required.

8 units, Aut, Win (Brown, Emmons)

145. The Tragic—(Same as English 145.)

5 units (Friedlander), given alternate years

147. Contemporary Drama—(Same as English 147.)

5 units (Friedlander), given alternate years

164. Introduction to Caribbean Literature: English, French, Spanish.

5 units (Davis), given alternate years

168. American Indian Mythology, Legend, and Lore—Same as 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.

4 units, Win (Momaday)

169. Problems of Narrative in Eighteenth Century Fiction—(Same as French and Italian 169.)

4 units (Harari), given alternate years

174. The Concepts of Chaos, Cosmos and Metamorphosis in Literature — (Same as French and Italian 174.)

4 units (Braghiere), given alternate years

187. The Loss of the Self in Modern Theater—(Same as French and Italian 187.) This course will cover a number of works and theories of modern western theater (from Pirandello and Ibsen to Artaud and Beckett) and their relationship to the social structure in which they developed and against which they often reacted. In English.

4 units, Win (Braghieri)

189. Ritual, Myth and the Theater—(Same as French and Italian 189.)

4 units (Braghieri), given alternate years

190. The Humanities in Western Thought and Literature—(Same as Humanities Special Programs 190.) Prerequisites: Humanities 61, 62, 63. Counts as Humanities 194.

5 units, Aut (Evans)

194. Literature and the Humanities—(Same as Humanities Special Programs 194.) The critical study of major texts; theory and practice of criticism.

5 units, Spr (Foster)

208. Post-Classic Latin—(Same as English 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, Aut (G. Brown)

209. Motifs of Lyric Poetry.

4 units (Davis), given alternate years

218A. The Culture of England, 1890–1914—(Same as English 218A, History 244, and Modern Thought and Literature 228.)

5 units (Felstiner, Stansky), given alternate years

230. Russian Formalist and American "New" Criticism—(Same as Slavic Languages and Literatures 230.) Readings in the works of the Russian Formalists and certain American "New Critics." A knowledge of French, German or Russian is highly desirable.

4 units, Spr (Brown)

235. The Impressionist and Experimental Novel—(Same as English 235 and Modern Thought and Literature 246.) Critical analysis of impressionist masters (Conrad, Faulkner, Lowry), of major experimental novelists (Joyce, Kafka) and of several living writers (Hawkes, Barthes, etc.). Prerequisite: 135 or equivalent.

4 units, Spr (Brown)

252. Medieval and Renaissance Drama—(Same as Drama 252.)

4 units, Aut (Guerard)

254. Romantic Drama and Early Realistic Drama—(Same as Drama 254.)

4 units, Spr (Larson)
255. The Nature of Literature: Japanese and Western Views—(Same as Asian Languages 255.) An attempt to study different attitudes toward literature in Japan and in the West. Seminar with limited enrollment. 

5 units, Aut (Ueda)

256. Modern Drama from 1918—(Same as Drama 256.)

4 units, Win (——)

257. The “New Novel” in Europe and Latin America—(Same as Spanish and Portuguese 257.)

4 units (Franco), given alternate years

258. The Shorter Narrative — (Same as Spanish and Portuguese 258.)

4 units, (Franco) given 1974–75

259A. French Symbolist Poets and Some Americans—(Same as English 259A.) Baudelaire, Verlaine, Rimbaud, Mallarmé, and Valéry, with some American poets for comparison and contrast—for example, two or three of the following: Poe, Tuckerman, Frost, Williams, Stevens, Winters, Roethke. Bi-lingual editions will be used; a reading knowledge of French is not absolutely necessary.

5 units, Spr (Fields)

259B. North American and Latin American Poetry—(Same as English 259B and Spanish 262.) Selected poets from the twentieth century. Reading knowledge of Spanish required.

5 units, Spr (Felstiner and Franco)

260. The History of Literary Theory—(Same as English 260.)

5 units (Trimpi) given alternate years

262. Nietzsche and the Modern Novel — (Same as English 262 and Modern Thought and Literature 262.)

5 units (Foster), given alternate years

263A. Existential and Visionary Literature — (Same as English 263A and Modern Thought and Literature 263A.)

5 units (Halliburton), given alternate years

263B. The Existential Hero in Modern Literature—(Same as English 263B and Modern Thought and Literature 263B.)

5 units (Ruotolo), given alternate years

267. Gothicism in Literature and Art—(Same as English 267.) Introduction to the Gothic in medieval literature and art; study of Renaissance, eighteenth and nineteenth century revivals; theoretical questions about the comparative study of the psychology of revivalism.

5 units, Win (Bender)

269A. Toward an Understanding of Romanticism — (Same as English 269A and Modern Thought and Literature 269A.)

5 units (Lindenberger) given alternate years

269B. Toward an Understanding of Modernism—(Same as English 269B and Modern Thought and Literature 269B.) Major currents in modern literature such as the Symbolist aesthetic, existentialism, myth, psychoanalysis, and new conceptions of nature and cultural history. Prerequisite: one course in modern literature, either English or European. Reading knowledge of French or German desirable.

5 units, Spr (Foster)

270. Modern Critical Thought: The Symbolist Heritage—(Same as French 270 and Modern Thought and Literature 270.)

5 units (Cohn), given 1974–75

289B. Yeats, Eliot, Neruda—(Same as English 289B.)

5 units (Felstiner), given alternate years

293. Workshop in Verse Translation — (Same as English 293.) With the collaboration of foreign language departments. For qualified graduates and undergraduates: please see instructor during previous quarter.

5 units, Win (Felstiner)

311. Seminar: Methods and Materials for the Study of Medieval Literature—(Same as English 311.)

5 units (E. Brown), given alternate years

315F. Seminar: The Enlightenment and Its Literary Traditions—(Same as English 315F and Modern Thought and Literature 360.)

5 units (Watt), given alternate years

316C. Seminar: Romantic Irony—(Same as English 316C, and Modern Thought and Literature 363.) An attempt to define the notion of Romantic Irony by studying the theoretical formulations of F. Schlegel, Schiller, and Coleridge and the ways in which such a philosophical attitude determines the structure and content of the poetry of Blake, Coleridge, Shelley, Byron, Keats, and Yeats,
and the novels of Lewis Carroll, Virginia Woolf, and Joyce Cary.
5 units, Spr (Mellor)

335. Seminar: The Modern Novel—(Same as English 335.)
5 units (Guerard), given alternate years

349. Methodenlehre der Literaturwissenschaft—(Same as German Studies 349.)
4 units (Mueller-Vollmer), given alternate years

351. History of Dramatic Criticism—(Same as Drama 351.)
4 units, Win (Chioles)

353. Seminar in Dramatic Period—(Same as Drama 353.) Classical Drama.
4 units, Aut (Chioles)

356. Seminar in Comparative Drama — (Same as Drama 356.) Late nineteenth century realism: Ibsen, Strindberg, Chekhov.
4 units, Win (Lyons)

360A. Seminar: History of Literary Theory: Ancient—(Same as English 360A.)
5 units (Trimpi), given alternate years

360B. Seminar: History of Literary Theory: Medieval/Renaissance — (Same as English 360B.) Prerequisite: 360A.
5 units (Trimpi), given alternate years

360C. Seminar: Neoclassicism: Ancient Origins and Later Developments — (Same as English 360C.) This seminar, by investigating further relationships between Horace and Longinus and their background, will seek a redefinition of the concept of Neoclassicism in the sixteenth, seventeenth, and eighteenth centuries.
5 units, Win (Trimpi)

361. Seminar: The Modern Tradition — (Same as English 361 and Modern Thought and Literature 361.) Introduction to the interdisciplinary study of modern thought and literature with emphasis on such modern developments as structuralism, phenomenology, and Marxism.
5 units, Spr (Halliburton)

362B. Seminar: Problems of Psychological Interpretation—(Same as English 362B and Modern Thought and Literature 362B.) Such problems as the relation between biography and literature, the application of psychological theories to literary criticism, and the psychology of reader-response. Readings in psychological literary criticism and modern fiction.
5 units, Win (Moser) given alternate years

368A. Seminar: American Critics—(Same as English 368A.)
5 units (Halliburton), given alternate years

369. Seminar: Major Modern Critics — (Same as English 369 and Modern Thought and Literature 369.) Reading and discussion of critical writings and theories of influential modern figures such as Auerbach, Kenneth Burke, Spitzer and Lukacs. Emphasis on twentieth century (e.g., existentialism, structuralism, Marxism), but course will also place modern critics in tradition beginning with Aristotle.
5 units, Aut (Halliburton)

370. Idéologie et Technique Romanesque au 18ème Siècle—(Same as French and Italian 369.)
4 units (Harari), given 1974-75

382. German and European Romanticism—(Same as German Studies 382 and Modern Thought and Literature 374.) Readings in German, English, and French: optional; lectures and discussions in English: upon demand.
4 units, Win (Mueller-Vollmer)

393. Workshop in Verse Translation—(Same as English 393.)
5 units (Dave), given alternate years

400. Phenomenological Approach to Literature — (Same as German Studies 400 and Modern Thought and Literature 376.) Readings in English. Reading knowledge of German and French desirable.
4 units, Spr (Mueller-Vollmer)

RELATED COURSES
For related courses, see departmental offerings in Asian Languages, Classics, Drama, English, French, German Studies, Humanities Special Programs, French and Italian, Modern Thought and Literature, and Spanish and Portuguese.

COURSES OFFERED OVERSEAS
101. Literature and the Visual Arts: Neoplatonic Ideas in Literature, Painting, Sculpture, and Architecture — (Taught at Stanford in Italy.)
4 units, Aut (Lindenberger)
188. Major Modern Dramatists: Pirandello, Brecht, Genet, Beckett—(Taught at Stanford in Italy.)
4 units, Aut (Lindenberger)
191. Italian Opera as Drama—(Taught at Stanford in Italy.)
4 units, Win (Lindenberger)

COMPUTER SCIENCE

Chairman: Robert W. Floyd
Associate Professors: Jerome A. Feldman, Harold S. Stone. Consulting: Peter Franaszek
Assistant Professors: Forest Baskett III, Vinton Cerf, Václav Chvátal, C. Cordell Green, Roger Schank
Senior Research Associates and Lecturers: Kenneth M. Colby, Arthur L. Samuel
Research Computer Scientists and Lecturers: Bruce G. Buchanan, Lester D. Earnest, David C. Luckham
Lecturers: John R. Ehrman, Jerome H. Friedman, Bertram Raphael, Gio Wiederhold, Charles T. Zahn, Jr.
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 numerical analysis, combinatorial mathematics, mathematical programming, artificial intelligence, programming systems and languages, logical design of computer systems, mathematical theory of computation, computer control of external devices, graphic data processing, analysis of algorithms, and software engineering.

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, mathemati-
cal 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, 35 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 Engineering, Mechanical Engineering, Linguistics, Psychology, Music, and others for projects that contribute to the research goals of the Laboratory. Research appointments at the pre- and post-doctoral levels are available to students with relevant interests.

The Department conducts a weekly colloquium, 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 section “Degrees” in this bulletin. The Department offers two distinct programs. In either 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 Computer 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 related 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 numbered 200 or above. The course program must be approved by the Computer Science Department’s Committee on Graduate Study.

A candidate is also required to demonstrate 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 Computer Science: Computer Engineering” may be conferred upon students who have developed 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 Computer Science and Electrical Engineering Departments. In 1972-73 the members were Edward S. Davidson, chairman, Vinton G. Cerf, Gene H. Golub and Edward J. McCluskey.

A student who wishes to enter the Computer 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 Computer Science and Electrical Engineering to provide depth in hardware and software design. This sequence includes courses 140A, B and one of the following: (a) 211, 212 and 311; (b) 211, 212 and 246; (c) 112, 246 and 311.


3. At least one course in numerical analysis. Acceptable courses: 135, or both 137A and 137B.


6. At least 3 units of seminar with a total not to exceed 6 units. Acceptable courses: 300, Electrical Engineering 380.

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 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 how his or her program
and previous preparation meet these objectives.

This program is normally open to students with a bachelor's degree in Mathematics, Statistics, Physics, or Engineering. A bachelor'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 adviser 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 to do so.

3. Before admission to candidacy the student must pass a preliminary comprehensive exam and a specialization area exam. The comprehensive exam covers the introductory level graduate material in the major areas of Computer Science. The specialization area exam focuses on the particular area in which the student expects to write his or her dissertation. Further information may be obtained from the Department's Academic Secretary.

4. The most important requirement for the Ph.D. degree is the dissertation. The Department is now prepared to supervise dissertations in the mathematical theory of computation, numerical analysis, programming languages, artificial intelligence, analysis of algorithms, computer control of external devices, software engineering, and in certain applications of computers, such as in operations research, and logic.

5. As part of the training for the Ph.D., each student is required during one or more quarters to perform some 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.

**PH.D. MINOR**

For a minor in Computer Science the candidate must complete 15 quarter units of Computer Science courses, following a program approved by the Computer Science Department Committee on Graduate Study. In addition the candidate must take and pass a special minor examination. Automatic approval will be given for any program comprising 15 quarter units, not including courses 105 or 106, but including 135 (or 137A,B), 111 (or 109), and 206.

**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 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**

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 (—) MWF 12, first 4 weeks only
Win (—) 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 (—) MWF 11, first 4 weeks only
Win (—) MWF 10, 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. 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,
Win (—) MWF 1:15
Spr (—) MWF 9
Sum (—) MTWTh 9
(—) 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


*3 units, Aut (Cerf) MWF 11
Win (—) MWF 1:15
Spr (—) MWF 1:15
Sum (—) MTWTh 10

COMPUTER SCIENCE

Instruction sets. Detailed study of the logic design of a small computer. Recommended: 111 (may be concurrent).

3 units, Aut (Staff) MWF 9
Win (Davidson) MWF 9

135. 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 (——) TTh 11:00–12:15

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, Win (——) MWF 11

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. 137A is primarily concerned with functions of a single variable. Problems discussed include solution of nonlinear equations, interpolation and approximation of functions, numerical differentiation and integration, and solution of ordinary differential equations. Evaluation of functions, summation of series, including analysis of convergence and estimation of truncation and round-off errors. Pitfalls in automatic computation and their remedies. 137B is primarily concerned with functions of several variables including problems of linear algebra and least squares approximation. 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 130; or equivalents; and for 137B: Mathematics 113, or equivalent.

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 winter and spring quarters, 1972–73.) Structure of assemblers, linkage editors, load- ers, macro facilities, interpreters, and compilers. Introduction to operating systems. Not recommended for students with background in systems programming. Alternate: 240A,B. Prerequisite: 111 or equivalent.

140A. 3 units, Aut (Bredt) TTh 1:15–2:30

140B. 3 units, Win (Bredt) TTh 1:15–2:30

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; data base 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 (——) MWF 3:15

144B. 3 units, Spr (Knuth) MWF 3:15


3 units, Win (——) MWF 2:15

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; asympt-
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 (McCarthy) 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

211. Switching Theory and Logic Design—(Enroll in Electrical Engineering 381.) 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.

3 units, Aut (Peterson) MWF 9 and
(McCluskey) MWF 11
Win (Staff) MWF 11
Sum (Staff) MTWTh 11

212. Digital System Organization and Switching Theory—(Enroll in Electrical Engineering 382.) Characteristics of switching, memory, and input/output devices. Comparison of digital integrated-circuit families. Introduction to large-scale integration. Logic design of counters, shift registers, arithmetic circuitry, correlators, etc. Project in detailed design of a system such as a stored program computer, digital differential analyzer, desk calculator, or radar signal processor. Logic laboratory. Prerequisite: 211.

3 units, Aut (Peterson) MWF 9 and
(McCluskey) MWF 11
Win (Staff) MWF 10

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.

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 [by arrangement]

226. The Representation Problem in Artificial Intelligence — Formalisms for representing 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

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. Prerequisites: 206 and 224 or consent of instructor.

3 units, Spr (Feldman, 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: 137B or equivalent.

3 units, Aut [TTh 2:45-4:00]


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 [by arrangement]

239. Topics in Numerical Analysis—Given only when a suitable faculty member is available.

By arrangement


240A. 3 units, Win [TTh 2:40-3:55]

240B. 3 units, Spr [TTh 2:40-3:55]

246. Operating Systems—(Enroll in Electrical Engineering 380.) 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) MWF 11

3 units, Spr (Bredt) TTh 1:15-2:30

249. Topics in Programming Systems — Given only when a suitable faculty member is available.

By arrangement

256. Computability—Formal languages and their relation to automata theory. Mechanical theorem proving by resolution. Gödel
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257. Advanced Computability — Recent results in topics listed for 256. Prerequisite: 256 or equivalent.

3 units, Win (——) MWF 10


3 units (——) alternate years, given 1973–74

259. Topics in Theory of Computation — Given only when a suitable faculty member is available.

By arrangement

265. Computer Models for Natural Languages — (Same as Linguistics 265.) The consideration of linguistic problems in the context of computers. Modifications of linguistic theory from computational evidence. Parsing and generating systems. Question-answering programs. Problems of mechanical translation. Prerequisite: some knowledge of computers and introduction to linguistics or equivalent.

4 units, Aut (——) TTh 10:30–12:00

266. Research in Computational Linguistics — (Same as Linguistics 266.) Examination of unsolved problems in computational linguistics.

4 units, Win (——) F 1:15–4:05

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 — 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 212 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) Th 1:15–5:05

319B. Parallel Computing Seminar — (Enroll in Electrical Engineering 385B.) Student-faculty discussions of research problems in areas of control of parallel operations, parallel program schemata, parallel computer organizations, higher level languages for parallel operations, etc. Prerequisite: consent of instructor.

1 unit, Aut, Win, Spr, Sum (Bredt, McCluskey) M 1:15–5:05

319C. Computer Architecture Seminar — (Enroll in Electrical Engineering 385C.) Student-faculty discussions on advanced topics and research problems. Areas of interest include new computer organizations, parallel computers, efficient algorithms for advanced computers including algorithms for compiling, scheduling, and program optimization.

1 to 4 units, Aut, Win, Spr, Sum (Stone) by arrangement

319D. Computer Systems Analysis Seminar — (Enroll in Electrical Engineering 385D.) Student-faculty discussions on measuring, modeling and analyzing the performance of computer systems and computer system components. Prerequisite: consent of the instructor.

1 unit, Aut, Win, Spr, Sum (Baskett) by arrangement
319E. Pipeline Computer Seminar—(Enroll in Electrical Engineering 385E.) Student-faculty discussions of research in pipelining as a tool for computational efficiency. Aspects of design, control, system architecture, applications and performance are discussed. Prerequisite: consent of instructor.

1 to 4 units, Aut, Win, Spr (Davidson) by arrangement

319F. Communications Network Seminar—(Enroll in Electrical Engineering 385F.) 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

320. Artificial Intelligence Seminar.
1 to 3 units, any quarter (Staff) by arrangement

1 to 3 units, any quarter (Staff) by arrangement

331. Large Scale Systems in Mathematical Programming — (Enroll in Operations Research 341.)

1 to 3 units, any quarter (Staff) by arrangement

1 to 3 units, any quarter (Staff) by arrangement

—(Same as Linguistics 365.)
3 units, Spr (——) by arrangement

360. 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.


Discrete Mathematics—See Electrical Engineering 284.


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,C.


Statistical Methods of Econometrics — See Economics 272.

Theory of Automata—See Philosophy 162 and Electrical Engineering 494.


DRAMA

Emeriti: James G. Emerson (Professor); Helene Blattner, Elisabeth Buckingham (Associate Professors); Naomi Wrage (Assistant Professor)

Chairman: Charles R. Lyons

Professors: Wendell Cole, Charles R. Lyons, Eleanor Prosser, H. Donald Winbigler

Associate Professors: Shirlee Dodge, Douglas A. Russell, Helen W. Schrader

Senior Lecturers: Evelyn Draper, Frederick Hunt

Assistant Professor: William S. Eddelman

Acting: John Chioles, John Cochran

Lecturers: Barbara Cox, Michael Ramsaur

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.
2. **Acting.** Fundamentals of Acting. Drama 120A, 120B, 120C.
3. **Literature and Criticism.** Introduction to Criticism. Drama 150.
   Three courses to be chosen from the Dramatic Literature sequence Drama 151–158, Senior Seminar. Drama 290.
5. **Performance.** Each major must complete a minimum of 6 units in laboratory courses in departmental theater productions to be divided between Drama 129 and Drama 139 with a minimum of 4 units in Drama 139.
6. **Electives.** Electives offer opportunities for further work in acting, design, dramatic literature, or history or a combination of these. Nine units of work are to be chosen from Drama courses numbered 100 or above.

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
- **Introduction to Criticism.** Drama 150.
- **Dramatic Literature.** Two courses from the sequence Drama 151-158, and 290.
- Electives in literature, history, design, or acting to total at least eleven 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.

**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 aesthetics 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.

Applicants for graduate study should write directly to the Department of Drama for information and applications. All applicants must furnish their scores on the Aptitude Test of the Graduate Record Examination as part of their application. Applicants must also submit a sample of their best written scholarly work. 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.

For University regulations governing advanced degrees, see the section "Degrees" in this bulletin. The following are departmental requirements.

General Requirements — 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 72 units of graduate courses and seminars in support of the degree in addition to his 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.

All candidates, regardless of their field of specialization, are expected to fulfill the following general requirements:

1. Language requirement. The candidate must demonstrate reading knowledge of two foreign languages in both of which there is a major body of dramatic literature. For one of these, the candidate must satisfactorily complete a literature course in which the readings are in the original language of the literature studied. The other language requirement may be fulfilled in any of the following ways:

- 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.
- A reading examination given each quarter by the various language departments, except for Latin and Greek.
- 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 requirements in the other language must be met by the end of the third year.

2. Course requirements. The candidate is required to take the course sequence in research and criticism (350, 351, and 352) and a minimum of four seminars in dramatic literature. One of the graduate seminars is to be taken outside of the Department of Drama. All candidates for the Ph.D. degree must take the one or two years (depending upon previous graduate experience) in the 370 series in directing. Candidates in criticism/directing must complete the second year workshop in directing, 371A, 371B, 371C, and a third year production project, 372; candidates in history/design must complete the series of advanced design courses, 330A, 330B, 330C and a third year design project, 331.

3. Examinations. When course work is completed, the candidate takes written comprehensive examinations in his or her four fields of concentration (see below). Upon successful completion of all qualifying examinations, the candidate is admitted to a University oral examination based on his or her four fields.

During the first year of residence, the candidate, in consultation with his or her adviser, will select four fields of concentration. One of the four fields is designated as the candidate's major field of specialization so that much preparatory research and study for the dissertation will have been completed before completion of course work.

One field of concentration is to be chosen from each of the following groups:

1. Comparative drama in one literary period. (Examples: Classical Drama, Medieval Drama, Renaissance Drama, European Drama in the Eighteenth Century, Modern Drama from 1870 to 1918, or 1900 to 1940, Contemporary Drama from 1945 to present, etc.)
2. One major playwright.
3. One national drama. (To be chosen from English, American, French, Italian, Spanish, German, Russian.)
4. One area of theory to be defined by the candidate. (Examples: one aspect of dramatic theory, one critical method, Tragedy, Directing, etc.)

Only two areas of study in a candidate's program are permitted to overlap significantly. (Examples: French Drama and Molière; Renaissance Drama and Shakespeare.) At least one area of study must be before 1700. A candidate will be responsible for the theatre history in all areas of specialization.

4. Dissertation. Either immediately preceding or after completion of the comprehensive examinations, the candidate will file formal application for candidacy as prescribed by the University. The dissertation must be completed and approved within 5 years from the quarter in which candidacy is granted. A candidate taking more than 5 years will be required to reinstate his or her candidacy by repassing comprehensive 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 Contemporary Theater**—Survey of the arts of contemporary performance; lectures, demonstrations and discussion of readings in contemporary drama.
   
   3 units, Aut (Eddelman and Staff) MWF 9

20. **Acting for Freshmen** — Introduction to improvisational acting and basic acting techniques.
   
   3 units, Aut, Win, Spr (Staff)
   
   TTh 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

**Intermediate Courses**

Courses numbered 100-199 are intermediate courses designed primarily for the major but open to all undergraduates who have the necessary prerequisites.

100. **Introduction to Dramatic Criticism**—Approaches to textual analysis, dramatic structure and genre.

   4 units, Aut (Staff) MWF 9

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. 120A,B,C must be taken in sequence.

   120A. 3 units, any quarter (Cochran, Mooney, Olon-Scrymgeour)
   
   Section 1, TTh 10-12
   Section 2, MW 10-12

   120B. 3 units, Win (Mooney, Olon-Scrymgeour) TTh 10-12

   120C. 2 units, Spr (Mooney, Olon-Scrymgeour) TTh 10-12

121A,B,C. **Fundamentals of Acting II**—The study of characterization in workshop productions of complete plays. A company class. It is recommended that 121A,B,C be taken in sequence. By audition. Prerequisites: 120A,B,C and 123.

31. **Introduction to Stage Lighting**—An introductory course in the art and practice of lighting design as it applies to the major types of staging and theatrical forms.

   3 units, Spr (Hunt) MWF 1:15 plus lab.
   
   by arrangement

32. **Introduction to Costume Design and Construction**—Introduction to the process and literature of costume design. Design and construction projects worked on in class and in laboratory.

   3 units, Win (Cox) MWF 1:15 plus lab.
   
   by arrangement

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 2 units, any quarter (Staff)
   
   by arrangement
121A. 3 units, Aut (Olon-Scrymgeour)  
MWF 2:15-4:05
121B. 3 units, Win (Mooney)  
MWF 2:15-4:05
121C. 3 units, Spr (Lyons)  
MWF 2:15-4:05

123. Stage Movement I—It is recommended  
that 123 be taken concurrently with 120A,B,C. May be repeated for credit.  
1 unit, any quarter (Dodge)  
Section 1, T 3:15-5:05  
Section 2, W 2:15-4:05

124. Stage Movement II—It is recommended  
that 124 be taken concurrently with 121A,B,C. May be repeated for credit.  
2 units, any quarter (Dodge)  
MWF 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.  
2 units, Aut (Draper) by arrangement  
Win (Staff) by arrangement

126A,B,C. Black Performing Arts—Prerequisite: sophomore standing and consent of instructor.  
126A. 3 units, Aut (Cochran) TTh 10-12  
126B. 3 units, Win (Cochran) TTh 10-12  
126C. 3 units, Spr (Cochran) TTh 10-12

129. 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 unit, any quarter (Staff) by arrangement

130A,B. Scene Design—Visual analysis of historical styles as interpreted for the modern theater and developed throughout various presentational media. Specific problems in spatial perceptions and compositions. One hour lecture per week in period interiors and furnishings from the Classical through Contemporary periods. Work in model building. Prerequisite: 30 or consent of instructor.  
130A. 3 units, Aut (Eddelman) TTh 10-12  
plus lab. by arrangement  
130B. 3 units, Win (Eddelman) TTh 10-12  
plus lab. by arrangement

131A,B. Lighting Design—Introduction to stage lighting. Prerequisite: 31 or consent of instructor.  
131A. 3 units, Aut (Hunt) MW 10-12  
plus lab. by arrangement  
131B. 3 units, Win (Hunt) MW 10-12  
plus lab. by arrangement

132A,B,C. Costume Design and History—Introduction to costume history, design, planning and construction with weekly discussion of class design assignments. Prerequisite: 32 or consent of instructor.  
132A. 3 units, Aut (Russell) MWF 1:15  
plus lab. by arrangement  
132B. 3 units, Win (Russell) MWF 1:15  
plus lab. by arrangement  
132C. 3 units, Spr (Russell) MWF 1:15  
plus lab. by arrangement

133. Theatrical Makeup—Laboratory course in the art and craft of stage make-up.  
1 unit, Aut (Cox) T 10-12

135. Project in Design and Technical Theater—Project in stage design, costume design, or lighting design. Prerequisite: consent of instructor.  
3 units, any quarter (Staff) by arrangement

139. 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 2 units, any quarter (Staff)  
by arrangement

151. Greek and Roman Drama.  
4 units, given alternate years

152. Medieval and Renaissance Drama.  
4 units, Aut (Prosser) MWF 9

153. Neoclassic Drama.  
4 units, given alternate years

154. Romantic and Early Realistic Drama.  
4 units, Spr (Staff) MWF 9

155. Modern Drama (1880–1918).  
4 units, given alternate years

156. Modern Drama from 1918.  
4 units, Win (—) MWF 9

4 units, Aut (Cole) MWF 11
INTRODUCTION TO DIRECTING — Prerequisites: 120A,B,C and 30, 31, 32.  
3 units (Mooney) TTh 2:15–4:05

ADVANCED COURSES

Courses numbered 200–299 are designed for advanced undergraduates and graduates.

250. Senior Seminar in Genre.  
4 units, Win (———) TTh 10–12

251. Greek and Roman Drama.  
4 units (———) given alternate years

252. Medieval and Renaissance Drama.  
4 units, Aut (Prosser) MWF 9

253. Neoclassic Drama.  
4 units (———) given alternate years

254. Romantic and Early Realistic Drama.  
4 units, Spr (———) MWF 9

255. Modern Drama (1880–1918).  
4 units (———) given alternate years

256. Modern Drama From 1918.  
4 units, Win (———) MWF 9

257. American Drama From 1920.  
4 units, Aut (Cole) MWF 9

260. Theaters and Staging I (Classical) — Survey of theaters, staging methods, styles of theatrical production from the Greeks through the Neo-Classical.  
3 units, Aut (Cole) MWF 9

261. Theaters and Staging II (Modern) — Survey of theaters, staging methods, styles of theatrical production from Neo-Classical to Modern.  
3 units, Win (Cole) MWF 9, given 1974–75

270. Independent Project in Directing — Prerequisite: consent of instructor.  
2 to 4 units, any quarter (Staff) by arrangement

293. 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

300. Research Methods.  
4 units, Aut (Prosser) TTh 10–12

301. History of Dramatic Criticism.  
4 units, Win (Chioles) TTh 10–12

302. Contemporary Critical Approaches.  
4 units, Spr (Lyons) given alternate years

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 — Shakespeare’s Tragedies.  
4 units, Spr (Prosser)

352. Seminar in Comparative Drama — Late 19th Century Realism: Ibsen, Strindberg, Chekhov.  
4 units, Win (Lyons) TTh 2:15–4:05

353. Seminar in Dramatic Period: Classical Drama.  
4 units, Aut (Chioles) TTh 2:15–4:05

354. Seminar in a Special Critical, Aesthetic, or Historical Problem.  
4 units, Spr (———) TTh 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 (Hampton) MWF 4:15–6:05  
370B. 4 units, Win (———) MWF 4:15–6:05  
370C. 4 units, Spr (———) MWF 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 multi-form theater space. Public performances.  
371A. 4 units, Aut (———) MWF 4:15–6:05
371B. 4 units, Win (——) MWF 4:15-6:05
371C. 4 units, Spr (——) MWF 4:15-6:05

   4 units, any quarter (Staff) by arrangement

   Any quarter (Staff) by arrangement

M.F.A. COURSES
(Open to M.F.A. Students Only)

166M. Introduction to Directing—See Drama 170.
   2 units (——)

173M. Theatrical Makeup II.
   1 unit (Cox) by arrangement

182M. Technical Production II.
   2 units, any quarter (Hunt, Ramsaur) by arrangement

183M. Technical Production III.
   1 unit, any quarter (Hunt, Ramsaur) by arrangement

241M. Lighting I.
   2 units, any quarter (Hunt, Ramsaur) by arrangement

242M. Lighting II.
   2 units, any quarter (Hunt, Ramsaur) by arrangement

243M. Lighting III.
   1 unit, any quarter (Hunt, Ramsaur) by arrangement

242M. Acting II.
   3 units, any quarter (——) by arrangement

243M. Voice.
   1 unit, any quarter (Draper) by arrangement

245M. Dance/Drama.
   1 unit, any quarter (Dodge) by arrangement

271M. Costume I.
   2 units, any quarter (Russell) by arrangement

272M. Costume II.
   2 units, any quarter (Russell) by arrangement

273M. Costume III.
   1 unit, any quarter (Russell) by arrangement

281M. Scene Design I.
   2 units, any quarter (Eddelman) by arrangement

282M. Scene Design II.
   2 units, any quarter (Eddelman) by arrangement

283M. Scene Design III.
   1 unit, any quarter (Eddelman) 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
   Spr (Schrader) MW 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

EAST ASIAN STUDIES

Committee in Charge: The Committee on East Asian Studies, a subcommittee of the Committee on International Studies
Chairman: Lyman Van Slyke
Director of Master's Program: To be named

The Center for East Asian Studies administers the master's program in East Asian
Studies, an interdisciplinary program in the humanities and the social sciences encompassing Anthropology, Art, Asian Languages, Economics, History, Philosophy, Political Science, Religion, and Sociology.

Stanford's program in East Asian Studies is established for three types of students:

1. those who wish to specialize in East Asia for the Ph.D. but have not yet decided on the discipline (Anthropology, History, Political Science, etc.) in which they wish to work;
2. those who have chosen a discipline for their Ph.D. preparation, but wish to have an intensive area and language training before beginning their discipline training;
3. those who wish to concentrate in East Asian studies as a preparation for careers in government, journalism, business, or teaching at other than the college or University level.

This program is designed to be completed in no more than two academic years. Since each student will enter the program with his unique background, interest, and capabilities, a certain degree of flexibility and deviation from the standard requirement is entirely conceivable. Approximately one-half of the student's work is to be devoted to studying either the Chinese or Japanese language; the other half consists of nine courses of substantive content other than language training. Although some requirements can be waived, e.g., by transferring credit from an undergraduate institution, the student is still expected to fulfill the basic nine-course requirement.

Minimally, the student is to achieve language competence equivalent to completion of third-year level in either Chinese or Japanese. Students entering without any language preparation may meet this requirement in a variety of ways, by combining summer intensive courses with regular academic year work. The language requirement may be waived in part either by receiving credit for courses at other institutions or by passing examinations administered by the Asian Languages Department. The Department administers a placement examination on the first day of classes in the summer and autumn quarters to determine the appropriate course level for incoming students.

Those who complete the minimum three-year language requirement before completing other requirements are expected to continue work involving the use of Chinese or Japanese as long as they are in the program.

Students are required to take at least one seminar in which they will write a research paper on some aspect of East Asia (defined at Stanford as China, Japan, and their overseas communities). This seminar must be taken in a department in which two other courses have been taken, regardless of the specific prerequisites of the seminar. One of these two courses may be a non-East Asian course, provided it is demonstrably useful for understanding East Asian problems. Theory-oriented or methodological courses are possible examples. In addition, students will elect six courses numbered at least 100 and above related to East Asia. These requirements must be completed at Stanford University.

Those interested in applying for admission to the program should write for application forms to Director, A.M. Program, Center for East Asian Studies, Building 600T, Stanford University, Stanford, California 94305. The Graduate Record Examination (aptitude sections) is required; scores should be sent to the Graduate Admissions Office at Stanford. Deadline for submission of applications for admission and financial aid is January 15, 1973.

ECONOMICS

Emeritus: Bernard F. Haley (Professor)
Chairman: Moses Abramovitz
Vice Chairman: James N. Rosse


Visiting: Harold Demsetz


Visiting: Joseph M. Burns, Donald J. Harris, Melvyn B. Kraus, Harl E. Ryder

Assistant Professors: Michael J. Boskin, Mi-
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 courses for undergraduates are conducted by the Institute, as well.

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, 141, 145, 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 count as economics courses in satisfying these requirements. A list of these courses is available in the Economics Department office.

3. 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, together 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 199, 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 indicate 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 re-
quired 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 for the A.M. thesis or as one of the alternative two term papers. If an Honors I thesis is accepted as an A.M. thesis, 10 units will be given toward either the A.B. or the A.M. credit hour requirements but not both.

**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 Study, who together with his administrative assistants and the Graduate Studies Committee, of which he is chairman, has departmental responsibility for administering the graduate program. All entering students and second-year students are assigned individual faculty advisers, and where possible, an effort is made to assign advisers on the basis of sharing special interests within the field of economics. 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 Club 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 to advanced standing 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. Students matriculated to graduate standing in other departments of the University may, however, be admitted to candidacy. 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 Study 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 and courses completed with a grade of less than C 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 in subjects closely related to economics may be included with the approval of the Director of Graduate Study in Economics.

2. Completion of a thesis acceptable to the department or of two term papers of acceptable quality in courses 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 Study, 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, at each of these stages programs of study will be weighed individually according to the following departmental standards or requirements:

Admission to Candidacy — The Graduate Studies Committee will, as a matter of departmental procedure, admit students to candidacy for the degree of Doctor of Philosophy in Economics when three conditions have been satisfied:

1. The student has prepared in economic theory at least to the level of competence required in the two comprehensive field examinations in "Price and Allocation Theory" and in "Theory of Income and Economic Fluctuations." These comprehensive examinations are normally offered to first-year students at the end of Spring Quarter and cover the subject matter of Economics 202, 203, 204, and 210, 211, and 212, respectively.

2. 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.

3. The student in consultation with his or her adviser prepares, and the Graduate Studies Committee accepts, a proposed program of study satisfying the standards established below for Recommendation for the Degree.

4. At the end of the third year the Graduate Study Committee will evaluate each stu-
dent for performance in comprehensive exams and for research capability. If a student has submitted a thesis proposal and had it approved by his or her thesis reading committee by the end of the third year, that shall be regarded as sufficient evidence of his research capability. Every student is urged to do so. Those who cannot comply should see the Director of Graduate Study.

5. As soon as a student has the thesis proposal approved by his or her thesis adviser, he or she is to file for candidacy with the University Graduate Study Office.

6. As soon as a thesis proposal is acceptable to the adviser, the adviser chooses the second and third readers. The oral committee will be made up of the three readers plus one. The Director of Graduate Study will appoint the fourth member.

7. Before the student files for candidacy, the maximum leave of absence should be two years. Under special circumstances a third may be granted if requested at the end of the second year of absence.

Students admitted to graduate standing are normally expected to satisfy the requirements for Admission to Candidacy by the end of their first year in residence. For this reason prior training in mathematics is strongly recommended.

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 satisfy 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 three fields and a minor subject
2. Proficiency in at least two other areas within economics
3. Qualification in Econometrics
4. Qualification in Economic History
5. Professional competence in a foreign language or course work developing a needed research skill
6. Teaching experience
7. Research training and specialized study in seminars
8. University oral examination
9. Completion of dissertation

It should be noted that the third and fourth 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 three 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:

- 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 pro-
gram, students may choose to prepare themselves in at least one of the fields of study listed under Option A. In addition, students electing this option will complete requirements in their minor subject which must be approved in advance by the Graduate Studies Committee.

Normally, students complete their minor department requirements and their third field in economics by the end of their second year of study.

2. Distribution Requirement. To achieve a balanced program, students are required to show proficiency in at least two fields other than those in which they will take comprehensive exams under options A or B. Normally, a total of three five-unit courses approved by the Director of Graduate Studies, passed by grades of 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. 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 not elect the Econometrics comprehensive may still offer Economics 172 as one of their courses satisfying the distribution requirement under 2 above.

4. 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 courses from outside the Economics Department if they demonstrably contribute better to the Ph.D. program.

5. 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.

6. 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.

7. 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.

8. When these standards have been satisfied and upon a recommendation from the student's dissertation adviser, the Director of Graduate Study 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.

9. 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.

**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 $2835 plus an allowance for tuition. In the case of teaching assistants, students are currently receiving $2500, $2835, or $3000 per academic year, depending on appointment, 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 1973–74.*

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.

\[5\text{ units, Aut, Win, Spr (Hickman, Bach, Shaw)} MTWThF\]

\[4\text{ units, Sum ( ) } MTWThF\]

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.

\[5\text{ units, Aut (Johnson, Shoven) MTWThF}\]

\[5\text{ units, Win, Spr ( ) MTWThF}\]

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.

\[5\text{ units, Aut, Win, Spr (Shaw, Hurd, Scadding) MTWThF}\]
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 (Leland, Scadding) MTWTThF

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 (—) Win (—)

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, Win, Spr (—) MTWTThF 8

100. Topics in the History of Economic Thought—See 200.

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, Aut (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)

108A,B. Undergraduate Workshop in World Food Problems—(Same as Food Research Institute 150, 151.) The two quarter courses count as 5 units toward Economics major A.B. requirement. A two-quarter workshop to examine the current adequacy of world food supplies on a country and regional basis. Members of the workshop will examine concepts and measurement of the quality of nutrition, problems of measurement of food supplies, the incidence and causes of inadequate nutrition, and projections of nutritional problems over time. Each member of the workshop will investigate the sufficiency of food supplies in a particular less developed country or region and present a report on his findings. Enrollment limited to 12. Prerequisite: consent of instructors.

5 units each quarter, Win, Spr (Jones, Taylor)


5 units, Spr (Scitovsky)

111. Money and Finance—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, Win (Shaw) MTWTThF

115. Economic History of Western Europe—Historical trends in the Western European economy from 1750 to past the First
World War. Emphasis upon the historical characteristics and economic development of Great Britain, France, and Germany. Prerequisites: non-majors 1; majors 51 and 52.

5 units (Falkus) MTWThF

116. Economic History of the United States—Historical trends in the American economy from the colonial period to World War I; special references to problems of national and regional industrial development, economic stability, and income distribution, including social and political influences thereon. Prerequisites: non-majors 1; majors 51 and 52.

5 units, Spr (Sanderson, David) 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 underdevelopment viewed in historical perspective as an aspect of the phenomenon of uneven development in the world economy. The historical process of capitalist development is analyzed with regard to the mechanisms of capital accumulation, technical change, trade, and imperialism. In this context the emergence of underdevelopment is considered in terms of the process by which relatively backward sectors were integrated into the expanding world economy and subsequently evolved. The discussion is focused upon various theories relevant to this process and to current structure and operation of underdeveloped economies.

5 units, Aut (Timmer) 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 (Gurley) MTWThF

121A. Economic Development in East Asia I—The economic development of China in this century, with emphasis on Communist China. The impact of Maoist ideology on economic development. Course also covers Korea, Taiwan, and Indonesia. Prerequisite: 1.

5 units, Win (Gurley) MTWThF

121B. Economic Development in East Asia II—A case study in the modernization and industrialization of non-Western countries. Social change and economic growth in modern Japan since the Meiji Restoration. Special emphasis on the post-“takeoff” period. Prerequisites: 1 and 121A or consent of instructor.

5 units, Spr (Ratcliffe) 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, Win (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 monococnomic, 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. Prerequisites: 1.

5 units each quarter, Aut, Win (Kofi)

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 (Falcon, Timmer) given 1974-75

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, Spr (Sanderson) MTWThF


5 units, Win (Kirk) 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 (Kraus) MTWThF

142. Public Finance and Fiscal Policy II—Continuation of 141 with emphasis on discussions, case studies, and individual research. Prerequisites: 51, 52 and 141.

5 units, Spr (Kraus) MTWThF

143. Economics of Natural Resources—Analysis of economic causes and consequences of air and water pollution; evaluation of alternative pollution control institutions; case studies. Prerequisite: 51.

5 units, Win (Ratcliffe) 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, Win (Falcon, Jones) MWF 10


5 units, Spr (Michael) MTWThF

147. Economics of Human Resources—Models of educational processes. Analysis of rates of return to investment in human resources; including health and on-the-job training. Educational planning and economic growth. Prerequisite: 51.

5 units, Win (Sanderson) 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. Prerequisite: 1.

5 units, Win (Muth) MTWThF

149. Location Theory and Spatial Analysis—
This course will present the principal theories and techniques that have been found useful for the analysis of the spatial expression of social and economic systems. They include central place theory, models of spatial interaction, the economic theory of location, space in development planning, and certain aspects of spatial statistics. Theoretical and methodological developments will be related to their application to hypothesis testing and planning. Students will be encouraged to apply these theories and techniques to their current research interests and to present the preliminary results of their research toward the end of the quarter. Prerequisites: 51 and 52.

5 units, Spr (Davies)

151. Economic Analysis I—See 51.

152. Economic Analysis II—See 152.


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 (Gonzalez-Vega)

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 (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, Win (Pearson) MTWThF

166. International Economics II—Selected topics in international economics, with emphasis on individual study, seminar presentations, and discussions. Enrollment limited to 16. Prerequisite: 165.

5 units, Win (Pearson) MTWThF

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. Prerequisite: 1.

5 units, Spr (Meier)

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
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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 (Hurd)

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 (Pencavel) 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. Prerequisites: 51 and Mathematics 41 or the equivalent.

5 units, Aut (Ryder) MTWThF

181. Optimization and Economic Analysis—The development of optimization techniques, including calculus, linear and nonlinear 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 (Leland) MTWThF

190. Introduction to Accounting—See 90.

192. Undergraduate Seminars in Economics—Courses 192 through 197 are each one quarter 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 for more information about seminars of interest.

192. Economics of Information, 5 units, Spr (Spence, Rosse)


5 units, Aut (Johnson, Shaw)


5 units, Win (Ratcliffe)


5 units, Win (Demsetz)

196. The Economics of Financial Markets.

5 units, Aut (Burns)

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 (Sanderson, Foley)

COURSES PRIMARILY FOR GRADUATE STUDENTS


A. CORE THEORY CURRICULUM

200. Topics in the History of Economic Thought—The philosophy of science; the nature of scientific revolutions; and the development of economic analysis. The classical school from Smith through Mill; Marxist economics; the marginalists; institutional economics; general equilibrium from Walras through Arrow-Debreu. Their relation to economic conditions in their time and to
modern economics. Open to advanced undergraduates with consent of instructor.

5 units, Aut (Harris)

201. Value, Distribution and Growth — A general scheme is developed for analysis of the relations between prices, distribution and growth, based on the linear model of production. In this framework, alternative approaches to a theory of value, distribution and growth are considered, focusing on Ricardian, Marxian, New-Keynesian, and Neoclassical theories. The significance of various analytical problems that appear in these theories is examined, including Marx's "transformation problem," Ricardo's "invariable standard of value," Wicksell Effects, and "reswitching" of techniques of production.

5 units, Win (Harris)

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: consent of instructor.

5 units, Aut (Leland)

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 (Spence)


5 units, Spr (Starrett)


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 (Foley)

211. 5 units, Spr (Johnson)

212. 5 units, Win (Hickman)

235, 236. Advanced Macroeconomics — This sequence is concerned with macroeconomic theory, forecasting and control, with emphasis on quantitative analysis. Use of econometric models for analyzing economic trends and fluctuations, preparing and evaluating short- and long-term forecasts of economic activity, and appraising quantitative policies for stability and growth. Topics include: theoretical specification of sub-sectors and complete models, comparative analysis of large econometric models, methods of testing and improving models, international linkage of national econometric models, effects of alternative statistical estimators on model performance, analysis of sources of forecast errors, econometric versus statistical forecasting models, multiplier analysis of fiscal and monetary policies and their coordination, optimal decision rules for macroeconomic policy. Prerequisites for 235: 210, 211, 212. Prerequisites for 236: 235 and 171 or equivalent.

235. 5 units, Spr (Hickman)

236. 5 units, (—)

301A, B, C. Seminar in Microeconomics.
10 units (—) by arrangement

310A, B, C. Seminar in Macroeconomics.
10 units (—) by arrangement

B. 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)


5 units, Spr (Falcon)

220. Marxist Economics — This course offers alternative frameworks for analyzing economic problems such as price theory, na-
tional 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, Spr (Curley)

221A. Economic Development in East Asia I—See 121A.
221B. Economic Development in East Asia II—See 121B.

222. Economic Development in East Asian Countries — An analysis of development problems and policies common to East Asian countries. Emphasis is on agricultural and industrial policies, saving and investment techniques, foreign trade and aid and economic systems.

5 units (——)

223. Economic Development in Latin America—See 123.
229. Analytical Techniques for Development Planning—See 129.

10 units (——) by arrangement

C. 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, Win (David, Sanderson)


5 units, Aut (David)

227. European Economic History—Analysis of economic growth in western European countries from the Age of Mercantilism with special reference to British experience.

5 units, Spr (Falkus)

325A,B,C. Seminar in Economic History.

10 units (——) by arrangement

D. MONETARY THEORY AND INSTITUTIONS

230. Monetary Theory — Advanced topics in monetary theory with special reference to policy criteria and control techniques. Prerequisite: 211.

5 units, Spr (McKinnon)


10 units (——) by arrangement

E. 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

F. ECONOMICS OF LABOR


5 units, Aut (Pencavel)


5 units, Win (Pencavel)
345A,B,C. Seminar in Labor Economics.
10 units (——) by arrangement

G. URBAN ECONOMICS

249. Urban Economic Analysis — Analyses of the structure of economic activity in urban areas and the economic aspects of urban problems. Topics considered include: the location and differential growth rates of cities; the intra-metropolitan distribution of firms and residences; the urban transportation problem; residential segregation, slums, and government housing policy. Prerequisite: 304 or Engineering-Economic Systems 212.
5 units, Spr (Muth)

250. Topics in Urban Economics—Analysis of labor markets, with special reference to the problems of poverty in urban areas, and the local public sector. Among the former group are included: aspects of labor demand and supply, discrimination in employment, unemployment, human capital investment, and government labor market policies. The latter group includes: the incidence of the property and other local taxes, the determinants of local tax and expenditure levels, economic aspects of local governmental structure, and the fiscal problems of central cities. Prerequisite: same as 249.
5 units (——)

349A,B,C. Seminar in Urban Economics.
10 units (——) by arrangement

H. ECONOMICS OF INDUSTRY

254. 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, Win (Rosse)

256. 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, Aut (Owen)

10 units (——) by arrangement

I. INTERNATIONAL ECONOMICS


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 (Kraus)

365A,B,C. Seminar in International Economics.
10 units (——) by arrangement

J. 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 (Hurd)

5 units, Win (Anderson)

370A,B,C. Seminar in Econometrics.
10 units (——) by arrangement

K. MATHEMATICAL ECONOMICS

Field I: Theory of Choice:

280. Foundations of the Theory of Choice—Choice behavior and revealed preference theory; axiomatic derivation of numerical measures of probability and utility; special topics in utility theory (additive utilities, extensive measurement theory, etc.); risk sharing and multi-person decision theory; social choice and Arrow's General Possibility Theorem.
5 units, Aut (Wilson)

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 (Starrett)

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 (Leland)

Field II: General Theory

283. Linear Models in Economics—The theory of linear models. Application of linear programming in economics, theory of positive matrices and its application to static and dynamic input-output analysis; activity analysis and the von Neumann model. Prerequisites: Mathematics 113 and 114, or equivalent.

5 units, Aut (Kurz)

284. Advanced Dynamic Programming: Optimal Economic Growth—Current techniques for optimal policies of consumption and capital accumulation. Prerequisites: Mathematics 45, 113 and 114 or equivalent. Recommended: 283 and Mathematics 130 or consent of instructor.

5 units, Win (Ryder)

287. General Equilibrium Theory—Comprehensive treatment of utility and production theories, existence of competitive equilibrium; the theory of the core of the economy. Prerequisites: Mathematics 45, 115, and 116 and 117 or equivalent. Recommended: Mathematics 205A,B,C.

5 units, Spr (Foley)

288. Special Topics—The topics for 1972-73 will be announced. May be repeated for credit. Prerequisites: consent of instructor and working knowledge of differential calculus.

5 units, Spr (Starrett)

385A,B,C. Seminar in Mathematical Economics.

10 units (———) by arrangement

L. COLLOQUIUM

395A,B,C. Traditions of Economic Analysis, 10 units (———) by arrangement

COURSES OFFERED OVERSEAS

112. International Economic Development—(Taught at Stanford in Britain)
3 to 5 units, Sum (Meier)

124E. Britain and the European Economic Community—(Taught at Stanford in Britain)
5 units, Sum (Meier)

150. Spatial Structure of European Cities—(Taught at Stanford in Italy)
4 units, Aut (Muth)

155. European Housing Policy—(Taught at Stanford in Italy)
4 units, Aut (Muth)

ENGLISH

Emeriti: Robert W. Ackerman, John W. Dodds, Paul H. Kocher, Herbert D. Merritt, George F. Sensabaugh, Claude M. Simpson, Jr., Wallace E. Stegner (Professors)

Chairman: John Loftis

Acting Director of the Creative Writing Center: Nancy H. Packer


Associate Professors: John B. Bender (on leave autumn and winter quarters, 1973-74), George D. Dekker, J. Martin Evans, John Felstiner, Kenneth W. Fields, Albert J. Gelpt, David Halliburton (English and Comparative Literature), Anne K. Mellor, Diane W. Middlebrook (on leave autumn quarter, 1973), Robert M. Polhemus, Ron-

Senior Lecturer: Larry Friedlander (on leave winter and spring quarters, 1974)


Lecturers: Paulette Bates, Charles Kinder, Jane Palmer, Albert Phillips, Belle K. Randall, Scott Turow, Dan Vining, 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 have taken at least one course in English or American literature (not including Freshman Writing).

Any student who declares an English major should begin preparing to fulfill the Department’s requirement of proficiency in a foreign language. [Information on how to satisfy this requirement should be obtained as early as possible from the Department office. Those whose earlier academic experience puts them at a serious disadvantage in satisfying the foreign language requirement may, with the approval of the Department, substitute certain alternative programs of study. For information, consult the chairman of undergraduate studies.]

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, 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, 104, 200A, 204, 205, 206; Linguistics 1, Linguistics 100, Linguistics 204.


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 148, 190, 190A, 191, 192, 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), The English Lyric (English 250), plus two quarters of Directed Writing of Poetry (English 192), or of a more advanced course, all with grades of B or better.

3. The English Department regards the knowledge of a foreign language and some familiarity with its literature as a necessary part of any general University education, and as especially important for an intelligent understanding of the English language and its literature. Students majoring in English will be required to demonstrate proficiency in a foreign language.

4. There are many courses in other departments of particular interest to an English major which may in special circumstances be used to fulfill departmental requirements for the major. A list of these courses is available in the English Department office, Room 41D.

Note: English courses that are given at Stanford Overseas Campuses, that are numbered 100 and over, and that deal in substantial part with English or American literature may normally be used to fulfill elective requirements, or, where appropriate, area requirements for the English major.

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. Application 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 fundamental 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.

Students in the program will have completed work in English and American Literature, as follows:

Area requirements (a through f)—six courses
Junior and Senior Seminars—two courses
Program of concentration—four courses
Senior Essay—15 units

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 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 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 offered 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.”

### 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>
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<tbody>
<tr>
<td>Freshman English</td>
<td>5</td>
</tr>
<tr>
<td>One course in the English language, English</td>
<td>5</td>
</tr>
<tr>
<td>102 or 204.</td>
<td></td>
</tr>
<tr>
<td>English 101. The Structure of the English Language</td>
<td>5</td>
</tr>
<tr>
<td>English 191. Advanced Exposition</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. Modern British Literature, 1789 to the Present</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American literature (preferably in the chief American poets and American novelists)</td>
<td>10</td>
</tr>
<tr>
<td>Education 184. Literature for Adolescents</td>
<td>3</td>
</tr>
<tr>
<td>Course in Drama, preferably Oral Interpretation</td>
<td>3</td>
</tr>
<tr>
<td>Drama 160, Theatre Practice, or Drama 164, Fundamentals of Acting and Directing, or equivalent experiences in dramatics, or Communication 100 and 102, Editorial Techniques and Lab</td>
<td>4</td>
</tr>
</tbody>
</table>
Electives (courses in literature by and about American minorities, and in literary criticism are strongly recommended)

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.

Graduate transfer students who are qualified for a teaching major or minor in English should confer with Professor Grommon before taking English 113, 115, or 117.

Teaching Minor

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman English</td>
<td></td>
</tr>
<tr>
<td>English 191. Advanced Exposition</td>
<td>3</td>
</tr>
<tr>
<td>English 102. The History of the English Language or English 204</td>
<td>5</td>
</tr>
<tr>
<td>English 173A, B, C: Shakespeare</td>
<td>5</td>
</tr>
<tr>
<td>English 117. Modern British Literature, 1789 to the Present</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American literature</td>
<td></td>
</tr>
<tr>
<td>Elective, preferably in the English novel or English 101. The Structure of the English Language</td>
<td>10</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 interested 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 qualifying 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 204 (The Goals of Grammar), or Linguistics 205 (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 must expect to spend more than the minimum time in residence. Credits for previous graduate work at Stanford or elsewhere more than five years old may be reevaluated or rejected.

Only candidates for the Ph.D., the Master of Arts in Teaching (MAT), or the Master of Arts in Creative Writing, will be accepted as graduate students.

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. It is strongly advised that students planning further graduate study in English begin early to satisfy the Old and Middle English requirements for the Ph.D., and those planning a career in teaching English begin early to satisfy the language requirements for the teaching credential.

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. Among the four seminars, students are encouraged to take at least one in literary theory or criticism.
3. A minimum of 60 additional units of graduate courses and seminars (excluding 398, 396A, and 397) distributed according to the adviser's judgment and the candidate's needs.
4. 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 Studies 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.

5. 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 Study 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. Qualification: (See paragraph 4 above.)

For qualification in the doctoral program 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.

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. Among the four seminars, students are encouraged to take at least one in literary theory or criticism.

3. Qualification: (See paragraph 4 above.)

4. 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 David Halliburton, 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 4 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 Comparative Literature or Modern Thought and Literature. As much as 20 units of this requirement may be satisfied through courses in Reading and Research.

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 5. 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 Albert Guerard 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. Freshman Writing — Writing, chiefly expository, emphasizing the control of meaning through critical and creative thinking, and through mastery of style. These courses satisfy the University writing requirement.

1. 3 units, Aut, Win, Sum (Staff)
2. Continuation of 1.
   3 units, Win, Spr (Staff)

1F, 2F. Freshman Writing — For foreign students. (See Undergraduate Writing Program.)

4. Freshman Writing — Creative writing. Prerequisite: English 1 and permission of instructor. There will be small groups devoted to various kinds of writing, including fiction and poetry. This course may replace one quarter of regular Freshman Writing.
   3 units, Win (Staff)

10A. Studies in English Literature — Intensive study of selected masterpieces of English literature, including poetry, drama, and the novel. 10A or 10B offer similar but separate readings. Students may take either or both in any order.
   4 units (3 units if in conjunction with 10W), Aut (Watt)

10W. Writing: English Literature — In conjunction with 10A; with additional class meeting and instruction in writing. Satisfies one quarter of the Writing Requirement. Students must be enrolled in 10A for 3 units.
   3 units, Aut (Staff)

10B. Studies in English Literature — See 10A.
   4 units (3 units if in conjunction with 10W), Win (Evans)

10W. Writing: English Literature — In conjunction with 10B; with additional class meeting and instruction in writing. Satisfies one quarter of the Writing Requirement. Students must be enrolled in 10B for 3 units.
   3 units, Win (Staff)

20. Studies in American Literature — Intensive study of selected masterpieces of American literature, including poetry, drama, the essay, the novel.
   4 units (3 units if in conjunction with 20W), Aut (Chace)

20W. Writing: American Literature — In conjunction with 20; with additional class meeting and instruction in writing. Satisfies one quarter of the Writing Require-
ment. Students must be enrolled in 20 for 3 units.

3 units, Aut (Staff)

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, Aut (Fifer)

40. Drama—(Same as Comparative Literature 40.) Principal dramatic forms; development of dramatic art, masterpieces of the theater from various periods, countries.

5 units, Win (L'Heureux)

45. The Tragic — (May be taken as 145 by English majors.)

5 units, given alternate years

48. Literature and the Performing Arts—(May be taken as 148 by English majors.)

5 units, given alternate years

50. Poetry—(Same as Comparative Literature 50.) An introduction, through the study of language, figures of speech, metrics, critical theory, and careful reading of poems.

5 units, Win (Rebholz)

Spr (Stone)

60. The Minority Voice in Contemporary Literature—(May be taken as 160 by English majors.)

5 units, given alternate years

61. Forms of Afro-American Literature—This course concerns itself with important, neglected areas of the Afro-American experience as reflected in its written and oral literatures. (May be taken as 161 by English majors.)

4 units (3 units if in conjunction with 61W), Spr (Young)

61W: Writing: Afro-American Literature — In conjunction with 61; with additional class meeting and instruction in writing. Satisfies one quarter of the Writing Requirement. Students must be enrolled in 61 for 3 units. Students will be urged to write fiction or poems or personal essays concerning the experience of Mexicans born in this country. Knowledge of Spanish and barrio dialects is essential.

3 units (Islas), given 1974–75

62A. Contemporary Mexican Writers — (in translation). (May be taken as 162A by English majors.)

5 units, given alternate years

62W. Writing: Chicano Literature — In conjunction with 62; with additional class meeting and instruction in writing. Satisfies one quarter of the Writing Requirement. Students must be enrolled in 62 for 3 units. Students will be urged to write fiction or poems or personal essays concerning the experience of Mexicans born in this country. Knowledge of Spanish and barrio dialects is essential.

3 units (Islas), given 1974–75

63. Images of Women in Literature—(May be taken as 163 by English majors.)

5 units, given alternate years

65. Medieval Culture: An Interdisciplinary Introduction—(Same as History 65 and German Studies 65A.)

5 units, Win (Langmuir, Snow)

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)

67. Edda and Saga—(May be taken as 167 by English majors.)

5 units, given alternate years

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.)

4 units (3 units if in conjunction with 68W), Win (Momaday)

68W. Writing: American Indian Mythology, Legend, and Lore — In conjunction with 68; with additional class meeting and instruction in writing. Satisfies one quarter
of the Writing Requirement. Students must be enrolled in 68 for 3 units.

3 units, Win (Fields)

69. Literature Under Attack — (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 (Evans)

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 (Momaday, Staff) Win, Spr (Staff)


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, I, 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: Dekker, Evans, Fifer, Ford, Foster, L’Heureux, Loftis, Martin, Maxeiner, Mellor, Momaday, Moser, Solomon, Trimpi, Watt, Williams.) 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, Spr (Traugott)

102. The History of the English Language—Studies in the evolution of the English language as a medium of literary expression.

5 units, Win (Maxeiner)

104. Principles of Standard English—(Same as 204.)

5 units, given alternate years

110, 111, 113, 115, 117. English Literature—A basic survey.

110. The Earliest English Literature—Cultural backgrounds, reading (in translation), and critical analysis of Anglo-Saxon heroic legend, elegies, and other forms.

5 units, Win (G. Brown)

111. Middle English Literature—Emphasis on major works, most of which will be read in the original language (often in simplified texts).

5 units, Spr (Maxeiner)

113. The Renaissance.

5 units, Aut (Whitaker)

115. The Neoclassic Period.

5 units, Win (Fifer)

117. Modern British Literature, 1789 to the Present.

5 units, Spr (Felstiner)

(Note: In subsequent years 117 will be divided into two courses: 117, Romantic and Victorian Literature, and 119, Modern British Literature.)

121. American Literature to 1855.

5 units, Aut (Martin)
122. American Literature, 1855-1917.
   5 units, Win (Solomon)
125. American Literature, 1917 to the Present.
   5 units, Spr (Chace)
135. Forms of the Modern Novel.
   5 units, given alternate years
136. Trends in Modern Fiction.
   5 units, Spr (Momaday)
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)
145. The Tragic—(Same as Comparative Literature 145.) See 45.
147. Contemporary Drama—(Same as Comparative Literature 147.)
   5 units, given alternate years
148. Literature and the Performing Arts—See 48.
157. Chief American Poets, Nineteenth and Twentieth Centuries.
   5 units, given alternate years
159. Twentieth Century British and American Poetry.
   5 units, given alternate years
160. The Minority Voice in Contemporary American Literature—See 60.
161. Forms of Afro-American Literature—See 61.
162. Chicano Literature—See 62.
162A. Contemporary Mexican Writers—(in translation.) See 62A.
163. Images of Women in Literature—See 63.
164. Introduction to Caribbean Literature: English, French, Spanish—(Same as Comparative Literature 164.)
   5 units, given alternate years
166. The English Bible as Literature—See 66.
167. Edda and Saga—See 67.
169. American Indian Mythology, Legend, and Lore—(Same as Comparative Literature 169.) See 68.
171. Chaucer.
   5 units, Aut (Ryan)
   Spr (G. Brown)
173A. Shakespeare—Intensive study of eight plays: Richard II, 1 Henry IV, Henry V, Merchant of Venice, Troilus and Cressida, Measure for Measure, Lear, Winter's Tale.
   Students may take any or all of the 173 series in any order.
   5 units, Aut (Rebholz)
   5 units, Win (Whitaker)
   5 units, Spr (Riggs)
189G. Critical Analysis—Students will join French students in an advanced course at the University of Tours for intensive study, in English, of an English or American writer.
   Limited to English majors and others specially qualified. To be taken winter term at the University of Tours, about October 15, 1973 to February 1, 1974. Stanford-in-France only.
   5 units (Le Moal)
190. Directed Writing: Fiction—Intermediate course. May be taken twice. Prerequisite: 90.
   5 units, Aut, Win, Spr, Sum (Staff)
190A. 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, Aut (L'Hérouex)
191. Advanced Exposition—Advanced course dealing with problems of writing expository prose. Prerequisite: 2 or the equivalent.
   3 units, Aut, Spr, Sum (Staff)
   5 units, Aut, Win (Staff)
   Spr (Middlebrook)
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 submit-
ted 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 elec-
tive requirements without permission.

Any quarter, by arrangement

196A. Junior Honors Seminar—Required of
all juniors in the English Honors Program.
5 units, Win (Polhemus)
Spr (Rebholz)

196B. Senior Honors Seminar—Required of
all seniors in the English Honors Program.
5 units, Aut (Mellor)

197. Senior Honors Essay.
15 units (during 2 quarters)
Aut, Win, Spr (Staff)

198. Individual Work—Advanced under-
grads 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 elec-
tive requirements without permission.
Group seminars are not considered appropri-
tate to English 198.

Any quarter, by arrangement

199. Senior Independent Study — Open, on
approval by the Department, to seniors ma-
joring in English who wish to work through-
out 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 in-
dependent study to the secretary of the De-
partment before preregistration in May of
their junior year. Each student who is ac-
cepted will be assigned to an instructor, with
whom he or she will prepare an appropriate
reading list before the end of the spring
quarter.
10–15 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 depart-
ments who wish to broaden their programs
will find many of these courses useful.

200A. Introduction to Old Norse—(Same as
German 200A.) Introduction to the lan-
guage; reading of selected texts.
5 units, Aut (Harris)

200B. Old Icelandic Sagas—(Same as Ger-
man 200B.) Study of the sagas; reading of
one or more in the original. Prerequisite:
200A.
5 units, Spr (Harris)

204. Principles of Standard English—(Same
as 104.)

205. Old English—Elements of Old English
grammar; critical reading of short poems and
selected prose in Old English.
5 units, Aut (G. Brown, Harris)

206. Middle English—Introduction to lan-
guage and style in the literature of the En-
GLISH High Middle Ages. No prerequisite;
205 suggested.
5 units, Win (Harris)

208. Post-Classical Latin—(Same as Com-
parative Literature 208 and Classics 208.)
Careful reading of Latin texts of graded diffi-
culty, 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, Aut (G. Brown)

210. Old English Poetry Exclusive of Beo-
wulf.
5 units, given alternate years

211. Readings in Medieval English Litera-
ture.
5 units, given alternate years

212A. Medieval to Renaissance: The Devel-
opment of Literary Forms.
5 units, given alternate years

212B. Continuation of 212A.
5 units, given alternate years
213. Literature of the Sixteenth Century.  
5 units, Win (Whitaker)

214. Literature of the Seventeenth Century: Backgrounds, Forms, Styles.  
5 units, given alternate years

215. Literature of the Eighteenth Century.  
5 units, given alternate years

216. Literature of the Nineteenth Century.  
216A. English Romantic Poetry and Prose.  
5 units, Aut (Ford)

216B. Victorian Poetry and Poetics.  
5 units, given alternate years

217A. The Bloomsbury Group.  
5 units, Win (Stone)

218A. The Culture of England, 1890–1914 —(Same as Comparative Literature 218A, History 244, and Modern Thought and Literature 218A.)  
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 — Faulkner, Ransom, Tate, Porter, Welty, O'Connor.  
5 units, Win (Gelpi)

231. The English Novel through the Eighteenth Century—Study of the most significant novels, with emphasis on development of the form.  
5 units, Spr (Watt)

232. The English Novel in the Nineteenth Century—Study of the most significant novels, with emphasis on development of the form.  
5 units, Spr (Polhemus)

233. The Twentieth Century English Novel.  
5 units, given alternate years

5 units, given alternate years

5 units, Win (Dekker)

235 and Modern Thought and Literature 261.) Advanced course in the critical analysis of impressionist masters (Conrad, Faulkner, Lowry), of major experimental novelists (Joyce, Kafka) and of several living writers (Hawkes, Barthelme, etc.). Lectures and discussion groups. For graduate students, honors candidates in English, and others specially qualified.  
5 units, Aut (Guerard)

237. Eighteenth Century Prose.  
5 units, given alternate years

238. Victorian Prose.  
5 units, given alternate years

5 units, Win (Loftis)

245. Drama of the Restoration and Eighteenth Century.  
5 units, Aut (Loftis)

250. The English Lyric.  
5 units, Aut (Staff)

5 units, Win (Trimpi)

254A. Some Eighteenth Century Poets.  
5 units, given alternate years

254B. Poetry and Ideas: Johnson to Blake —(Same as Modern Thought and Literature 254.)  
5 units, Win (Davie)

255. Form and Theme in the Modern English Lyric—The emergence and development of the Romantic lyric, Collins and Gray to Hopkins and Hardy.  
5 units, Aut (Dekker)

255A. Nineteenth Century Poetry as Myth-Making—Confronted with the historical disintegration of Christianity and the Great Chain of Being, nineteenth century poets were forced to use poetic language to shape their experiences into mythic structures. An examination of the personal myths constructed by Blake, Coleridge, Wordsworth, Shelley, Keats, Hopkins, Browning, and Yeats.  
5 units, Win (Mellor)

256. The Poet in America: 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 (Gelpi)

256B. American Poetry, 1900–1945.
5 units, Win (Gelpi)

256C. American Poetry, 1945 to the Present.
5 units, Spr (Gelpi)

257. Transcendental and Counter Transcendental: Six Nineteenth and Twentieth Century American Poets.
5 units, given alternate years

258. American Poetry since 1945.
5 units, given alternate years

259A. French Symbolist Poets and Some Americans—(Same as Comparative Literature 259A.) Baudelaire, Verlaine, Rimbaud, Mallarmé, and Valéry, with some American poets for comparison and contrast—for example two or three of the following: Poe, Tuckerman, Frost, Williams, Stevens, Winters, Roethke. Bi-lingual editions will be used; a reading knowledge of French is not absolutely necessary.
5 units, Spr (Fields)

259B. North American and Latin American Poetry — (Same as Comparative Literature 259B and Spanish 262.) What would it mean to speak of “American” poetry, and to relate the shared influences, the cultural sanctions, the nature of poetic expression in the U.S. and Latin America? In this country we have not, for various reasons, fully appreciated the relation. Whitman, Marti, W. C. Williams, Vallejo, Neruda, Lowell, Cardenal and others. Reading knowledge of Spanish required.
5 units, Spr (Felstiner, Franco)

260. The History of Literary Theory — (Same as Comparative Literature 260.)
5 units, given alternate years

262. Nietzsche and the Modern Novel— (Same as Comparative Literature 262 and Modern Thought and Literature 262.)
5 units, given alternate years

263A. Existential and Visionary Literature —(Same as Comparative Literature 263A and Modern Thought and Literature 263A.)
5 units, given alternate years

263B. The Existential Hero in Modern Literature—(Same as Comparative Literature 263B and Modern Thought and Literature 263B.)
5 units, given alternate years

264. The American Exiles—A study of some exiles in London (James to Pound) and some in Paris (Stein to Baldwin).
5 units, Spr (Williams)

265. The Feminine Mystique in American Fiction — (Same as Modern Thought and Literature 265.) The presentation of women in some American novels and short stories; also, women writers whose fiction chronicles the struggle toward self-hood.
5 units, Win (Martin)

266. Romantic Historical Literature—(Same as Comparative Literature 266.)
5 units, given alternate years

267. Gothicism in Literature and Art — (Same as Comparative Literature 267.) Introduction to the Gothic in medieval literature and art; study of Renaissance, eighteenth and nineteenth century revivals; theoretical questions about comparative study and the psychology of revivalism.
5 units, Aut (Bender)

269A. Toward an Understanding of Romanticism—(Same as Comparative Literature 269A and Modern Thought and Literature 269A.)
5 units, given alternate years

269B. Toward an Understanding of Modernism — (Same as Comparative Literature 269B and Modern Thought and Literature 269B.) Major currents in modern literature such as the Symbolist aesthetic, existentialism, myth, psychoanalysis, and new conceptions of nature and cultural history. Prerequisite: one course in modern literature, either English or European. Reading knowledge of French or German desirable.
5 units, Spr (Foster)

270. Beowulf—Reading and critical analysis of Beowulf, with some attention to other heroic poetry in Old English. Prerequisite: 205 or equivalent.
5 units, Win (Harris)

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, Spr (Evans)

277. Swift and Pope.  
5 units, Aut (Williams)

278. Johnson and His Circle.  
5 units, Spr (Fifer)

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)

282. Tennyson.  
5 units, Win (Stone)

284A. Emerson and Thoreau.  
5 units, given alternate years

284B. Emerson, Whitman, and Emily Dickinson.  
5 units, given alternate years

285A. Hawthorne and Melville.  
5 units, given alternate years

285B. Twain and James.  
5 units, given alternate years

287. Conrad and Faulkner.  
5 units, Spr (Moser)

288A. Joyce—Joyce’s essential work up to Finnegans Wake.  
5 units, Win (Chace)

288B. Virginia Woolf—A study of Virginia Woolf’s fiction, criticism, and her Bloomsbury environment.  
5 units, Win (Ruotolo)

289A. Eliot and Pound.  
5 units, given alternate years

289B. Yeats, Eliot, Neruda—(Same as Comparative Literature 289B.)  
5 units, given alternate years

291. Workshop in Creation and Criticism—  
(Same as Modern Thought and Literature 291.)  
3 to 5 units, given alternate years

293. Workshop in Verse Translation —  
(Same as Comparative Literature 293.) With the collaboration of foreign language departments. For qualified graduates and undergraduates: please see instructor during previous quarter.  
5 units, Win (Felstiner)

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 — (Same as Comparative Literature 311.)  
5 units, given alternate years

312. Seminar: Middle English Literature—Prerequisite: 206 or equivalent.  
5 units, Spr (Maxeiner)

313. Seminar: Methods and Textual Criticism in the Renaissance.  
1 unit, 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—Concentration on the theme of love in Shakespeare’s earlier comedies, *The Faerie Queene*, III and IV, Ovidian poetry, *Astrophil and Stella*, and Donne’s *Elegies* with readings and reports on the literary and philosophical background.  
5 units, Spr (Bender, Rebholz)

315. Literary Problems of the Restoration and Eighteenth Century—Prerequisite: 115 or 215, 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

315F. Seminar: The Enlightenment and Its Literary Traditions—(Same as Comparative Literature 315F and Modern Thought and Literature 360.)  
5 units, given alternate years

316. Literary Problems of the Romantic Period—Prerequisite: 117 or 216, or equivalent treatment of Romantic period.

316A. Seminar: Romanticism and Romanti-cisms.  
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 363.) An attempt to define the notion of Romantic Irony by studying the theoretical formulations of F. Schlegel, Schiller, and Coleridge and the ways in which such a philosophical attitude determines the structure and content of the poetry of Blake, Coleridge, Shelley, Byron, Keats, and Yeats, and the novels of Lewis Carroll, Virginia Woolf, and Joyce Cary.  
5 units, Spr (Mellor)

317. Literary Problems of the Nineteenth and Twentieth Centuries—Prerequisite: 117 or 216, or equivalent.

317A. Seminar: The Bloomsbury Group.  
5 units, given alternate years

317B. Seminar: The Nineties.  
5 units, given alternate years

5 units, Win (Martin)

322. Problems of Nineteenth and Twentieth Century American Literature.  

5 units, given alternate years

332. Seminar: Nineteenth Century Comic Fiction.  
5 units, given alternate years

5 units, Aut (Ruotolo)

5 units, given alternate years

335. Seminar: The Modern Novel—(Same as Comparative Literature 335.)  
5 units, given alternate years

5 units, given alternate years

335B. Seminar: British Poetry Since Hardy.  
5 units, Win (Davie)


5 units, given alternate years

339. Seminar: Rediscovered Poets: 1900–1940—A study of some important neglected poets, both American and English, and the movements with which they were associated. To include Louise Bogan, Janet Lewis, Mina Loy, Alice Corbin, Adelaide Crapsey, Elizabeth Madox Roberts, Alice and Viola Meynell, and others. We will consider the influence of French, Oriental, and American Indian poetry, as well as Imagism and the Metaphysical Revival.  
5 units, Aut (Fields)

360A. Seminar: History of Literary Theory: Ancient—(Same as Comparative Literature 360A.)  
5 units, given alternate years

360B. Seminar: History of Literary Theory: Medieval/Renaissance—(Same as Comparative Literature 360B.) Prerequisite: 360A.  
5 units, given alternate years

360C. Seminar: Neoclassicism: Origins and Later Developments—(Same as Comparative Literature 360C.) This seminar, by investigating further relationships between Horace and Longinus and their background, will seek a redefinition of the concept of
Neoclassicism in the sixteenth, seventeenth, and eighteenth centuries
5 units, Win (Trimpi)

361. Seminar: The Modern Tradition — (Same as Comparative Literature 361 and Modern Thought and Literature 361.) Introduction to the interdisciplinary study of modern thought and literature with emphasis on such modern developments as structuralism, phenomenology and Marxism.
5 units, Spr (Halliburton)

362A. Seminar: Psychology and Literature — (Same as Modern Thought and Literature 362A.)
5 units, given alternate years

362B. Seminar: Problems of Psychological Interpretation — (Same as Comparative Literature 362B and Modern Thought and Literature 362B.)
5 units, given alternate years

364. Topics in British Literature.

364A. Seminar: Literature of World War I.
5 units, given alternate years

364B. Seminar: Capitalism and Literature in the Nineteenth Century — (Same as Modern Thought and Literature 364B.) The theme of money in Victorian and Edwardian fiction with glosses from some works of psychology, anthropology and economics (Freud, Marx, Keynes, Veblen, etc.).
5 units, Spr (Stone)

365. Topics in American Literature.

365A. Seminar: The Landscape in American Literature — (Same as Modern Thought and Literature 365A.)
5 units, Win (Momaday)

365B. Seminar: American Historical Romance — Theory and practice of historical romance by Cooper, Hawthorne, and their contemporaries.
5 units, Spr (Dekker)

365C. Seminar: Studies in American Fiction, 1940–1974 — Ideas, themes, and forms in such novelists as Warren, Bellow, Ellison, Mailer, Heller, Nabokov, O'Connor, Barth, Updike, Pynchon, and Doctorow, with attention to the traditions of American fiction and to some immediately contemporary writers.
5 units, Spring (Solomon)

368. Topics in Criticism.

368A. Seminar: American Cities — (Same as Comparative Literature 368.)
5 units, given alternate years

369. Seminar: Major Modern Critics — (Same as Comparative Literature 369 and Modern Thought and Literature 369.) Reading and discussion of critical writings and theories of influential modern figures such as Auerbach, Kenneth Burke, Spitzer, and Lukács. Emphasis on twentieth century (e.g., existentialism, structuralism, Marxism), but course will also place modern critics in tradition beginning with Aristotle.
5 units, Aut (Halliburton)

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, Aut (Whitaker)

376. Seminar: Milton.
5 units, given alternate years

382. Seminar: Pater and the Pre-Raphaelites.
5 units, given alternate years

385. American Authors of the Nineteenth and Twentieth Centuries.

385A. Seminar: T. S. Eliot.
5 units, given alternate years

385B. Seminar: Pound.
5 units, Aut (Gelpi)

385C. Seminar: Wallace Stevens.
5 units, given alternate years

385D. Seminar: William Carlos Williams.
5 units, given alternate years

5 units, Win (Moser)

387. Seminar: James, Conrad, and Ford.
5 units, given alternate years

388. British Authors of the Nineteenth and Twentieth Centuries

388A. Seminar: Conrad.
5 units, given alternate years

388B. Seminar: Virginia Woolf and Her Circle.
5 units, given alternate years

390. Advanced Fiction Writing — A work-
shop 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.

3 to 5 units, Aut (Guerard)
Win, Spr (L’Heureux)

391. Advanced Work in Writing and Criticism.
Any quarter, by arrangement

392. The Writing of Poetry — Primarily for students seriously interested in the composition of poetry. May be repeated for credit. Prerequisite: consent of instructor.
3 to 5 units, Aut, Win (Fields)
Spr (Davie)

393. Workshop in Verse Translation — (Same as Comparative Literature 393.) In collaboration with foreign language departments. Graduate students and qualified undergraduates. Prerequisite: consent of instructor.
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 Writing—A short seminar for first-year graduate students and other prospective teachers of Freshman Writing. 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 Writing)

396A. Teacher’s Workshop—Discussion of the methods new teachers of Freshman Writing are using in their classes and evaluation of the effectiveness of those methods. Consideration of ways of improving the teaching of writing. Open for credit to graduate students teaching Freshman Writing for the first time; experienced teachers may attend informally.
5 units (2 to 4 by special arrangement),
Win, Spr (Director and Teaching Administrator)

397. 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 Writing for the first time.
5 units (2 to 4 by special arrangement),
Aut (Director 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

The following courses, listed separately in this catalog under Modern Thought and Literature, may be of interest to graduate students in English:

Modern Thought and Literature 229. Politics, Society, and Art in Modern European History.


Modern Thought and Literature 246. Language and Social Interaction.

Modern Thought and Literature 260A,B. “Modernisms.”

Modern Thought and Literature 270. Modern Critical Thought: The Symbolist Heritage.


Modern Thought and Literature 337. European Intellectual History Since the Enlightenment.
Modern Thought and Literature 385.
Seminar: Freudian Theory.
For additional offerings in literature, see Comparative Literature.

Courses Offered Overseas

80H. France and England in the Twelfth Century—(Taught at Stanford in France.)
4 units, Aut (E. Brown)

81H. France and England at the Close of the Middle Ages—(Taught at Stanford in France.)
4 units, Win (E. Brown)

173A. Shakespeare—(Taught at Stanford in Britain.)
3 to 5 units, Aut, Win (Riggs)

180B. Medieval Epic and Romance—(Taught at Stanford in France.)
4 units, Aut (E. Brown)

180C. Politics and Drama in Elizabethan England—(Taught at Stanford in Britain.)
5 units, Aut, Win (Riggs)

180G. Confrontations with Italy in English and American Writers—(Taught at Stanford in Italy.)
4 units, Win (Lindenberger)

181B. The Medieval Lyric—(Taught at Stanford in France.)
4 units, Win (E. Brown)

181E. Hardy and Conrad—(Taught at Stanford in Britain.)
5 units, Sum (Moser)

182E. Forms of the English Novel—(Taught at Stanford in Britain.)
3 to 5 units, Sum (Moser)

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

Senior Lecturer: John G. Barson

Assistant Professor: Josué V. Harari (French and Comparative Literature)

Lecturers: Marguerite Bauer, Clio P. Dorr, Jacqueline Ollivier.

Italian Division

Assistant Professors: Michael Leone (on leave spring quarter 1974); Acting: Paolo Braghieri

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. Regularly given 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 two 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
Stylistique
Phonétique et Orthoépie
Histoire de la langue française depuis le Moyen Age
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 student's 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 jointly consider all applications for admission to the program.

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 be counted towards 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 Tours

Each year French majors, in their sophomore or junior year, as well as other students with an adequate command of the French language, may apply for the Departmental program at the University of Tours during the following autumn and winter quarters. Students reside in the Cité Universitaire, attending courses both at the University and with the faculty supervisor who accom-
companies the group. Applications must be received by April 15. Forms and information may be obtained from the Department.

**INTENSIVE 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. Those students who need work in conversation, as determined by the Director of Studies at the Tours campus, will be required to take a language course or have equivalent training in conversation for the first quarter, and possibly the second quarter of the session overseas. All courses in language bear the designation French 80 or 90 with the successive levels indicated as a second digit. Assignment to a particular level is made by the Director of Studies and language faculty at the campus.

**ITALIAN**

**Bachelor of Arts in Italian**

This major is oriented toward a concentration in 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 their equivalent among courses taken at the Florence campus), 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 campus through directed work (in Italian and/or in the above mentioned disciplines) arranged by the students with their advisers. Although attendance at the Florence campus 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 LANGUAGE 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. Those students who need work in conversation, as determined by the Director of Studies at the Florence campus, will be required to take a language course or have equivalent training in conversation for the first quarter, and possibly the second quarter of the session overseas. All courses in language bear the designation Italian 80 or 90 with the successive levels indicated as a second digit. Assignment to a particular level is made by the Director of Studies 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>Units</th>
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<tr>
<td>French 210. Problèmes de l'expression écrite</td>
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<tr>
<td>French 211. Phonétique et orthographe</td>
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<tr>
<td>French 212. Histoire de la langue française depuis le Moyen Age</td>
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<tr>
<td>French 289. Méthodologie</td>
</tr>
<tr>
<td>French 292. Du Classicisme à l'Age des Lumières</td>
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<tr>
<td>French 293. Du Romantisme à nos jours</td>
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<tr>
<td>One course from the Civilization series</td>
</tr>
<tr>
<td>French 290. Du Siècle de Louis XIV à la Révolution or French 291. De la Révolution à l'époque contemporaine</td>
</tr>
<tr>
<td>Two electives from courses numbered above 200</td>
</tr>
<tr>
<td>Total</td>
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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 occasionally 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 M.A. 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: 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 may be 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**

103. The Nineteenth Century French Novel
   —The major novelists of the century, includ-
ing Stendhal, Balzac, Hugo, Flaubert, Huysmans, and Zola.

3 to 4 units (Giraud) given 1974–75

104. Contemporary French Novelists—Significant authors of contemporary France: Proust, Gide, Malraux, Sartre, Camus, etc. Lectures, readings in English.

3 units, Win (Cohn) TTh 11

105. The Writings of Albert Camus.

3 units, Spr (Cohn) TTh 11

106. The Fictional and Critical Writings of Sartre.

3 units (Cohn) given 1974–75

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.)

3 to 4 units, Win (Giraud)

108. The Committed Writer in France from Montesquieu to Sartre — Literary writers who have incorporated a political or social point of view in their fictional works: Montesquieu, Voltaire, Stendhal, Anouilh, Sartre. Background reading in modern and intellectual French history.

3 units (Weinstein) given 1974–75

109. The Don Juan Legend in Literature and Music—(Same as Comparative Literature 109.) Reading and discussion of Don Juan versions by Tirso de Molina, Molière, Mozart, Grabbe, Musset, Zorrilla, Montherlant, Frisch, and interpretations by Stendhal, E.T.A. Hoffman and Kierkegaard.

5 units, Aut, Win, Spr (Staff) MTWThF

110. Le frangais sans complexes — (Supplement du Frangais 2.) Cours de conversation au niveau linguistique du Frangais 2. Prerequisite: 1 or equivalent.

3 units, Aut, Win (Staff)


4 units, Aut (Harari) TTh 3:15–4:30

116. The Fate of Modern Fiction—(Same as Comparative Literature 116.) Has fiction become a critical discourse using literary techniques or a literary discourse using critical techniques? Readings from Borges, Cortazar, Calvino, Landolfi, Beckett, Leiris, Nabokov, and Barth.

4 units (Harari) given 1974–75

117. “Literary” Criticism and Structural Analysis—(Same as Comparative Literature 117.) A critical appraisal of structuralist and post structuralist thought: Barthes, Deleuze, Derrida, Foucault, Girard, Levi-Strauss, and others.

4 units, Spr (Harari) TTh 3:15–4:30

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 22, 24, 26, and October 1 (for autumn quarter); November 19, January 7 and 9 (for winter quarter); February 26, April 1 and 3 (for spring quarter); May 21 (for summer and autumn quarters). The placement test is not given in the summer.

1. Initiation au français—Etape 1 — 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) MTWThF


5 units, Aut, Win, Spr (Staff) MTWThF

25. Le français sans complexes — (Supplément du Français 2.) Cours de conversation au niveau linguistique du Français 2. Prerequisite: 1 or equivalent.

3 units, Aut, Win (Staff)


5 units, Aut, Win, Spr (Staff) MTWThF

35. Coup d’oeil 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.

3 units, Aut, Win (Hester)

5. Intensive French for Beginners—(Equivalent to 1, 2 and 3.) A rationalist direct method stressing simultaneous acquisition of listening, speaking, writing, and reading skills, introduces students to the essentials of first-year grammar and vocabulary. Classes are conducted entirely in French, with oral presentation immediately reinforced in small group conversation sections. Written exercises, original compositions, and daily work in the Language Laboratory are also an integral part of the course.

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.

3 units, Aut, Spr (Staff) MWF 8

20. L'art de la conversation — Le français dans les situations de la vie de tous les jours. Prerequisite: French 3 or equivalent.

3 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 discuteront 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. Revue complète de grammaire essentielle, lectures choisies de genres différents, et discussions. Correspond au Français 22 et 23. Prerequisite: one year of college French or equivalent. Two extra units offered for individual work.

6 to 8 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.

3 units, Aut, Win, Spr (Staff)

80-90. Intensive 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 (——) TTh

123. Composition, grammaire et étude de textes—Convergences et divergences de la langue orale et écrite, grammaire descriptive, analyse logique, analyse grammaticale. Prerequisite: 24 or equivalent.

3 units, Aut (Ollivier) MWF 9

124. Langue, style et écriture — Continuation du Français 123. Le commentaire littéraire, les styles de la critique, composition originale.

3 units, Win (Bauer) 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 (Newman-Gordon) MWF 10

Literature Courses

For literature courses in English, see also General Courses, page 323.
130. L'Amour, la société et la rébellion —
Etude générale de la littérature française du roman courtois du Moyen-Age jusqu'à l'essai philosophique de la Renaissance (Chrestien de Troyes, Villon, poètes du 16ème siècle, Rabelais, Montaigne). Prerequisite: 24 or equivalent.

3 units, Aut (Hester) MWF 1:15

131. La Liberté, la volonté et la passion—
Etude 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.

3 units, Win (Harari) TTh 3:15-4:30


3 units, Spr (Bertrand) MWF 11

Note — Prerequisites for the following courses are normally 130, 131, and 132, or 85 and 86, or equivalent.

135. Introduction à la poésie française —
Analyse et étude de poèmes choisis, thèmes, images, versification, technique descriptive, depuis le 16ème siècle jusqu'à nos jours.

4 units (Lapp) given 1974-75

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)


4 units (Lapp) given 1974-75


4 units (Lapp) given 1974-75


4 units, Spr (Weinstein) MTTh 2:15

152. La Muse comique; le rire au 17ème siècle—Corneille, Le Menteur; Racine, Les Plaideurs; Molière, Le Malade imaginaire, Le Tartuffe, Dom Juan.

4 units (Lapp) given 1974-75

153. Voyages, utopies et tradition philosophique au 18ème siècle—Récits de voyage et philosophie; dimension morale, idéologique et politique de la société du 18ème siècle. Fénélon, Montesquieu, Diderot, Voltaire, Crébillon, Laclos et Rousseau.

4 units (Harari) given 1974-75

169. Problems of Narrative in Eighteenth Century Fiction — (Same as Comparative Literature 169.) The logic and organization of narrative discourse in the works of Defoe, Fielding, Smollet, Sterne, Montesquieu, Prevost, Voltaire, Diderot, and Laclos. Readings in the original, discussions in English.

4 units (Harari) given 1974-75

170. Le Romantisme: Révolution et Innovation — Développement d'une nouvelle esthétique et du concept de modernité chez les romantiques français. Lectures de textes de Mme de Staël, Stendhal, Victor Hugo, Vigny, Gautier, Balzac, Baudelaire et d'autres.

4 units (Giraud) given 1974-75


4 units, Aut (Giraud) MWF 10

173. Symbolism — Characteristic poems of Baudelaire, Mallarmé, Rimbaud, and Verlaine will be discussed in the context of the late 19th-century literary and artistic climate in France. Lectures in English; readings in French.

4 units, Spr (Cohn)

175. Le Théâtre au 19ème siècle—Lectures principales: Dumas père, Hugo, Vigny, Musset, Dumas fils, Augier, Becque, Rostand.

4 units (Weinstein) given 1974-75
180. La Poésie française du Symbolisme au Surréalisme.  
4 units (Newman-Gordon) given 1974–75

181. Le Théâtre français au 20ème siècle.  
4 units (Newman-Gordon) given 1974–75

187. Poètes de notre temps—Michaux, Char, Prévert, Supervielle, Reverdy, Léon-Paul Fargue.  
4 units, Aut (Newman-Gordon) MWF 11

188. Le Surréalisme—Définition du Surréalisme à travers les Manifestes d’André Breton. Etude de poèmes et de romans surréalistes par A. Breton, Soupault, Eluard, Aragon, J. Gracq.  
4 units (Newman-Gordon) given 1974–75

189. Le roman comme “point de vue sur les choses”—Alain Fournier, Proust, Mauriac, Sartre, Nathalie Sarraute.  
4 units, Win (Newman-Gordon)

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, Win (Giraud)

192. 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) MWF 2:15

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

205. Le français moderne—Le système phonétique français; valeur (voyelles ouvertes et fermées); quantité (syllabes normales, courtes et longues); liaisons et enchâinement; la question de l’e muet; comparaison de la prononciation française et anglaise; la grammaire: tendances analytiques et synthétiques; l’ordre des mots; l’adjectif (morphologie et syntaxe).  
3 units (Juilland) given 1974–75

4 units, Aut (Bertrand) MWF 1:15

211. Phonétique et Orthographe — Etude théorique et travaux correctifs: articulation, rythme, intonation. Pédagogie de la graphie traditionnelle et de la graphie phonétique. Prerequisite: 24 or equivalent.  
4 units, Spr (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, Win (Juilland) Th 2:15–4:05

4 to 5 units (Cohn) given 1974–75

283. Individu et société dans le roman français contemporain—De La Peste de Camus au “roman de contestation” actuel.  
4 units (Bertrand) given 1974–75

289. Methodology Course — Analysis and discussion of classroom practices and related pedagogical material in the context of the rationalist direct method of teaching French language.  
4 units, given 1974–75

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, Win (Bertrand)

291. De la Révolution à l’époque contemporaine.  
4 units, Spr (Bertrand)
GRADUATE COURSES

292. (A.M. Program. Open also to advanced Undergraduates) Du Classicisme à l'Âge des Lumières — Les transformations du Classicisme dans les genres littéraires: de Corneille à Voltaire, de Mme de La Fayette à Choderlos de Laclos, de Pascal à Diderot, de La Fontaine à Chénier.

4 units, Aut (Weinstein) M 2:15-4:05

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, Spr (Newman-Gordon) MWF 1:15

310. Introduction to Romance Linguistics—Archaic Latin; Classical Latin; Vulgar Latin; source of knowledge; ancient, modern inscriptions; authors; borrowings; the comparative method; formation of the Romance languages; classification of Romance languages and dialects; earliest Romance literary monuments.

4 units (Juilland) given 1974-75

311. Introduction to Medieval Literature—Study of five masterpieces of medieval French literature from the perspective of modern criticism. No prerequisite.

4 units, given 1974-75

315. Grammaire historique de la langue française.

3 units (Juilland) given 1974-75

335. The Fifteenth Century.

4 units, given 1974-75

341. La Renaissance en France I — Les Proseateurs; Rabelais et Montaigne.

4 units (Hester) given 1975-76

342. La Renaissance en France II — Les poètes de la Pléiade et les poètes baroques de la fin du 16ème siècle.

4 units (Hester) given 1974-75

343. La Poésie de la Renaissance avant la Pléiade—Les Rhétoriqueurs, Marguerite de Navarre; les poètes de Lyon: Scève, Louise Labé, Pontus de Tyard.

4 units (Hester) given 1975-76

350. Graduate Seminars.

Medieval Allegory.

4 units, given 1974-75

Rabelais.

4 units, Spr (Hester)

Montaigne.

4 units (Lapp) given 1974-75

Stendhal.

4 units, Spr (Weinstein) W 2:15-4:05

Balzac.

4 units (Weinstein) given 1974-75

Flaubert.

4 units (Giraud) given 1974-75

Mallarmé.

4 units, Win (Cohn) given 1974-75

Baudelaire.

4 units (Cohn) given 1974-75

Rimbaud.

4 units (Cohn) given 1975-76

351. La Poésie de Malherbe à La Fontaine.

4 units (Lapp) given 1975-76

353. Le Théâtre classique française—Corneille, Molière, Racine.

4 units, Win (Weinstein) T 2:15-4:05


4 units, Aut (Harari) M 7-9 pm

369. Idéologie et technique romanesque au 18ème siècle—(Same as Comparative Literature 370.) Lectures of Montesquieu, Prévost, Marivaux, Fielding, Sterne, Diderot, Voltaire, Laclos, Rousseau and Sade.

4 units (Harari) given 1974-75


4 units (Weinstein) given 1974-75

372. The Symbolist Poets.

4 units (Cohn) given 1974-75

373. La Critique littéraire au 19ème siècle—Sainte-Beuve, Taine, Brunetière.

4 units (Weinstein) given 1974-75

379. La doctrine de l'Art pour l'Art et la littérature sociale au 19ème siècle.

4 units, Aut (Giraud)
380. La “grande génération”—Proust, Gide, Péguy, Claudel, Romain Rolland, Valéry.
   4 units (Newman-Gordon) given 1974–75

381. Proust.
   4 units, Aut (Newman-Gordon)
   F 2:15–4:05

   4 units, Spr (Giraud)

   4 units (Newman-Gordon) given 1974–75

388. Apollinaire—Alcools et Calligrammes.
   4 units (Newman-Gordon) given 1974–75

   4 units (Bertrand) given 1974–75

   4 units, Win (Bertrand)

398. Tutorials—Initiated by a professor, Tutorials are intended for at least three (but preferably more) graduate students who wish to study on an informal basis a subject 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

2. First-Year Italian—(Continuation of 1.)
   5 units, Aut, Win, Spr (Staff) MTWThF

2A. L’Italia d’Oggi—Introduction to Italian life. Conversation and lectures on various aspects of contemporary Italy (polities, art, cinema, press, customs). Especially designed for students who plan to go to Italy. Prerequisite: Italian 1.
   3 units, Win, Spr (Staff)

3. First-Year Italian — A grammatical and linguistical approach to Italian through contemporary readings (short stories or novels) or viewing and studying of films and their scripts.
   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

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 (Napolitano) 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 (Staff) MWF

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 (Staff) MWF

Note: Italian 51, 52, 53 are offered for 3 units. May be taken for 4 units by arrangement with instructor.

80–90. Intensive 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

140. Dante, *The Divine Comedy* — Reading and discussion of the *Inferno* and *Purgatorio*, with selected cantos from the *Paradiso*. In Italian.
4 units, Spr (Leone) MWF

141. Dante, *The Divine Comedy* — (In English.)
4 units, Aut (Leone) MWF

143. The Courtly Tradition and its Relationship to Italian Medieval Literature.
4 units, Spr (Leone) MWF

146. Love Sacred and Love Profane—Boccaccio's *Decameron* and the tradition of the "Novella"; Petrarca's love in the *Canzoniere* and the *Secretum*; the Petrachist tradition.
4 units, Win (Leone) MWF

4 units, Aut (Braghieri)

4 units, Win (Braghieri)

163. The Courtly Game of Knighthood in Renaissance Chivalric Poetry — The heroic aspirations of a no longer heroic society as mirrored and ironized in such works as Pulci’s *Morgante*, Boiardo’s *Orlando Innamorato*, Ariosto’s *Orlando Furioso*, and Tasso’s *Gerusalemme Liberata*. In English.
4 units, Spr (Braghieri)

171. Literature of the Italian Romanticism — The course will examine late 18th and 19th Century Italian literature and its relationship to European romanticism (Alfieri, Foscolo, Leopardi, Manzoni, Mazzini, etc.). In Italian.
4 units, Spr (Braghieri)

180. The Anguish of Sexuality as an Expression of Modern Alienation — Examination of the sexual phenomenon as reflected in the works of major contemporary Italian novelists (Svevo, Moravia, Pavese, Bassani, Soldati, Parise, etc.).
4 units, Win (Leone) MWF

181. Currents and Protagonists of 20th Century Italian Literature — Presentation and analysis of significant poets and novelists viewed in relationship to the major literary movements from Futurism to Neorealism.
4 units, Aut (Braghieri and Leone) MWF

187. The Loss of the Self in Modern Theatre — (Same as Comparative Literature 187.) In English.
4 units, Win (Braghieri)

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

Teacher Training Courses

288. Methods of Teaching French—(Same as Education 288.)
3 units, Win (Politzer) W 4:15–6:05
and 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
Associate Professor: Joachim Bark. Acting: Arnold Heidsieck
Senior Lecturer: Gertrude Mahrholz
Lecturers: Peter R. Frank (Curator, German Collection, Stanford Library), Josef Hutschenreiter, Ulrike Lieder

Offerings and Facilities

The Department accepts candidates for the degree of Bachelor of Arts, Master of
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 Studies and Humanities. For a description of the requirements, see the section "Graduate Program in Humanities" in this bulletin.

GRADUATE PROGRAM IN HUMANITIES
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.

Intensive Language Work Abroad
Each undergraduate student accepted by the Overseas Campuses Program for work at a Stanford center in Germany may complete up to 12 units of German during the six-months of his or her residence in Europe. The work is primarily designed to develop the student's ability to understand, speak, and read German, but courses are given at various levels. All German courses are taken at the Stanford center and are identified by the number 80, indicating the level at which the courses were taken. Course identification may vary from 80.1 to 80.12. A student majoring in German will have the work taken abroad evaluated on his or her return in terms of the specific degree requirements.

Stanford-Bonn Program
The University maintains a program in Bonn, Germany, for the benefit of advanced students majoring in German or in such programs as Art History, Musicology, etc. To participate, students majoring in German or in humanities and science fields as Art History, Musicology, Political Science, History, Economics, Anthropology, Comparative Literature, etc. are chosen from courses offered by the University of Bonn. All candidates may also take part in the program. Majors in German Studies and Philosophy may enroll for two quarters. While in Bonn, they can complete specific course requirements as well as a number of elective courses. The latter may vary from 60.1 to 60.12. A student majoring in German will have the work taken abroad evaluated in terms of the specific degree requirements.

PROGRAMS OF STUDY
BACHELOR OF ARTS
After completion of the courses offered for first and second-year students (1, 2, 3, 51, 52, 53), majors in German normally select, with the help of their adviser, a minimum of 25 units of German courses beyond the 52 level, with a minimum of 12 units at the 80 level. A student majoring in German will have the work taken abroad evaluated on his or her return in terms of the specific degree requirements. All majors are required to take the Undergraduate Record Examination.

Students interested primarily in German as a language should take the language work listed under "Advanced and Graduate Courses." Students concentrating in German literature must take the complete 150-series, in sequence if possible. Students interested in German thought should take the "German Thought" courses, and one Senior Seminar. The aim of this program, which permits maximum efficiency, is to allow students to plan a more broadly based major than in any one of the other areas of concentration without limiting their choices exclusively to that area.

1. German Language: Students interested primarily in German as a language should take the language work listed under "Advanced and Graduate Courses." Students concentrating in German literature must take the complete 150-series, in sequence if possible. Students interested in German thought should take the "German Thought" courses, and one Senior Seminar. The aim of this program, which permits maximum flexibility, is to allow students to plan a more broadly based major than in any one of the other areas of concentration without limiting their choices exclusively to that area.

2. German Literature: Students concentrating in German literature must take the complete 150-series, in sequence if possible.

3. German Thought: Students interested in German thought should take the "German Thought" courses, and one Senior Seminar.

4. German Studies: The aim of this program, which permits maximum flexibility, is to allow students to plan a more broadly based major than in any one of the other areas of concentration without limiting their choices exclusively to that area.
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 student will write an essay representing six to nine units of academic work. This essay will be on a topic chosen by the student in consultation with a faculty member in the department.

Certificates in Translation and Interpretation

Study leading to the award of a certificate in translation or a certificate in translation and interpretation may be combined with degree programs (A.B. and A.M.) in any subject matter area. The program provides students with an ancillary skill in the practice of their professions. The requirements for the Certificate in General Translation (with A.B.) may be met by completing all translating courses through the 200T-series and for the Certificate in Advanced Translation and/or Interpretation (with A.M.) by continuing in the 300T-series. The program should normally be started in the sophomore year. Each student will participate in at least one Stanford Overseas Program. In his or her final year, the student will produce an original translation of a literary or documentary work.

Master of Arts

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 36 units of graduate work. If students enroll for three quarters for a minimum of 12 units per quarter, they can fulfill the A.M. requirements in one year—which they are strongly advised to do. The A.M. program must include:

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<th>Units</th>
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<tr>
<td>201 and 202. Language and Style</td>
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<tr>
<td>300. Proseminar</td>
</tr>
<tr>
<td>302. Methods of Teaching German</td>
</tr>
<tr>
<td>Two courses in German literature</td>
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<tr>
<td>Two courses in German thought</td>
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<td>Total</td>
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In addition, students must take 10 units of graduate level courses in German and/or approved courses in related fields, such as Linguistics, Comparative Literature, Philosophy, History, or History of Art. Students concentrating in German Studies should choose these related courses in the Central European field, in such departments as: Political Science, Economics, Anthropology, History.

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.

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. However, 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. During the first year at Stanford, all graduate students will be given the MLA-Cooperative Foreign Language Proficiency Tests (designed for teachers and advanced students) to give them an indication of their achievement in listening-comprehension, speaking, reading, and writing. The Department expects all of its Ph.D. candidates to demonstrate teaching proficiency in German. Experience shows that this takes at least a year of supervised teaching; very often it takes longer. All graduate students are also strongly advised to start developing skill in the teaching of literature by participating, on a voluntary basis, in teaching of the 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 who plan to continue through the Ph.D. normally take the following program:

<table>
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<tr>
<th>Units</th>
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<tbody>
<tr>
<td>201 and 202. Language and Style</td>
</tr>
<tr>
<td>205. Introduction to Modern German</td>
</tr>
<tr>
<td>228. Middle High German</td>
</tr>
<tr>
<td>241. Deutsche Geistesgeschichte I</td>
</tr>
<tr>
<td>242. Deutsche Geistesgeschichte II</td>
</tr>
<tr>
<td>300. Proseminar</td>
</tr>
<tr>
<td>Two courses in German literature</td>
</tr>
<tr>
<td>One seminar (325, 350, or 400)</td>
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<td>Total</td>
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</table>

Electives chosen from graduate level courses in German or approved courses in re-
lated fields may be added if the student desires.

1. Concentration in Language Studies

Students choosing this concentration will specialize in such fields as: the older dialects and medieval literature, comparative diachronic linguistics centering on early Germanic dialects, linguistics and language teaching. Detailed plans of study are available on request.

2. Concentration in Literature

Students concentrating in Literature will take, during the spring quarter of their second year, 302. Methods of Teaching German. The other course requirements are: a minimum of two courses or seminars per quarter for at least four of the six quarters following the first year. The Department will make a strong attempt to arrange the offerings in Literature each quarter around such epochs as Von der Mystik zum Barock, Von der Aufklärung zur Klassik, Von der Romantik zum Realismus, Probleme des Modernismus. The lecture courses are not survey courses but introductions to topics within these epochs. 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 his or her first year, will require research papers.

By carefully planning their programs, students may choose to participate in the Graduate Humanities Program, in the Comparative Literature Program, or in the Modern Thought and Literature Program, and work toward a Ph.D. in German Studies and Humanities, German Studies with a minor in Comparative Literature, or German Studies with a minor in Modern Thought and Literature. Usually such programs require more than a total of 9 quarters of course work.

3. Concentration in German Thought

After completing the requirements for the first year, students concentrating in German Thought will take 302. Methods of Teaching German in the spring quarter of the second year. The other requirements are a minimum of two courses per quarter, including four courses or seminars in the 351–375 and 376–400 series, and four additional courses or seminars from the 326–350 and 376–400 series. Seminars, of which the student is expected to take a minimum of two after his first year, will require research papers. Students are advised to take some electives outside the Department.

By carefully planning their programs, students may choose to participate in the Graduate Humanities Program, in the Comparative Literature Program, or in the Modern Thought and Literature Program, and work toward a Ph.D. in German Studies and Humanities, German Studies with a minor in Comparative Literature, or German Studies with a minor in Modern Thought and Literature. Usually such programs require more than a total of 9 quarters of course work.

GENERAL COURSES

(65A–290A, 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 requirement must do the assigned readings in German.

65A. Medieval Culture: An Interdisciplinary Introduction — (Same as English 65, 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 between them. Lectures by faculty from various departments and sections conducted by the faculty listed.

5 units, Win (Langmuir, Snow) MTW 10 and W or Th 2:15–4:05

120A. Politics and Literature in East and West Germany.

3 units, given 1974–75

122A. Nietzsche.

3 units (Mason) given 1975–76

124A. 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 1974–75

126A. Contemporary German Literature.

3 units, Aut (Flores) MWF 11

130A. Brecht and the Modern Drama—The place of Brecht's dramatic theory and practice in the development of the modern dra-
ma. Ibsen, Strindberg and Expressionism, Pirandello, Brecht, Beckett and the Theater of the Absurd.

2 units, Spr (Flores) MWF 11

131A. Faust in Legend and Literature.
5 units, Aut (Foulkes) given at Stanford-in-Germany

134A. Art and Utopia — Thematic reading and discussion of specific works from Kant and Schiller to Freud and Marcuse which deal with the dynamic function of aesthetics in political theory.
3 units (Flores) given 1974-75

137A. Nazism and Literature—Reading and discussion of the thematic treatment of Nazism and its aftereffects in fiction, drama, and poetry by such writers as Thomas Mann, Brecht, Frisch, Böll, Grass, Rolf Hochhuth, Nelly Sachs, Paul Celan, Peter Weiss, and Jakov Lind. Analysis of the impact of Nazism on postwar literature and culture.
3 units (Mason) given 1974-75

140A. University Reform in West Germany.
3 units, Aut (Foulkes) given at Stanford-in-Germany

149A. Critical Approaches to Modern German Culture.
4 units, Win (Bark) given at Stanford-in-Germany

179A. National Socialism: Its Roots, Development, and Political System.
3 units, Win (Bark) given at Stanford-in-Germany

251A. The Faust Legend from Simon Magus to I.A. Richards.
4 units per quarter, Win-Spr (Exner) MWF 10

GERMAN COURSES
UNDERGRADUATE COURSES
(1-199)

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 had any work in German before entering Stanford.

1. First-Year German.
5 units, Aut, Win, Spr (Staff)

1P. First-Year German — Individually programmed beginning German. Students proceed at their own speed.
3 to 15 units, Aut, Win, Spr (Staff)

2. First-Year German—Continuation of 1.
5 units, Aut, Win, Spr (Staff)

2B. German Conversation — (For students going to Beutelsbach; open to others.) Prerequisite: 1.
3 units, Aut (Staff) MWF 10 Spr (Staff) MWF 10

3. First-Year German—Continuation of 2.
5 units, Aut, Win, Spr (Staff)

5. Intensive First-Year German—Equivalent of 1, 2 and 3 combined. Enrollment limited.
12 units, Sum (Staff) MTWThF 8:00-9:30 and 10:30-12:00

10. Elementary German for Seniors and Graduate Students — An accelerated course for beginners who want to learn how to read expository German. No auditors permitted.
4 units, Win (Mahrholz) MTWTh 9 Sum (Staff) MTWThF 9

51. Second-Year German — This course introduces the student to a wide variety of contemporary German prose. Speaking and writing are emphasized as well as listening and reading. Prerequisite: 3.
5 units, Aut, Win, Spr (Staff)

52. Second-Year German—Continuation of 51. This course broadens the scope of 51 by including poetry and expository prose.
5 units, Aut, Win, Spr (Staff)

53. Second-Year German—Continuation of 52.
5 units, Aut, Win, Spr (Staff)

61T–63T. These courses are normally taken in the first year of the translator's program. May also be taken by students not in the program if space permits. Prerequisite: 3.

61T. German for Translators.
5 units, Aut (Staff) MTWThF 10

62T. German for Translators.
5 units, Win (Staff) MTWThF 10

63T. Problems of Translation.
5 units, Spr (Staff) MTWThF 10
82–86. **Intensive German** — Given only at Stanford-in-Germany.
6 units, any two quarters

100. **Practice in Listening and Speaking** — 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: 52 or equivalent.
3 units, Spr (Schulz) MWF 9

101. **German Composition** — Prerequisite: 52 or consent of instructor.
3 units, Aut (Mahrholz) TTh 11

102. **German Composition** — Continuation of 101.
3 units, Win (Albrecht) MWF 11

105. **German Newspapers** — Current newspapers from East and West Germany will be read and discussed in German. This course may be taken twice for credit. Prerequisite: 51 or equivalent.
3 units, Aut (Albrecht) MWF 11

111–119. The subject matter of these courses will change from year to year. Students will read original German texts in various disciplines. Prerequisite: 52 or consent of instructor.

112. **Readings in German Art History**.
3 units, given 1974–75

113. **Readings in Political Science**.
3 units, given 1974–75

116. **Readings in German Philosophy**.
3 units, Aut (Heidsieck) MWF 11

141–149. Courses in the 140-series introduce the student to German literature in various genres and to German culture. Prerequisite: 51 or equivalent.

141. **Poetry from Goethe to Nietzsche**.
4 units, Aut (Rumold) MWF 9

142. **Poetry from Nietzsche to the Present**.
4 units, given 1974–75

143. **Drama from Storm and Stress to Expressionism**.
4 units, given 1974–75

144. **Drama from Expressionism to the Present**.
4 units, Spr (Snow) MWF 9

145. **The Novelle**.
4 units, given 1974–75

146. **Modern Fiction**.
4 units, Win (Flores) TTh 12:30–2:05

147. **Zentren der Kultur**.
4 units, Win (Schulz) MWF 11

4 units, given 1974–75

151–153. 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: 52 or consent of instructor.

151. **The Classical Period**.
4 units, Aut (Rumold) MTWTh 10

152. **Romanticism and Realism**.
4 units, Win (Flores) MTWTh 10

153. **From Naturalism to the Present**.
4 units, Spr (Albrecht) MTWTh 10

155. **Realism in Nineteenth-Century Fiction** — Reading and discussion of works by Dickens, Flaubert, Ludwig, Raabe, Fontane, Zola, Hauptmann. Prerequisite: 53 or consent of instructor.
4 units, given 1974–75

161T. **Translation of Texts in the Social Sciences**.
3 units, Aut (Lieder) TTh 11:00–12:15

162T. **Translation of Texts in the Social Sciences**.
3 units, Win (Lieder) TTh 11:00–12:15

163T. **Documentary Translation**.
3 units, Spr (Lieder) TTh 11:00–12:15

199. **Individual Reading** — Enrollment only by special permission of Department. Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Prerequisite: 3 or consent of instructor.
1 to 2 units, any quarter (Staff) by arrangement
ADVANCED AND GRADUATE COURSES
(200-299)

200A. Introduction to Old Norse—(Same as English 200A.) Introduction to the language; reading of selected texts.
   5 units, Aut (Harris) MTWTh 1:15

200B. Old Icelandic Sagas—(Same as English 200B.) Study of the sagas; reading of one or more in the original. Prerequisite: 200A.
   5 units, Spr (Harris) MTWTh 1:15

201. Language and Style — Prerequisite: qualifying examination.
   2 units, Win (Schulz) TTh 11

202. Language and Style—Continuation of 201.
   2 units, Spr (Schulz) TTh 9

204. 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.
   4 units, Aut (Robinson) MWF 2:15

205. Introduction to Modern German—Contrastive analysis of English and German morphology and syntax.
   4 units, Aut (Lohnes) MWF 11

206T. Advanced Translation.
   3 units, Aut (Lieder) TTh 1:15-2:30

207T. Translation Seminar.
   3 units, Win (Lieder) TTh 4:15-5:30

208T. Translation Seminar — Continuation of 207T.
   3 units, Spr (Lieder) TTh 4:15-5:30

209T. Introduction to a Note-Taking System.
   1 unit, Aut (Lieder) W 1:15

222. Linguistics and the Analysis of German—(Same as 322, Linguistics 284.) An introduction to linguistic theory and analysis, with special emphasis on the analysis of Modern German.
   4 units, Win (Robinson) T 2:15-3:05 and Th 2:15-4:05

225. Linguistics Colloquium: Topics in German Linguistics—(Same as 325, Linguistics 380.) Specific topics determined by student interest. May include any aspect of modern German linguistics.
   4 units, Spr (Robinson) T 2:15-3:05 and Th 2:15-4:05

227. Medieval Thought.
   4 units (Snow) given 1974-75

228. Middle High German.
   4 units, Aut (Snow) MTWTh 9

229. Readings in Middle High German—Prerequisite: 228.
   4 units (Staff) given 1974-75

   4 units, Win (Rumold) MWF 11

241-243. These courses introduce the student to the continuum of German intellectual and cultural history, and its relationship to the intellectual life of the other nations of Europe from the 18th century to the present. Emphasis is given to authors whose ideas have had a significant influence on shaping the thinking of our modern world. Prerequisite: 52 or consent of instructor.

241. Deutsche Geistesgeschichte I—Von der Aufklärung zur Romantik.
   4 units, Aut (Heidsieck) MWF 1:15

242. Deutsche Geistesgeschichte II—Von der Romantik bis Nietzsche.
   4 units, Win (Mueller-Vollmer) MWF 1:15

   4 units, Spr (Flores) MWF 1:15

252. Medieval and Baroque Drama.
   4 units, Aut (Snow) T 3:15-4:05 and Th 2:15-4:05

   4 units, Spr (Rumold) MWF 1:15
259. Rilke und Hofmannsthal.
   4 units (Mason) given 1975-76
260. Hofmannsthal.
   4 units, Win (Exner) MWF 2:15
261. Kafka.
   4 units, Spr (Foulkes) MWF 3:15
263. Thomas Mann.
   4 units, Spr (Exner) MWF 2:15
265. Brecht.
   4 units (Flores) given 1974-75
   4 units (Bark) given 1974-75
272. Problems in 19th-Century German Literature.
   4 units, Spr (Foulkes) MWF 1:15
275. Deutsche Literatur in Ost und West.
   4 units, Win (Flores) given 1974-75
278. Zeitgenössische Lyrik.
   4 units, Aut (Albrecht) MWF 3:15
279. Moderne Lyrik.
   4 units (Mueller-Vollmer) given 1974-75
290. Senior Seminar: Tragedy and Comedy—Political, Mythical and Psychoanalytic Aspects—May be elected by non-majors. Given in English.
   4 units, Spr (Heidsieck) T 1:15-3:05
299. Individual Work—Open only to German majors and to students who are working on special projects. Students taking honors in German will use this number for the honors essay. May be repeated for credit.
   1 to 15 units, each quarter (Staff) by arrangement
299B. Individual Work — Exclusively for Bonn University courses completed by undergraduate students in the Stanford Bonn Program.
   1 to 8 units, Aut, Win (Staff) by arrangement

GRADUATE COURSES

300. Proseminar.
   4 units, Aut (Bark, Frank) T 1:15-3:05
301. Individual Work — Exclusively for graduate students in German working on thesis or engaged in special work.
   1 to 12 units, each quarter (Staff) by arrangement
301B. Individual Work — Exclusively for Bonn University courses completed by graduate students in the Stanford Bonn Program.
   1 to 10 units, Aut, Win (Staff) by arrangement

LANGUAGE STUDIES (302–325)
302. Methods of Teaching German—(Same as Education 291.)
   2 units, Spr (Lohnes) TWTh 11
303. Curricular Problems — Given on request only.
   3 units (Lohnes) by arrangement
304T. Advanced Documentary Translation—Texts will be taken from the fields of business, economics, law, science, and technology.
   3 units, Aut (Lieder) by arrangement
305T. Advanced Documentary Translation—Continuation of 304T.
   3 units, Win (Lieder) by arrangement
306T. Advanced Documentary Translation—Continuation of 305T.
   3 units, Spr (Lieder) by arrangement
307T. Interpretation—Interpretation of conversations and negotiations; introduction to consecutive and simultaneous interpretation; conference terminology and parliamentary procedure; writing of reports and précis.
   3 units, Aut (Lieder) by arrangement
308T. Interpretation — Continuation of 307T.
   3 units, Win (Lieder) by arrangement
309T. Interpretation — Continuation of 308T.
   3 units, Spr (Lieder) by arrangement
314. Old High German and Old Saxon—Introduction to the early documents of High and Low German.
   4 units (Staff) given 1974-75
319. Early New High German—Introduction to the language and literature 1350–1600. Prerequisite: 228.
   4 units, Spr (Staff) given 1975–76
322. Linguistics and the Analysis of German—(Same as 222 and Linguistics 284.) An in-
Introduction to linguistic theory and analysis, with special emphasis on the analysis of Modern German.
4 units, Win (Robinson) T 2:15-3:05 and Th 2:15-4:05

325. Seminar: Topics in German Linguistics—(Same as 225 and Linguistics 380.) Specific topics determined by student interest. May include any aspect of modern German linguistics.
4 units, Spr (Robinson) T 2:15-3:05 and Th 2:15-4:05

GERMAN LITERATURE (326-350)

326. Problems of Teaching Literature—Students may enroll for practice in literature teaching on a voluntary basis.
1 to 3 units, each quarter (Staff) by arrangement

327. Introduction to Medieval Literature.
4 units (Snow) given 1974-75

328. Hartmann von Aue—Prerequisite: 228.
4 units (Snow) given 1974-75

329. Gottfried von Strassburg—Prerequisite: 228.
4 units, Spr (Snow) T 3:15-5:05

4 units (Snow) given 1974-75

344. Prosaformen des 19. Jahrhunderts—Conducted in German. Study of major 19th-Century German prose texts from authors such as Dorothe-Hilshoff, Gotthelf, Stifter, Keller, Meyer, and Fontane against the background of major non-German prose writers such as Trollope, George Eliot, Flaubert and Tolstoy. Emphasis on the concept of “provincial literature.”
4 units, Aut (Exner) MWF 4:15

349. Methodenlehre der Literaturwissenschaft—(Same as Comparative Literature 349.)
4 units (Mueller-Vollmer) given 1974-75

350. Seminars—All seminars dealing primarily with creative literature will be listed under this number. These seminars may also be taken as colloquia.

A Comparative Study of the German Stage in the 20’s and 60’s.
4 units, Win (Heidsieck) T 3:15-5:05

GERMAN THOUGHT AND LITERATURE (351-400)

351. German Literature—Problems of Interpretation. Topic by arrangement with instructor.
4 units (Staff) by arrangement

360. Religionskritik im 19. Jahrhundert—(Same as Modern Thought and Literature 373.)
4 units (Bark) given 1974-75

382. German and European Romanticism—(Same as Comparative Literature 382 and Modern Thought and Literature 374.)
4 units, Win (Mueller-Vollmer) MWF 3:15

400. Seminars—All seminars in German Thought and Literature will be listed under this number. These seminars may also be taken as colloquia.

Phenomenological Approach to Literature—(Same as Comparative Literature 400 and Modern Thought and Literature 376.)
4 units, Spr (Mueller-Vollmer) Th 4:15-6:05

COURSES OFFERED OVERSEAS

131A. Faust in Legend and Literature—(Taught at Stanford in Germany)
4 units, Aut (Foulkes)

140A. University Reform in West Germany—(Taught at Stanford in Germany)
3 units, Aut (Foulkes)

149A. Critical Approaches to Modern German Culture—(Taught at Stanford in Germany)
4 units, Win (J. Bark)

179A. National Socialism—Its roots, development and political system. (Taught at Stanford in Germany)
3 units, Win (J. Bark)

HISTORY

Chairman: Gordon A. Craig


LECTURERS: George S. Rentz, Stephen Stein

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 may meet the field requirement; the instructor may designate the field for which the colloquium is appropriate. The Department issues a detailed list indicating how each specific course is classified as to field.

Also, all History majors will be expected to demonstrate proficiency in a foreign language (the completion of two years of a single language at the college level or equivalent, e.g. passing a placement examination). 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.

(NOTE—The Cory and Riotte scholarships are available for women students in the Department.)

HONORS PROGRAM IN HISTORY

For a limited number of undergraduate majors, the Department offers two options leading to Honors in History: (a) a special program of senior research, and (b) comparative studies in history. Students accepted for this program who elect program (a), 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 program "a" will be eligible for Honors or High Honors in History, depending upon the quality of work performed. Students electing program "b" will take two one-quarter courses of reading in comparative history. Each student undertaking this program must secure the approval of a member of the department who will serve as his or her adviser for the program. The program might lead to the writing of an essay, an oral examination, or a written examination. Students completing program "b" will be eligible to receive Honors in History provided the work performed is of Honors quality. For more detailed information, apply to Professor Barton J. Bernstein, Director of the Honors Program.

James Birsdall 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, but 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.

**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
   Near East
   Middle East
   Late Traditional and Modern Japan and China, 1600 to the Present
   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
Near East to 1800
Middle East to 1800
Near East since 1800
Middle East since 1800
Africa
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.

(8) 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 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; Sections W 4:15–6:05, Th 8–10 a.m., Th 4:15–6:05*

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 (Craig, Staff) Lectures MTW 9; Sections W 4:15–6:05, Th 8–10 a.m., or Th 4:15–6:05*

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 (Thompson, Staff) Lectures MTW 9; Sections W 4:15–6:05, Th 8–10 a.m., Th 4:15–6:05*

4. **Medieval Culture: An Interdisciplinary Introduction**—(Same as English 65, German Studies 65A.) 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 between them. Lectures by faculty from various departments and sections conducted by the faculty listed.

   *5 units, Win (Langmuir, Snow) Lectures MTW 10; Sections W 2:15–4:05 or Th 2:15–4:05*

5. **Tradition, Change, and Revolution in Latin America Since 1750**—Designed for the
non-specialist, this introductory course will analyze the historical roots of contemporary Latin America by comparing and contrasting the history of Spanish America with that of Portuguese-speaking Brazil. Emphasis will be on social change and continuity, nation-building and dependency, and the political changes occurring in this first of Third-World areas to achieve sovereignty in modern times.

5 units, Win (Wirth, Stein)

91. History of East Asian Civilizations.
5 units, Aut (Kahn, Staff)

92. History of East Asian Civilizations.
5 units, Win (Duus, Staff)

ADVANCED COURSES

Courses numbered 100 through 199 are primarily lecture courses designed for advanced undergraduates.

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 Empire in the 2nd Century), H160 (Individual Work in Ancient History), H261 (Individual History in Greek History) and H262 (Individual Work in Roman History); all of which are accepted for credit toward a major in history.

MEDIEVAL AND RENAISSANCE EUROPE

104. Medieval Europe, 300–1400.
5 units, Spr (Bark)

107A. Medieval Europe, 1050–1200.
5 units, Aut (A. Bernstein)

107B. 13th Century Europe.
5 units, Win (A. Bernstein)

5 units, Spr (Langmuir)

109A. Renaissance Society and Culture.
5 units (Spitz, Forster, Ryan) given 1974–75

109B. Renaissance Society and Culture.
5 units (Spitz, Forster, Ryan) given 1974–75

110. Age of the Reformation.
5 units, Win (Spitz)

114. Protestant Reformers.
5 units, Win (Pauck)

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. Three lectures a week will be offered by faculty from various departments, and one two-hour discussion section will be included as an integral part of the course.

5 units, Aut (Vucinich, Staff) Lectures MTW, Sections Th or F

5 units, Win (Emmons, Staff) Lectures MTW, Sections Th or F

5 units, Spr (Dallin, Staff) Lectures MTW, Sections Th or F

118A,B. Russian Intellectual History — (Same as Slavic Languages and Literatures 118A,B and Comparative Literature 118A, B.) Study of major trends and documents in the history of Russian thought from the late 18th century to the First World War. Attention will focus on the development of “general ideas” about man’s ethical, moral, and aesthetic nature, society, and politics. Readings (in translation) will be drawn from literature, criticism, memoirs, and correspondence, political and social theory, philosophy and history. A two-quarter course open to advanced undergraduate and graduate students. Enrollment limited to 30, permission of instructors required.

8 units, Aut, Win (Brown, Emmons) TTh 4:15-6:05

120A,B. The Development of Modern Russia: State, Society, Institutions.
8 units, Aut, Win (Emmons) given 1974–75

121. 20th Century Russia.
4 to 5 units (Lederer) given 1974–75

122A. Russian Foreign Relations, 1700-1917.
4 to 5 units (Lederer) given 1974–75
HISTORY

122B. Russian Foreign Relations Since 1917.
4 to 5 units (Lederer) given 1974-75

123A. The Soviet Union: Politics and Society Since 1917—(Same as Political Science 119A.)
5 units, Spr (Dallin) MTWTh 10

123B. International Communism.
5 units (Dallin) given 1974-75

124. Pre-Revolutionary Russia and the West: Patterns of Social and Economic Development.
4 to 5 units, Aut (Atkinson)

125. Eastern Europe Since 1914.
4 to 5 units, Win (Vucinich)

126B. The Balkan States, 1800-1918.
4 to 5 units (Vucinich) given 1974-75

127. Europe from the Time of Newton to the French Revolution.
5 units, Win (Paret)

128. Central Europe from the French Revolution to the First World War.
5 units, Win (Paret)

128A. War and Society.
5 units (Paret) given 1974-75

129. Germany in the Twentieth Century.
4 to 5 units, Spr (Craig)

5 units (Wright) given 1974-75

4 to 5 units, Aut (Joughin)

132C. France in the 20th Century: From Poincaré to Pompidou.
4 to 5 units, Win (Joughin)

134. European Intellectual History, 17th and 18th Centuries.
5 units, Spr (Lougee)

135. Diplomatic Revolution of Our Time—
(See Political Science 135.)
5 units, Win (George, Staff)

135C. How Nations Deal with Each Other.
(See Political Science 135C.)
5 units, Aut (Keohane, Staff) MWF 11

136A. European Intellectual History in the Nineteenth Century.
5 units (Robinson) given 1974-75

136B. European Intellectual History in the Twentieth Century.
5 units, (Robinson) given 1974-75

5 units, Win (Lougee)

138A,B. Problems of Arms Control and Disarmament—(Same as Political Science 138A, B.)
5 units, Win, Spr (Lewis, Barton, Staff) MTWTh 1:15

THE BRITISH COMMONWEALTH AND EMPIRE

140. England to 1460.
5 units (Langmuir) given 1974-75

4 to 5 units, Aut (Seaver)

142. Stuart England.
4 to 5 units, Win (Seaver)

144. Britain: the 19th Century.
3 to 5 units (Stansky) given 1974-75

144A. Britain in the 19th and 20th Centuries.
5 units, Aut (Thompson)

3 to 5 units (Stansky) given 1974-75

AFRICA

147. Kingdoms of Africa: Society and History.
4 to 5 units (Jackson) given 1974-75

147B. Modern African History.
5 units (- - -)

148A. The History of West Africa.
5 units (Irwin)

148B. Islam in West Africa.
4 to 5 units, Spr (Irwin)

THE UNITED STATES

150. Rise of the American Colonies.
4 to 5 units, Aut (Macphail)

151. The Revolution, Confederation and Constitution.
4 to 5 units, Win (Macphail)

4 to 5 units, Win (Rapson)
153B. Cultural History of the United States Since 1880.
4 to 5 units, Spr (Rapson)

157A. Black Community and Leadership, 1739–1877.
5 units, Aut (Ross)

157B. Black Community and Leadership, 1877–Present.
5 units, Win (Ross)

159. History of California.
4 units (Fehrenbacher) given 1974–75

159A. Jeffersonian and Jacksonian America.
4 to 5 units, Aut (Holt)

159B. Sectional Conflict: The United States, 1848–1865.
4 to 5 units, Win (Holt)

4 to 5 units, Spr (Mohr)

162. 19th Century America.
4 units (Fehrenbacher) given 1974–75

163. The American Character.
4 to 5 units, Aut (Mohr)

168. American Social History to 1860.
4 to 5 units (B. Bernstein) given 1974–75

4 to 5 units, Spr (B. Bernstein)

170. The United States, 1890–1929.
5 units, Aut (Kennedy)

171. The United States, 1929–Present.
5 units, Win (Kennedy)

172. American Foreign Policy and the Age of War: World War II and the Cold War.
4 to 5 units, Win (B. Bernstein)

4 to 5 units, Sum (Scott)

LATIN AMERICA

176. Latin America to 1825.
4 to 5 units, Aut (Bowser)

177. Modern Latin America.
4 to 5 units, Spr (Stein)

180B. Modern Brazil, 1750–Present.
5 units, Spr (Wirth)

182. Latin America and the African.
4 to 5 units, Win (Bowser)

MIDDLE EAST

3 to 5 units (Rentz) given 1974–75

3 to 5 units (Rentz) given 1975–76

3 to 5 units, Spr (Rentz)

EAST ASIA

191. Aspects of Late Traditional Chinese History.
4 to 5 units, Win (Kahn)

192. Modern China.
4 to 5 units, Win (Van Slyke)

193. Intellectual Trends in Modern China.
4 to 5 units, Spr (Cole)

5 units, Spr (Duus)

195. Cultural History of Central Asia. (See Asian Languages 152.)
4 units, Win (Dien) MWF 1:15

196A. China and the United States.
4 to 5 units (Van Slyke) given 1974–75

UNDERGRADUATE SEMINARS
AND COLLOQUIA

During 1973–74, 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 1973–74. 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, an-
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.

200. Honors Reading Course in Comparative History.
  5 units each for two quarters, Aut, Win, Spr (Staff) by arrangement

  3 units, Win (Tyack) TTh 11 plus 1 hour by arrangement

  5 units, Spr (Bark)

207A. Undergraduate Colloquium: Intellectual History of the 13th Century.
  5 units, Aut (A. Bernstein)

208. Undergraduate Colloquium: The Christianization of Europe.
  5 units, Win (Langmuir)

210. Undergraduate Colloquium: Renaissance Humanism and Reform.
  5 units, Spr (Spitz)

213. Undergraduate Colloquium: Literature of Exploration and Political Theory in the 17th and 18th Centuries—(See International Relations.)
  5 units, Spr (West)

215H. Senior Honors: Research in Medieval History.
  1 to 5 units (Bark, A. Bernstein, Langmuir) by arrangement

217H. Senior Honors: Research in Renaissance-Reformation History.
  1 to 5 units (Spitz) by arrangement

218S. Undergraduate Seminar: Problems in International Communism—(Same as Political Science 130C.) (Graduate students enroll in 420B.)
  5 units (Dallin) given 1974–75

219. Undergraduate Colloquium: Problems in Soviet History and Politics—(Graduate students enroll in 326.)
  5 units, Spr (Dallin)

219S. Undergraduate Seminar: Soviet Politics and Society Since 1917—(Same as Political Science 126B.)
  5 units (Dallin) given 1974–75

220A. Undergraduate Colloquium: Conflict and Cleavage in Communist Societies—(Same as Political Science 124D.) (Graduate students enroll in 320A.)
  5 units, Aut (Labedz)

221. Undergraduate Colloquium: Medieval Russia.
  5 units (Emmons) given alternate years

222. Undergraduate Colloquium: Lenin in the Russian Revolutionary Movement.
  5 units (Emmons) given alternate years

223. Undergraduate Colloquium: Russian Foreign Relations.
  5 units (Lederer) given 1974–75

224. Undergraduate Colloquium: Nationalism and Communism in Eastern Europe.
  5 units (Vucinich) given alternate years

224A. Undergraduate Colloquium: Resistance Movements in the Second World War—(Graduates enroll in 321 F.)
  5 units (Vucinich) given alternate years

225. Undergraduate Colloquium: Origin and Development of Nationalism in Eastern Europe—(Graduate students enroll in 325B.)
  5 units, Aut (Vucinich)

229. Undergraduate Colloquium: Politics, Society, and Art in Modern European History—(Same as Modern Thought and Literature 229.) Topics of the course vary from year to year. In 1973–74 the course is devoted to an analysis of the political attitudes expressed in the cartoons of Honoré Daumier. (Graduates enroll in 328A.)
  5 units, Win (Paret)

229A. Undergraduate Colloquium: Biography and History—The course explores techniques of biography, the strengths and limitations of the genre, and the place of biography in history. (Graduates enroll in 303.)
  5 units, Spr (Paret)
   5 units (Wright) given 1974-75

232B. Undergraduate Colloquium: The Americanization of Europe.
   5 units, Aut (Joughin)

236. Undergraduate Colloquium: European Socialisms in the Nineteenth and Twentieth Centuries.
   5 units (Wright) given 1974-75

237. Undergraduate Colloquium: Modern Sexual Thought.
   5 units, Aut (Robinson)

237S. Undergraduate Seminar: Psychology and History.
   5 units (Robinson) given 1974-75

239H. Senior Honors: Research in Modern European History.
   1 to 5 units (Craig, Dallin, Emmons, Joughin, Paret, Robinson, Thompson, Vucinich) by arrangement

   5 units, Spr (Seaver)

242S. Undergraduate Seminar: Research in Local English Archives — (Graduates enroll in 442.)
   5 units, Win (Seaver)

243A. Undergraduate Colloquium: The World of William Morris.
   5 units (Stansky) given 1974-75

244A. Undergraduate Colloquium: Late Victorian and Edwardian Britain: Politics, Culture, and Society.
   5 units, Win (Thompson)

246H. Senior Honors: Research in British History.
   1 to 5 units (Seaver, Thompson) by arrangement

   5 units (Jackson) given 1974-75

248. Undergraduate Colloquium: Topics in African History.
   5 units, Win (Irwin)

249H. Senior Honors: Research in African History.
   1 to 5 units (Staff) by arrangement

252. Undergraduate Colloquium: The Reconstruction Period as the Dawn of Modern America.
   5 units, Win (Mohr)

253. Undergraduate Colloquium: The Civil War as a Watershed.
   5 units, Spr (Holt)

257. Undergraduate Colloquium: The Black Ghetto in the Twentieth Century.
   5 units, Spr (Ross)

258S. Undergraduate Seminar: 19th Century American Politics.
   5 units (Fehrenbacher) given 1974-75

259. Undergraduate Colloquium: The Presidency from Washington to Lincoln.
   5 units (Fehrenbacher) given 1974-75

262S. Undergraduate Seminar: Youth in American History.
   5 units, Aut (Rapson)

263. Undergraduate Colloquium: Women in America.
   5 units (Degler) given 1974-75

268. Undergraduate Colloquium: The Shaping of Twentieth Century America.
   5 units, Win (B. Bernstein)

269S. Undergraduate Seminar: The Cold War.
   5 units (B. Bernstein) given 1974-75

270. Undergraduate Colloquium: Twentieth Century American Imperialism.
   5 units (B. Bernstein) given 1974-75

275H. Senior Honors: Research in United States History.
   1 to 5 units (B. Bernstein, Holt, Kennedy, Macphail, Mohr, Rapson, Tyack) by arrangement

278. Undergraduate Colloquium: 20th Century Mexico.
   5 units, Spr (Stein)

281. Undergraduate Colloquium: Dependency in Latin America — The Historical Perspective.
   5 units, Spr (Wirth)

282. Undergraduate Colloquium: Race Relations in Latin America.
   5 units, Win (Bowser)

285H. Senior Honors: Research in Latin American History.
   1 to 5 units (Bowser, Stein, Wirth) by arrangement
HISTORY

291. Undergraduate Colloquium: Peasant Rebellion in Pre-Modern China.
   5 units, Spr (Kahn)

293. Undergraduate Colloquium: Thought and Society in Modern China.
   5 units, Win (Cole)

294. Undergraduate Colloquium: Imperialism in East Asia.
   5 units, Aut (Duus)

   5 units (Van Slyke) given 1974–75

299H. Senior Honors: Research in Far Eastern History.
   1 to 5 units (Cole, Duus, Kahn, Van Slyke) by arrangement

GRADUATE COURSES

Courses numbered 300–399 are intended primarily for first-year graduate students, but other graduate students may be admitted by consent of the instructor.

301. Graduate Colloquium on the Historiography of American Education—(Same as Education 301.)
   3 to 5 units, Aut (Tyack) Th 9–11 and by arrangement

302. Graduate Colloquium: History of American Urban Education—(Same as Education 302.)
   4 to 5 units, Win (Tyack) W 9–11 and by arrangement
   Spr (Tyack) W 7–9 p.m. and by arrangement

303. Graduate Colloquium: Biography and History.
   5 units, Spr (Paret)

   5 units, Aut (Bowser)

307. Graduate Core Colloquium: Medieval History.
   5 units (A. Bernstein) given 1974–75

308. Graduate Colloquium: Topics in Medieval History.
   5 units, Aut (Langmuir)

312. Graduate Colloquium: Latin Paleography and Codicology.
   5 units, Win (A. Bernstein)

314D. Directed Reading in Medieval History.
   Units by arrangement (Bark, A. Bernstein, Langmuir)

315H. Graduate Research in Medieval History.
   Units by arrangement (Bark, A. Bernstein, Langmuir)

316D. Directed Reading in Renaissance and Reformation.
   Units by arrangement (Spitz)

317H. Graduate Research in Renaissance and Reformation.
   Units by arrangement (Spitz)

319. Graduate Colloquium: Humanism and the Reformation.
   5 units, Aut (Spitz)

320A. Graduate Colloquium: Conflict and Cleavage in Communist Societies—(Same as Political Science 224D.)
   Aut (Emmons)

321F. Graduate Colloquium: Resistance Movements in the Second World War.
   5 units (Vucinich) given alternate years

322A. Graduate Colloquium: Non-Russian Peoples of the Soviet Union.
   5 units, Spr (Vucinich)

323. Graduate Colloquium: Russian History.
   5 units (Emmons) by arrangement

324. Graduate Colloquium: The Origin and Development of Nationalism in Eastern Europe.
   5 units (Lederer) given 1974–75

325B. Graduate Colloquium: Topics in Byzantine Civilization.
   5 units, Aut (Vucinich)

326. Graduate Colloquium: Problems in Soviet History and Politics.
   5 units, Spr (Dallin)

327. Graduate Colloquium: Topics in Modern European History.
   5 units, Aut (Craig)

328A. Graduate Colloquium: Politics, Society and Art in Modern European History.
   5 units, Win (Paret)

329A. Graduate Colloquium: The History of Military Thought, Institutions, and Policy.
   5 units (Paret) given 1974–75
5 units, Aut (Lougee)

336. Graduate Colloquium: Latin Europe, Nineteenth and Twentieth Centuries.
5 units (Wright) given 1974–75

337. Graduate Colloquium: European Intellectual History Since the Enlightenment—(Same as Modern Thought and Literature 337.)
5 units, Aut (Robinson)

338D. Directed Reading in Modern European History.
Units by arrangement (Craig, Dallin, Emmons, Joughin, Paret, Robinson, Thompson, Vucinich)

339H. Graduate Research in Modern European History.
Units by arrangement (Craig, Dallin, Emmons, Joughin, Paret, Robinson, Thompson, Vucinich)

341. Graduate Colloquium: Topics in Tudor and Stuart England.
5 units, Aut (Seaver)

344A. Graduate Colloquium: Modern British History.
5 units, Spr (Thompson)

345D. Directed Reading in British History.
Units by arrangement (Seaver, Thompson)

346H. Graduate Research in British History.
Units by arrangement (Seaver, Thompson)

347. Graduate Colloquium: Biography in African History.
5 units, Jackson, given 1974–75

348B. Graduate Core Colloquium: The Interpretation of African History.
5 units, Aut (Irwin)

349D. Directed Reading in African History.
Units by arrangement (Staff)

349H. Graduate Research in African History.
Units by arrangement (Staff)

351A, B, C. Joint Graduate Colloquium in American History.
30 units, Aut, Win, Spr (B. Bernstein, Holt, Kennedy, Macphail, Mohr, Rapson, Tyack)

352. Graduate Colloquium: Life of the Mind in Colonial America.
5 units, Spr (Macphail)

363. Graduate Colloquium: The American Character.
5 units, Aut (Rapson)

364. Graduate Colloquium: Community and Society in America—(Same as Sociology 234). The structure and functioning of communities, their relationship to the family and the individual, and problems of social mobility and power.
5 units, Win (B. Bernstein)

374D. Directed Reading in United States History.
Units by arrangement (B. Bernstein, Holt, Kennedy, Macphail, Mohr, Rapson, Tyack)

375H. Graduate Research in United States History.
Units by arrangement (B. Bernstein, Holt, Kennedy, Macphail, Mohr, Rapson, Tyack)

376. Graduate Colloquium: New Findings in American History—(Open only to Coe Fellows.)
6 units, Sum (Scott)

379. Graduate Colloquium: Andean Latin America.
5 units, Win (Stein)

380. Graduate Colloquium: Latin American History.
5 units, Aut (Wirth)

384D. Directed Reading in Latin American History.
Units by arrangement (Bowser, Stein, Wirth)

385H. Graduate Research in Latin American History.
Units by arrangement (Bowser, Stein, Wirth)

388D. Directed Reading in the Middle East and in the Islamic World.
Units by arrangement (Rentz)

390A. Graduate Colloquium: Topics in Late Traditional and Modern Chinese History—The Late Traditional Period.
5 units, Aut (Kahn)

390B. Graduate Colloquium: Topics in Late Traditional and Modern Chinese History—The Modern Period.
5 units, Win (Van Slyke)
395. Graduate Colloquium: Topics in Modern Japanese History.
5 units, Spr (Duus)

398D. Directed Reading in Far Eastern History.
Units by arrangement (Duus, Kahn, Van Slyke)

399H. Graduate Research in Far Eastern History.
Units by arrangement (Duus, Kahn, Van Slyke)

ADVANCED GRADUATE COURSES

Courses numbered 400-499 are intended primarily for second- and third-year graduate students, but other graduate students may be admitted by consent of the instructor.

401. Graduate Seminar: The History of American Education: Urban Education — (See Education 401B.)
4 to 5 units, Spr (Tyack) by arrangement

407. Graduate Seminar: The University of Paris in the Middle Ages.
5 units (A. Bernstein) given 1974-75

409. Graduate Seminar: Topics in Later Medieval Intellectual History.
5 units, Spr (A. Bernstein)

410. Graduate Seminar: Early Modern Europe.
10 units, Win, Spr (Spitz)

419. Graduate Seminar: 20th Century Russia.
5 units (Lederer) given 1974-75

420B. Graduate Seminar: Problems in International Communism.
5 units (Dallin) given 1974-75

421. Graduate Seminar in Russian History.
(To be preceded by 323.)
5 units, Win (Emmons)

5 units, Win (Vucinich)

427. Graduate Seminar: Topics in Modern European History.
5 units (Craig) given 1974-75

429. Graduate Seminar: Napoleonic and Restoration Europe.
5 units, Spr (Paret)

10 units, Win, Spr (Joughin)

440. Graduate Seminar: Medieval History.
5 units, Spr (Langmuir)

442. Graduate Seminar: Social History in Local English Archives.
5 units, Win (Seaver)

444A. Graduate Seminar: The British Labor Movement.
5 units, Win (Thompson)

5 units (Jackson) given 1974-75

448. Graduate Seminar: Topics in West African History.
5 units, Spr (Irwin)

5 units, Spr (Ross)

454. Graduate Seminar: American Liberalism from Progressivism to the Cold War.
10 units, Aut, Win (B. Bernstein)

455. Graduate Seminar: The Progressive Era.
5 units, Spr (Kennedy)

5 units, Spr (Holt)

5 units (Degler) given 1974-75

480. Graduate Seminar in Modern Latin American History.
5 units, Win (Wirth)

5 units, Spr (Bowser)

484. Graduate Seminar: Populist Movements in Latin America.
5 units, Aut (Stein)

489. Graduate Seminar in Chinese History: The Ch'ing Period.
10 units, Win, Spr (Kahn)

490. Graduate Seminar in the History of Modern China: The Republican Period.
10 units, Win, Spr (Van Slyke)

491. Graduate Seminar: Sinology for Stu-
SCHOOL OF HUMANITIES AND SCIENCES

Students of Modern China—Bibliography and research methods in Chinese and Japanese language sources.

5 units, Aut (Cole)

495. Graduate Seminar: Research in Modern Japanese History.

5 units, Win (Duus)

COURSES OFFERED OVERSEAS

32. Twentieth-Century Europe—(Taught at Stanford in Britain.)

3 to 5 units, Aut, Win (Wright)

244B. Modern British Statesmen—(Taught at Stanford in Britain.)

5 units, Aut, Win (Wright)

HUMANITIES SPECIAL PROGRAMS

Emeriti: John W. Dodds, Paul H. Kocher, Philip H. Rhinelander, Jeffery Smith (Professors)

Chairman: Lawrence V. Ryan

Professors: William A. Clebsch (Religious Studies and Humanities), Lawrence V. Ryan (English and Humanities)

Assistant Professors: Robert E. McGinn (Humanities and, by courtesy, Philosophy), Eileen Serene (Philosophy and Humanities)

Humanities Special Programs include:
1. Experimental Courses
2. Honors Program in Humanities
3. Graduate Program in Humanities
4. American Studies

EXPERIMENTAL COURSES

109A. Renaissance Society and Culture—(Same as 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.

5 units (Ryan, Forster, Spitz)

given 1974-75

109B. Renaissance Society and Culture—(Same as History 109B.) Protestant and Catholic reform in the high Renaissance in Germany, France, Italy, and England.

5 units, (Ryan, Forster, Spitz)

given 1974-75

HONORS PROGRAM IN HUMANITIES

Committee in Charge: Lawrence V. Ryan (Director), Mark Edwards, J. Martin Evans, John B. Foster, Jr., David M. Kennedy, Eileen Serene

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. 282)
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. Examples: East Asian Studies, Medieval Studies, the Modern Novel, and Renaissance Studies.

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. 282.)

2. Two Humanities Seminars in the series 190-195—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.

61. The World of Pagan Antiquity. 5 units, Aut (Edwards, Staff) MWF 11; two hours by arrangement

62. Christian and Secular Europe: Medieval and Renaissance—Boethius, Arthurian romance, Dante, Castiglione, Marlowe, Montaigne, Cervantes. 5 units, Win (Ryan, Staff) MWF 11; two hours by arrangement

63. From the Enlightenment to the Present—Blake, Keats, Kierkegaard, Dostoevsky, Kafka, Virginia Woolf, Sartre, Ellison. 5 units, Spr (Ruotolo, Staff) 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

190-195. 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 Hum. 194. 5 units, Aut (Evans) TTh 2:15-4:05

191. History and the Humanities. 5 units, Aut (J. Bark) by arrangement

GRADUATE PROGRAM IN HUMANITIES

Committee in Charge: Lawrence V. Ryan (Director), Gilbert Carbajal, William A. Clebsch, Robert E. McGinn, Kurt Mueller-Vollmer, David S. Nivison, Raul Romero, Lewis W. Spitz

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 specialties, 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 other 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. Reading knowledge of at least one foreign language, ancient or modern.

5. 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.

6. 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; required of M.A.T. candidates whose teaching field is Humanities.

4 units, Spr (Staff) given 1974-75

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 (Raubitschek) TTh 4:15-6:05

302. **The Roman and Early Christian Period.**

4 units, Win (G. H. Brown) TTh 4:15-6:05

303. **The Middle Ages.**

4 units, Spr (Yearley) TTh 4:15-6:05

304. **The Renaissance.**

4 units, Aut (Ryan) MW 4:15-6:05

305. **The Early Modern Period.**

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

306. **Modernism and the Consciousness of the Humanities**—Normally taken after completion of 301-305.

4 units, Spr (Mueller-Vollmer) 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: permission of the instructor.

1 or 2 units, Aut, Win, Spr (Clebsch) by arrangement

**INTERNATIONAL RELATIONS, SPECIAL OFFERINGS FOR UNDERGRADUATES**

*Committee in Charge: Committee on International Relations, a subcommittee of the President’s Committee on International Studies, Richard A. Brody (Political Science); Gordon A. Craig (History); Alexander Dallin (History); Alexander A. George (Political Science); David Halliburton (English); Robert O. Keohane (Political Science); Gerald M. Meier (Graduate School of Business); John H. Merryman (School of Law); Peter Paret (History)*

The Committee on International Relations, composed of senior faculty from a number
of disciplines, is assisting in the development of innovative courses, seminars, and colloquia to assist undergraduates in studying the origins and implications of contemporary problems that transcend national boundaries.

The offerings take an interdisciplinary, problem-oriented approach and are designed to supplement related offerings in a wide variety of departments, institutes, and schools, described in other sections of this catalog. Unless stated otherwise, the courses are open to graduate students with the consent of the instructor.

The offerings are not intended in and of themselves to constitute the basis for an academic major. Undergraduates whose special academic interests lie in more than one department and do not fit into the major requirements of any department may wish to consider an Interdepartmental Major (see statement on this program in “Other Departments, Institutes, and Programs” section of this catalog) in which these courses, as well as others in various departments and schools, might be included.

The members of the Committee on International Relations are available to advise students on work in international relations throughout the University.

**BASIC COURSES**

**How Nations Deal with Each Other**—(Enroll in History 135C or Political Science 135C.) 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)

**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.

4 to 5 units, Spr (George, Lauren)

**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 problems of arms control. 138A is a prerequisite to 138B; the second quarter will provide for individual research.

5 units, Win, Spr (Barton, Brody, Craig, D. Dunn, T. Ehrlich, George, Lederberg, Lewis, Panofsky, Paret, A. Peterson)

**ADVANCED COURSES**

**International Aspects of Environmental Disruption**—(Enroll in Political Science 137C.) 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. Desirable prerequisite: Political Science 135C or History 135C.

5 units, Win (Corning)

**International Organizations in World Politics**—(Enroll in Political Science 133C.) Analysis of the role of international organizations in contemporary world politics, with particular reference to transnational relations. 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 (Keohane)

**Seminar on the Dynamics of Escalation**—(Enroll in Political Science 145.) An investigation of the dynamics of escalation in a number of different situations and the methods whereby this research can be undertaken. A major focus upon some of the ways in which political and military escalations are related to changes in domestic and international environments. Such environments include certain demographic, technological
and economic dimensions as well as other characteristics of state and international systems—especially Great Power systems.

5 units, Win (North)

Seminar on Nuclear Proliferation — (Enroll in Political Science 142C.) Investigation of the technical, economic, domestic and international political factors leading to the expansion and contraction of nuclear weaponry. Prerequisite: Political Science 138A. (Graduate students enroll in Political Science 243C.)

5 units, Spr (Brody)

Public Opinion and Foreign Policy—(Enroll in Political Science 142A.) This seminar will examine the several roles that the citizen can play in the process leading to the formulation of U.S. foreign policy. Special attention will be paid to the distinctions between decision processes, policy processes and bureaucratic problem solving, with an eye to examining the potentiality for citizen inputs. Questions of opinion formulation and the interaction between formed opinion and policy will dominate the seminar discussions.

5 units, Win (Brody)

Seminar on Political Leadership—(Enroll in Political Science 240A,B.) 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. Second quarter consists of student research. (Undergraduates enroll with consent of instructor in 140A,B.)

5 units, Win (George)

Seminar on Force and Diplomacy in the Modern Era — (Enroll in Political Science 145A.) Critical examination of theories of force as an instrument of foreign policy; evaluation of crises and conflicts in the post-World War II era with reference to lessons for theory and practices. (Graduate students enroll in 245A.)

5 units, Spring (George)

Seminar on Presidential Decision-Making: A Behavioral Approach—(Enroll in Political Science 196A,B.) Analysis of cognitive limits and other constraints on rational decision-making by political executives that generate stress and lead to adoption of various coping strategies. Relationship between political executives, their small advisory groups, and organizational behavior as it affects rational decision-making. Enrollment limited to 15 juniors and seniors. Desirable prerequisite: previous courses in American government, policy-making, organization theory, psychology. Second quarter consists of student research. (Graduate students enroll in 296A,B.)

5 units, Win, Spring (George)

Seminar on Transnational Relations — (Enroll in Political Science 241C.) Critical analysis of traditional state-centric assumptions about world politics, through an examination of the importance of transnational relations. The focus will be not only on transnational relations, such as the multinational business enterprise or the Roman Catholic Church, but also on analysis of world politics, transnational as well as statecentric, by issue area. (Undergraduates enroll with consent of instructor in 141C.)

5 units, Spring (Keohane)

Politics, Society and Art in Modern European History—(Enroll in History 229.) Topics of the course vary from year to year. In 1973-74 the course is devoted to an analysis of the political attitudes expressed in the cartoons of Honoré Daumier.

5 units, Win (Paret)

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 topics such as the impact of violence on political development, ethical theories of war, the use of war as an instrument of policy.

5 units (Paret) given 1974-75

Graduate Colloquium: The History of Military Thought, Institutions, and Policy—(Enroll in History 329A.) Advanced undergraduates may enroll with consent of instructor.

5 units (Paret) given 1974-75

History and Biography—(Enroll in History 229A.) An undergraduate/graduate colloquium. The course explores the methodology of biography, with special attention being given to the analysis of the interaction between the individual and his environment.

5 units (Paret) given 1974-75

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 (Sullivan) given 1974-75

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 development policy. Approximately one-half of the sessions are devoted to small group policy conferences in which students present and discuss "position papers" on specific policy problems. Considerable independent study is encouraged. These problems are studied primarily through sets of specially prepared source materials. Lectures present some international economic principles that can be applied to the problems and place the problems in their wider context. Prerequisite: Economics 1.

5 units, Spr (Meier)

International Economic Conduct—(Enroll in Freshman Seminar.) This seminar will study problems of competition and cooperation in the formation of foreign economic policy. Special attention will be given to how national economic autonomy can be reconciled with forces of international economic integration. Actual behavior in international economic relations is compared with the norms and codes of conduct established by international economic institutions and multilateral agreements. Essays will be written on recent policy problems in the international economy. These problems will provide an introduction to the context and process of policy-making in international economic affairs. Beyond this, some philosophical questions will be raised about non-discrimination, distributive justice, and sanctions.

3 to 5 units, Spr (Meier)

The Literature of Exploration and Political Theory, 17th and 18th Centuries—(Enroll in History 213.) An assessment of the impact of exploration and the literature of exploration on political thinking in the Enlightenment. Beginning with exploration as a problem limited to the relations among European dynasties and governments, the course proceeds to explore the growing use of exotic cultures as alternative models of political organization and the growth of the idea of culture itself. Finally, it examines the re-assertion of theories of international relations in a new, more global context.

5 units, Spr (West)

North American and Latin American Poetry—(Enroll in Spanish 282 or Comparative Literature 259B.) Selected poets from the Twentieth Century. Reading knowledge of Spanish required. How do poetic practices in North America and Latin America relate? Are there common influences? Can we compare the cultural context and the cultural sanctions inferable from what we read? Where has the poetry reflected, and perhaps conditioned, the felt historical experience of North Americans and Latin Americans?

5 units, Spr (Felstiner, Franco)

LANGUAGE LABORATORY

Director and Senior Lecturer in Spanish and Portuguese: Phillip B. Petersen
Assistant Director, Electronics Engineer and Lecturer: John Metcalfe

The Language Laboratory with one hundred and fourteen Level III (listen-respond-record) student positions offers varied programs in Amharic, Arabic, Cantonese, Cebuano, Czech, English as a foreign language, French, German, Greek, Hausa, Hebrew, Indonesian, Irish, Italian, Japanese, Korean, Latin, Lithuanian, Mandarin Chinese, Norwegian, Persian, Polish, Portuguese, Romanian, Russian, Spanish, Swahili, Twi, Vietnamese and Yoruba.

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 capitols, recorded from short-wave radio, is available for advanced students.

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

2 units, Spr (Metcalf) TTh 1:15
Sum (Metcalf) 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: Bernard J. Siegel

The Center for Latin American Studies administers three principal programs. They are the graduate A.M., 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 joint-degree programs.

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, 1974.

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 program and be formally accepted by the Subcommittee on the Latin American Studies Undergraduate Major not later than the beginning of the second quarter of their junior year; exceptions will be made only in very 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 three-man 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 research paper of acceptable quality relating to Latin America on a topic approved by the Subcommittee on the Undergraduate Major. 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.

Honors in Latin American Studies will be recommended for exceptional students who maintain a grade average at least midway between "A" and "B" for all area-related courses; complete a strong and well-designed program; and submit a senior paper judged to be outstanding by the Subcommittee on the Undergraduate Major.

SPECIAL UNDERGRADUATE PROGRAM

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, Latin American Studies 152, is required the spring quarter before departure and an extensive written report the following autumn quarter. Students from all departments are eligible to apply.

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 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. For additional Latin American Studies requirements, inquiry should be made to the Center. Candidates must have a teaching credential.

Inquiries concerning all programs should be directed to the Director, Center for Latin American Studies, Bolivar House, Stanford, California 94305.

COURSES

152. Undergraduate Seminar in Research Design for Independent Study—Restricted to students accepted for the Latin American Studies Summer Research Program.

5 units, Spr (Staff) M 4:15–6:05

169. Directed Individual Study — For students 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

199. Undergraduate Independent Research —Restricted to students in Latin American Studies Summer Research Program.

5 units, Aut (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.
5 units, Aut, Win, Spr (Staff)
T 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, Joseph H. Greenberg
Associate Professors: Clara N. Bush, Elizabeth C. Traugott
Assistant Professors: Eve V. Clark, Roger C. Schank, Thomas Wasow; Acting: Eduardo Hernandez-Ch., William R. Leben.

Lecturers: Elaine Kaufman, Frieda N. Politzer
Affiliated Faculty:
Professors: Alphonse Juilland, Robert L. Politzer
Associate Professors: Andrew M. Devine, Dorothy Huntington
English for Foreign Students:
Director: Clara N. Bush
Lecturers: Beverley McChesney, Frieda N. Politzer

Special Language Program:
Coordinator: Staff

PROGRAMS OF STUDY

The courses offered by the Linguistics Program are primarily intended for advanced degrees. Undergraduates interested in the study of human language are advised to consider an interdepartmental major which would include Linguistics 1, 45 and 100 and related courses in other departments. Undergraduates who wish to enter the field of linguistics may also work out an interdisciplinary major including Linguistics 100 and such primarily graduate courses as Linguistics 200, 215, and 230.

For University regulations governing advanced degrees, see the section “Degrees” in this bulletin.

Candidates for advanced degrees must have completed an equivalent of the training represented by an A.B. or B.S.

The student’s program should be prepared in advance in consultation with the student’s adviser.

MASTER OF ARTS

Requirements for the A.M. fulfill all but the units requirement in the first four steps of the Ph.D. (see below).
1. Language. Candidates must demonstrate their ability to use linguistic research in two foreign languages, such as French, German, or Russian.
2. Courses. 40 units of graduate work, of which at least 15 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, and 230. 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.
4. A thesis or research project (up to 6 units) of some scope and originality.

MASTER OF ARTS IN TEACHING

The degree of Master of Arts in Teaching is offered jointly by the Linguistics Program and the School of Education. In addition to completing a minimum of 24 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

The requirements of the Ph.D. minor in Linguistics are: 30 units of course-work in Linguistics, no more than six of which may be directed reading, and an examination on general linguistics and its relation to a field
of specialization (normally the major subject). The courses should be chosen in consultation with an adviser in Linguistics. The adviser will serve on the student’s doctoral 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 use linguistic research in two foreign languages, such as French, German, or Russian.

2. **Courses.** 80 units of graduate work beyond the A.B. or B.S. exclusive of dissertation units, at least 30 of which are in general linguistics, or, beyond the A.M., 40 units exclusive of dissertation units, at least 15 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, and 230. 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.** Three oral presentations which may be given as colloquia or in seminars; at least two should be given during the first three years of study.

7. **Dissertation.**
   a) Approval of dissertation topic and appointment of a dissertation committee by the Chairman.
   b) Successful passing of a University Oral examination on the Dissertation Project and related areas.
   c) Dissertation (up to 15 units).

**Special Language Courses**

(80, 81A,B,C)

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 advanced 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, Committee on Linguistics, ext. 4284.

**Research**

The Committee on Linguistics maintains a program of basic research in linguistics and related fields. The major projects are language universals, study of child language...
development, and sociolinguistics. A limited number of research assistantships are available, graduate and post-doctoral.

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 60-69); (6) computational linguistics (numbers 60-69); (7) applied linguistics (numbers 70-74); (8) methods (numbers 75-79); (9) languages (numbers 80-94).

UNDERGRADUATE


5 units, Aut (Ferguson, Greenberg, Huntington and Staff) MWF10

45. Language, Society and Culture—(Same as Anthropology 166.) The linguistic basis of culture, the relation of language to culture and society and the role of linguistic data in the reconstruction of history. [The course will emphasize three general topics: (1) language and cultural theories (evolutionary, functional, and diffusional), (2) language and cultural change (linguistic and non-linguistic factors in change), and (3) language and cultural history (especially linguistic evidence for cultural history)]. Prerequisite: Linguistics 1, Anthropology 1, or consent of instructor. (Graduate students should enroll in 145.)

5 units, Win (Greenberg) MWF11

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


5 units, Aut (Diebold) MWF 1:15

145. Language, Society, and Culture—Content same as 45.

5 units, Win (Greenberg) MWF 11

146. Bilingualism in the Chicano Community—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.) MWF 11

150. Tutorial Practicum — A practicum in the teaching of English to non-native speakers and bilinguals. Participants are trained in basic language-teaching skills and apply this training to the tutoring of school children or adults in the Bay Area. Open to all students interested in tutoring English language skills. Two-quarter sequence, Autumn-Winter or Winter-Spring.

3 units per quarter, Aut, Win, Spr (Staff) MWF 4:15

175A. Linguistic Field Methods I — (Same as Anthropology 161A.)

175B. Linguistic Field Methods II—(Same as Anthropology 161B.)

180. The Structure of the English Language—(Same as English 101.)

182. Languages of the World — (Same as Undergraduate Special 182.)

185A,B,C. Beginning Hausa.

5 units, Aut, Win, Spr (Leben) MTWTHF 12

186A,B,C. Intermediate Hausa.

5 units, Aut, Win, Spr (Staff) by arrangement

190A,B,C. Beginning Swahili.

5 units, Aut, Win, Spr (Kaufman) by arrangement
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5 units, Aut, Win, Spr (Staff)
by arrangement

193A,B,C. Beginning Yoruba.
5 units, Aut, Win, Spr (Kaufman)
by arrangement

199. Independent Study.
1 or more units, any quarter (Staff)
by arrangement

GRADUATE

Theory of Grammar

200. The Goals 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.
4 units, Aut (Clark) TTh 2:15-4:05

201. 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.
4 units, Win (Bush and Hernandez-Ch.) MW 2:15-4:05

205. 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.
Given alternate years

206. Grammatical Theories—Selected topics in non-transformational grammatical theory. May be repeated for credit. Prerequisite: 200 or consent of instructor.
Given alternate years

208. Typology and Universals of Language—(Same as Anthropology 164.) 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. Prerequisite: elementary linguistics course or consent of instructor.
Given alternate years

Given alternate years

Phonetics and Phonology

215. 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).
4 units, Aut (Bush and Hernandez-Ch.)

216. 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.
4 units, Win (Bush) MWF 10 plus one hour by arrangement

217. 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.
4 units, Spr (Bush) MW 3:15-5:05

220. 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.
4 units, Win (Ferguson) TTh 9-11

221. Sound Pattern of English—A comprehensive description of the stress and segmental rules of English within the framework of generative phonology. Prerequisite: 220 or consent of instructor.
4 units, Spr (Leben) MWF 2:15

222. Advanced 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 2:15-5:05
225. Workshop on Phonological Archiving—Basic problems in phonological archiving. Introduction to a computer archive system. Formal training in encoding data from source grammars, and problem exercises in the interpretation of actual source material. Prerequisite: 220 or equivalent.

4 units, Aut (Staff) by arrangement

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, Spr (Huntington) by arrangement

Syntax and Semantics

230. Foundations of Syntactic Theory—Introduction to the transformational theory of syntactic competence. Practical experience in formulating and testing linguistic hypotheses, reading and constructing rules, etc.

4 units, Win (Wasow) MWF 1:15

231. Advanced Syntax—In-depth study of particular topics, e.g. relativization, complementation. Emphasis on similarities and differences between recent models of transformational grammar. Prerequisite: 230 or consent of instructor.

4 units, Spr (Wasow) TTh 10-12

232. 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: 231 or consent of instructor.

4 units, Aut (Staff) MW 1:15-3:05

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, Win (Staff) MWF 11

240. Semantics—Emphasis on lexical representation, componential analysis, markedness, field meaning at the word vs. sentence levels.

244. Philosophy of Language—(Same as Philosophy 181.)

Language Variation and Sociolinguistics

245. Sociolinguistics—Selected topics on language and society, including language and social stratification, language standardization, language and national development.

4 units, Spr (Hernandez-Ch.) MWF 1:15

247. Language and Social Interaction—(Same as Anthropology 263.)


4 units, Aut (Hernandez-Ch.) MW 11-12:50

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.

4 units, Spr (Traugott) MW 10-12

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 232.)

Developmental Psycholinguistics

260. Child Language I—(Same as Psychology 240.) Review of present knowledge of processes of language acquisition from a linguistic point of view. Survey of recent and past literature. Prerequisite: 100 or 230, or consent of instructor.

4 units, Aut (Clark) TTh 10-11:50

261. Child Language II—(Same as Psychology 241.) Variable topics selected from semantics, syntax, or phonology. Topic for 1973-74: acquisition of basic grammatical categories.

4 units, Spr (Ferguson) TTh 1:15-3:05

Computational Linguistics

265. Computer Models for Natural Languages—Consideration of linguistic problems in the context of computers. Modification of linguistic theory from computational evidence. Parsing and generating systems. Question-answering programs. Problems of
mechanical translation. Emphasis on conceptual representation schemas. Prerequisites: 100 or its equivalent and some knowledge of computers.

4 units, Aut (Schank) MWF 10

266. Research in Computational Linguistics—Analysis of various approaches to computational linguistics.

4 units, Win (Schank) MWF 9

Applied Linguistics

270. Linguistics and the Teaching of English—(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 1973-74 include: choice of medium of instruction in multilingual societies, problems of language standardization, development of orthographical systems. May be repeated for credit. Prerequisite: 100 or equivalent.

4 units, Win (Hernandez-Ch.)

TTh 11–12:50

Methods

275. Field Research—Methods and research design for the study of language.

Given alternate years.

276. Research Methods in Sociolinguistics—Introduces the student to social science research methods within the context of sociolinguistic research. Completed or on-going studies in sociolinguistics will be used in illustration. Students will apply some of the methods discussed to individual research projects in sociolinguistics.

4 units, Win (R. Politzer) by arrangement

Languages

280. Languages of the Middle East—Structural sketches and sociolinguistic background information on the major contemporary languages of Southwest Asia and North Africa.

Given alternate years

281. Languages of Africa.

Given alternate years

282. Languages of the Pacific.

Given alternate years

284. Linguistics and the Analysis of German—(Same as German 222/322.)

Seminars

Students are admitted by consent of instructor. Seminars are offered on typology and universals of language, phonological theory, syntax, semantics, sociolinguistics, historical linguistics, developmental psycholinguistics, and computational linguistics. May be repeated for credit. Seminars offered in 1973-74 are:

330. Seminar in Syntax—Topics in the theory of syntax, including the relationship of syntax and semantics. Material from English and other languages. Prerequisite: 231.

5 units, Aut (Staff) MW 4:15–6:05

340. Seminar in Philosophy of Language—(Same as Philosophy 241.)


5 units, Win (Ferguson) TTh 2:15–4:05

350. Seminar in Ethnographic Semantics—(Same as Anthropology 288.)

360. Seminar in Developmental Psycholinguistics—Topics in the acquisition of the first language.

5 units, Win (Clark) M 2:15–5:05


5 units, Spr (Schank) MW 2:15–4:05

380. Seminar in German Linguistics—(Same as German 325.)

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 (Staff) Th 4:15

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
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 85, 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 8 units will be offered during the 6-week summer session. These are open to all regularly enrolled Stanford students. 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. The latter 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.

85. Spoken English I — Basic review and practice of grammatical patterns of spoken English with additional assigned practice in language laboratory. Students enrolled in 85 are expected to enroll concurrently in Pronunciation class (90). Prerequisite: consent of instructor.

5 units, Aut (Politzer) MTWThF

86. Spoken English II — 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) MWF

87. Spoken English III—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.

2 units, Aut, Win, Spr (Staff) TTh

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)
three hours per week by arrangement

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)
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)
by arrangement

96. Written English I — Intermediate work in expository writing with special attention to correct grammatical usage. Prerequisite: consent of instructor.

2 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

OTHER COURSES

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
104/204. Principles of Standard English.
205. Old English.
206. Middle English.

FRENCH AND ITALIAN
211. Phonétique et Orthoépie.
212. Histoire de la langue française depuis le Moyen Age.

GERMAN STUDIES
204. History of the German Language.
205. Introduction to the German Language.
228. Middle High German.
312. Old Norse.
313. Old Icelandic Sagas.

HEARING AND SPEECH SCIENCES
230. Physiology of Speech Production.
231. Speech Perception.
281. Seminar in Animal Communication.
310. Experimental Phonetics.

PHILOSOPHY
163B. Modal Logic.
183. Logic and Language.
201. Mathematical Linguistics.

PSYCHOLOGY
146. Language and Thought.
214. Psycholinguistics.
272. Seminar on Topics in Psycholinguistics.

SLAVICS
198. Russian Syntax.
211. Introduction to Old Church Slavonic and Early Russian Texts.
212. History of the Russian Literary Language.

MATHEMATICS
Emeriti: Harold M. Bacon, Stefan Bergman, George Polya, Gabor Szegö (Professors)
Chairman: Robert Osserman
Vice Chairman: Paul W. Berg
Associate Professors: John Coates, Per Enflo, Mary V. Sunseri.
Assistant Professors: Bruce M. Bennett, Gregory Brunfels, Caro K. Kiremidjian, Marvin E. Ortel, Leon M. Simon, Jonathon Stavi, Misha Zafran. Visiting: Shmuel Friedland, Shing-Tung Yau
Visiting Lecturer: Paul Shields

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. An Honors Calculus sequence (51, 52, 53) is also offered; these courses present the content of (41, 42, 43) supplemented by additional study of underlying concepts and exploration of some of the more interesting consequences of calculus in mathematics and science.

Algebra and Trigonometry (1) is offered for those who need or desire a better preparation 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, or 51, 52, 53, 54). 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. They are advised to begin or continue this language study in the first year.

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, 157, 159, 217A. Honors or graduate courses in the same subject may be substituted for the preceding courses—for example, 113H for 113, 206A for 106.

3. Five additional courses, each carrying at least three credits, chosen from 45, 46 and courses numbered 100 or above. Although not required, 45 is generally recommended.

Students completing the honors sequence 54, 55, 56 may take two elective courses 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**

Students who complete this program will be awarded the degree Bachelor of Science in Mathematics with Honors.

**Admission to the Program** — A student may apply for admission to the Honors Program not earlier than the last quarter of the sophomore year, and not later than the first two weeks of the first quarter of the senior year. Application must be made to the Committee on Undergraduate Affairs of the Department of Mathematics. Minimum requirements for consideration of an application are (1) a 3.5 average in Mathematics courses taken at Stanford; (2) completion of at least two quarters of Advanced Calculus (44 or 54, and either 45 or 55 or 115) and one quarter of Linear Algebra (113); (3) some evidence of the candidate’s interest in and aptitude for advanced work in mathematics; (4) submission of a detailed program of course work for the remaining quarters of the applicant’s undergraduate career (see “Program” below for suggestions). This program will be regarded not as strictly binding, but as indicating an intended plan of study; appropriate substitutions can be made later with the approval of the student’s advisor and of the Committee. In reaching a decision on the admission of an applicant, the Committee will pay special attention to items (3) and (4).

Each student enrolled in the Honors Program in Mathematics will

1. Satisfy the requirements for the B.S. in Mathematics, maintaining at least a 3.5 grade average in all mathematics courses.
2. Enroll in the Honors sections of mathematics courses whenever possible.
3. Complete at least 4 units of Mathematics 199. Independent work (199) requires that the student obtain the consent of a member of the Department faculty to supervise and evaluate the student’s work. This work may be spread over a period of two or more quarters as the student and the faculty member may agree.
4. Complete at least 6 units of additional work as approved by the Committee. This may consist of one of the following options, or of a combination of them:
   a) Additional independent work or seminar work as in (3) above;
   b) Additional undergraduate course work in mathematics or other subjects having high mathematical content and contributing to a broad mathematical and/or scientific knowledge;
   c) Completion of one or more of the basic graduate courses in mathematics such as courses 205, 206, 210, 217. (This is especially recommended for students who plan to enter graduate work in mathematics.)

**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 555 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 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 45 units of graduate courses (i.e., courses numbered 200 and above). In addition the student must pass Qualifying Examinations given by the Department, and demonstrate the ability to read French, German, or Russian.
Beyond the requirements for candidacy, the student must complete a course of study of at least 30 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 his second language examination and the University Oral Examination. A student must receive a grade of B or better in a course in order that it satisfy a requirement for the Ph.D. degree.

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, or 51, 52, 53, 54) 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, 46 and 55, 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, or 51, 52, 53, 54) 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, 157, 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, the Master of Arts in Teaching."

COURSES

INTRODUCTORY AND UNDERGRADUATE COURSES

Introductory courses will be offered only if twenty or more students enroll.

1. Algebra and Trigonometry—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 (——) MTWThF 8 and 2:15
Win (——) MTWThF 8

2A. Mathematics Workshop—The main aim of the workshop is to have students learn that they can do mathematics, regardless of their previous experience. The material a student covers will depend in large part on that student's own needs. Those planning to take calculus and university level science courses will be able to study pre-calculus mathematics, including algebra and trigonometry, to a sufficient depth so that they will be well prepared. Those who do not plan to continue their study of mathematics, but who want some familiarity with the mathematical way of thinking, will be presented with a wide variety of topics in math-
emematics and its applications from which to choose. The course is designed so that students work at their own pace with as much individual attention as they desire. See Time Schedule for times of sections.

4 units, Aut (deLeeuw) MWF 3:15 and sections
Win (deLeeuw) MWF 3:15 and sections
Spr (deLeeuw) MWF 3:15 and sections

2B. Mathematics Workshop — Continuation of 2A.
4 units, Aut (deLeeuw) MWF 2:15 and sections
Win (deLeeuw) MWF 2:15 and sections
Spr (deLeeuw) MWF 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 of 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, area and other applications. Law of large numbers, central limit theorem. Prerequisites: algebra and trigonometry.

3 units, Aut (—) MWF 8, 9, 10, 12, 1:15, and 2:15
Win (—) MWF 8, 10, and 2:15

6. Calculus and Probability — Continuation of 5. Prerequisite: 5.
3 units, Win (—) MWF 8, 9, 10, 12, 1:15, and 2:15
Spr (—) MWF 8 and 2:15

3 units, Aut (—) MWF 8 and 2:15
Spr (—) MWF 8, 9, 10, 12, and 1:15

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 same as for 41.

3 units, Aut (—) MWF 8, 10, 1:15, and 2:15
Win (—) MWF 10 and 2:15

3 units, Win (—) MWF 8, 10, 1:15, and 2:15
Spr (—) MWF 10 and 2:15

3 units, Aut (—) MWF 8
Spr (—) MWF 8, 10, 1:15, and 2:15

3 units, Aut (—) MWF 2:15

23. Analytic Geometry and Calculus — Continuation of 22. Prerequisite: 22.
3 units, Aut (—) 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 engineering, or who need a more extensive and detailed study of analytic geometry and calculus 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 equations, 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 trigonometry.

5 units, Aut (Suns) MTWThF 8
Bacon) MTWThF 9
Berg) MTWThF 10
Win (—) MTWThF 1:15

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) MTWTThF 9

42. Analytic Geometry and Calculus—Continuation of 41. Prerequisite: 41.

5 units, Win (Sunseri) MTWTThF 9
Spr (Bacon) MTWTThF 1:15

42A. Calculus—Continuation of 41A.
5 units, Win (Sunseri) MTWTThF 9

43. Analytic Geometry and Calculus—Continuation of 42. Prerequisite: 42.

5 units, Aut (——) MTWTThF 1:15
Spr (Sunseri) MTWTThF 9

43A. Calculus—Continuation of 42A. Concurrent registration in 44 is permissible.
3 units, Spr (Sunseri) TTh 9

44. Advanced Calculus I — Infinite series, convergence tests, parallel topics on improper integrals. Uniform convergence. Power series. Complex numbers. Prerequisite: 7, 23, 43, or 43A, or concurrent registration in 23, 43, or 43A and consent of instructor.

3 units, Aut (——) MWF 8, 9, 10, 12, 1:15, and 2:15
Win (——) MWF 9 and 1:15
Spr (——) MWF 9

45. Advanced Calculus II — Vectors and curves in the plane. Functions of two variables, directional derivatives, gradient, line integrals, double integrals. Plane mappings, vector fields, Green’s theorem. Prerequisite: 43.

3 units, Win (——) MWF 9, 10, and 1:15
Spr (——) MWF 9 and 1:15

46. Advanced Calculus III—Vectors, curves and surfaces in space. Functions of several variables, vector calculus, multiple integrals, surface integrals, Stokes’ theorem, divergence theorem, differential forms. Prerequisite: 45.

3 units, Spr (——) MWF 2:15

51. Honors Calculus — The aim of the sequence (51, 52, 53) is to present the content of (41, 42, 43) with additional study of the underlying concepts, generalizations, extensions and applications to mathematics and science of this material. Emphasis will be placed on the solution of problems and the technique of proof in analysis.

Students in the sequence will attend one of the sections of (41, 42, 43) or (41A, 42A, 43A) (unless they have appropriate advanced placement) as well as the scheduled afternoon meetings of the course. (Students with advanced placement may receive 1 or 2 units of credit for the course.)

6 or 7 units, Aut (Berg) MW 2:15

52. Honors Calculus—Continuation of 51.
6 or 7 units, Win (Berg) MW 2:15

53. Honors Calculus—Continuation of 52.
6 or 7 units, Spr (Berg) MW 2:15

54. Honors Calculus — 54, 55, and 56 constitute an honors sequence in advanced calculus. The material covered is a more general version of 44, 45, 46, together with some of the topics of 115, 116, and 117. Prerequisites: 53 and 113 (or concurrent registration in 113), and consent of instructor.

4 units, Aut (Brumfield) MWF 9

55. Honors Calculus—Continuation of 54.
4 units, Win (Brumfield) MWF 9

56. Honors Calculus — Continuation of 55.
4 units, Spr (Brumfield) MWF 9

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 (——)
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.
101. Linear Algebra and Differential Equations—Linear algebra serves to simplify and unify a large part of the theory of differential equations. Conversely, this application to differential equations motivates and illuminates much of the theory of linear algebra. The sequence (101, 102) seeks to exploit this reciprocal relationship between linear algebra and differential equations by developing them simultaneously. Students who complete the sequence will have the equivalent of courses 113 and 130, and will be eligible to enroll in 114, 120, or 131. Prerequisite: 44 or concurrent registration in 44.

3 units, Aut (—) MWF 2:15

102. Linear Algebra and Differential Equations—Continuation of 101.

3 units, Win (—) MWF 2:15

103. Linear Algebra and Differential Equations—Continuation of 102. Includes equivalent of 114.

3 units, Spr (—) MWF 2:15

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: 45.

3 units, Aut (—) MWF 1:15
Spr (—) 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 (—) MWF 9, 11, and 1:15
Win (—) MWF 9
Spr (—) MWF 9 and 1:15
Sum (—)

113H. Linear Algebra and Matrix Theory (Honors).

3 units, Aut (Bennett) MWF 11

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 (—) MWF 11
Win (—) MWF 11
Spr (—) MWF 10

114H. Linear Algebra and Matrix Theory (Honors)—Continuation of 113H.

3 units, Win (Bennett) 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 (—) MWF 11 and 1:15
Win (—) MWF 10


3 units, Win (—) MWF 11 and 1:15
Spr (—) MWF 10


3 units, Spr (—) MWF 11

120. Modern Algebra—Integral domains, fields, polynomials, divisibility theory, groups. Prerequisite: 113.

3 units, Win (Bennett) MWF 2:15
Spr (Zafran) MWF 2:15

121. Modern Algebra—Continuation of 120.

3 units, Spr (Bennett) MWF 2:15

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 (Chung) MWF 9

124. Introduction to Stochastic Processes—The discussion will include types of Markov chains, branching and queuing processes,
applications to order statistics, and an introduction to Brownian motion. Prerequisite: 123.

3 units, Spr (Chung) 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 (——) MW 8 and 11
Win (——) MW 11 and 2:15


3 units, Win (——) MW 11 and 2:15
Spr (——) MW 10


3 units, Spr (——) MW 11

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, from the unifying viewpoint of transformation groups. Prerequisite: 113.

3 units, Aut (Bennett) MW 2:15

143. Topics in Geometry — Selected topics. Possible choices include algebraic geometry, differential geometry, and foundations of geometry.

3 units, Spr (——) MW 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, Win (Hawley) MW 11

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) MW 1:15


161. Introduction to Set Theory—(Enroll in Philosophy 161.) 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.

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.

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.

190A. 3 units, Aut (Schiffer) MW 3:15

190B. 3 units, Win (Schiffer) MW 3:15

195. Mathematics Workshop Consulting—Students enrolled in this course will act as
consultants for those taking Mathematics 2, Mathematics Workshop, which is a self-paced course based on the mastery learning approach. Class time in Mathematics 195 will be used to discuss the materials developed for Mathematics 2, student-consultant interaction, and also generally to provide feedback for the refinement of mastery learning-programmed instruction techniques. This course may be repeated for credit.

3 units, Aut (deLeeuw) MWF 1:15 and by arrangement
Win (deLeeuw) MWF 1:15 and by arrangement
Spr (deLeeuw) 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 (Hawley) 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 see Professor deLeeuw.

(Staff) by arrangement

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS


205A. 3 units, Aut (deLeeuw) MWF 10
205B. 3 units, Win (Gleason) MWF 10
205C. 3 units, Spr (Gleason) 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.

206A. 3 units, Aut (Ortel) MWF 11
206B. 3 units, Win (Ortel) MWF 11
206C. 3 units, Spr (Ortel) 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 (Brumfiel) MWF 1:15
210B. 3 units, Win (Milgram) MWF 1:15
210C. 3 units, Spr (Milgram) 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 (Osserman) MWF 2:15
217B. 3 units, Spr (Osserman) MWF 2:15

220A,B. Methods of Mathematical Physics — Potential theory; Green’s function, integral equations; Hilbert space approach to problems of mathematical physics; elementary spectral theory; variational methods.

220A. 3 units, Aut (Schiffer) MWF 1:15
220B. 3 units, Win (Schiffer) MWF 1:15

230A,B. Advanced Probability — Funda-
mental concepts, weak and strong laws of large numbers, convergence of distributions and the central limit theorem, infinitely divisible distributions and stable laws. Pre-requisite: 205A.

230A. 3 units, Win (Chung) MWF 3:15
230B. 3 units, Spr (___) MWF 3:15


233. Topics in Probability Theory—Markov chains in discrete and continuous time. Only the elements of real analysis and probability theory (e.g., Math 115 and 123) will be assumed.

3 units, Aut (Chung) MWF 3:15

235A,B,C. Selected Topics in Ergodic Theory—Topics from: The Kolmogorov-Sinai theory of entropy; the isomorphism theorem for Bernoulli shifts and Bernoulli flow; K-automorphisms applications to mechanical systems, and automorphisms of compact groups.

235A. 3 units, Aut (Ornstein) by arrangement
235B. 3 units, Win (Ornstein) by arrangement
235C. 3 units, Spr (Ornstein) by arrangement

237A,B,C. Advanced Numerical Analysis—(Enroll in Computer Science 237A,B,C.)


Alternate years, given 1974-75


Alternate years, given 1974-75


245A. 3 units, Aut (Kiremidjian) MWF 11
245B. 3 units, Win (Kiremidjian) MWF 11
245C. 3 units, Spr (Kiremidjian) MWF 11

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; Fuchsian theory, Hamiltonian systems, existence of periodic solutions and orbital stability.

254A. 3 units, Win (Gilbarg) TTh 1:15-2:30
254B. 3 units, Spr (Gilbarg) TTh 1:15-2:30


256A. 3 units, Aut (Simon) TTh 11:00-12:15
256B. 3 units, Win (Simon) TTh 11:00-12:15
256C. 3 units, Spr (Simon) TTh 11:00-12:15


258A. 3 units, Aut (Cohen) MWF 1:15
258B. 3 units, Win (Cohen) MWF 1:15
**MATHEMATICS**


- **261A.** 3 units, Aut (Enflo) MWF 10
- **261B.** 3 units, Win (Enflo) MWF 10
- **261C.** 3 units, Spr (Enflo) by arrangement


*Alternate years, given 1974–75*

**263A,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 1974–75*

**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 1974–75*

**274. Topics in the Mathematical Theory of Surface Tension** — The course will deal principally with the qualitative properties of the interface between two fluids as determined by the fluid and boundary materials and the boundary geometry. Conditions for existence and for non-existence of solution surfaces will be given. Some experimental demonstrations may be included.

- **2 units, Win (Finn) MW 2:15**


- **281A.** 3 units, Aut (Samelson) MWF 9
- **281B.** 3 units, Win (Samelson) MWF 9
- **281C.** 3 units, Spr (Samelson) MWF 9

**283A,B. Selected Topics in Topology** — Topics from: loop spaces and classifying spaces, cohomology operations, homotopy theory, differential topology.

- **283A.** 3 units, Aut (Milgram) MWF 9
- **283B.** 3 units, Win (Brumfiel) MWF 1:15

**286A,B. Topics in Algebraic Geometry** — Local and global methods in the theory of singularities, applications to questions of birational desingularization and deformation theory. Prerequisite: basic graduate course in algebraic geometry, or its equivalent.

*Alternate years, given 1974–75*

**287A,B. Modular Forms and Algebraic Number Theory** — The course will begin with an essentially self-contained introduction to both the classical theory of modular forms of one complex variable, and the recent notion of a p-adic modular form. The rest of the course will be devoted to Serre's construction of the p-adic zeta function of a totally real number field via p-adic modular forms, and to related questions in Iwasawa's theory of Z_p-extensions of number fields and the K-theory of number fields. Prerequisites: 210 and 206, or equivalent. The bulk of the course will require only a rudimentary knowledge of algebraic number theory and functions of one complex variable.

- **287A.** 3 units, Aut (Coates) MW 3:15–4:30
  Win (Coates) MW 3:15–4:30

**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 (Stavi) MWF 11
- **290B.** 3 units, Win (Stavi) MWF 11
- **290C.** 3 units, Spr (Feferman) TTh 1:15–2:30

**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 1974–75*

**292A,B. Topics in Recursion Theory** — Selected principally from: recursive ordinals, hierarchies, hyperarithmetic sets, and other generalizations of recursion theory; advanced theory of recursively enumerable
sets and their degrees of undecidability. Pre-
requisite: 290 or equivalent.

Alternate years, given 1974–75

293A, B. Topics in Proof Theory — Selected
principally from: Gentzen's theory of formal
rules for finite and infinitary languages; an-
alysis 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, Win (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.

294A. 3 units, Win (Stavi) MWF 9
294B. 3 units, Spr (Stavi) MWF 11

350. Directed Reading.
Any quarter (Staff) by arrangement

351. Seminar Participation — Participation
in a student-organized graduate seminar un-
der 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 calcu-
lus 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

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 The-
ory.
By arrangement

388. Seminar in Probability and Stochastic
Processes.
By arrangement

389. Seminar in Mathematical Biology.
By arrangement

391. Seminar in Foundations of Mathemat-
ic.s.
By arrangement

MODERN
THOUGHT AND
LITERATURE

Committee in Charge: Albert J. Guerard
(English), Chairman, Marc Bertrand
(French), Keith Boyle (Art), John Foster
(English), Jean Franco (Spanish and Com-
parative Literature), René Girard (French
and Modern Thought and Literature) on
leave autumn and winter quarters, David
Halliburton (English and Comparative
Literature, and Modern Thought and Lit-
erature), Bridget O'Laughlin (Anthropol-
yogy), winter and spring quarters, Michelle
Rosaldo (Anthropology), autumn quarter,
Robert Sears (Psychology), autumn quar-
ter

The Committee sponsors a program lead-
ing to the Ph.D. in Modern Thought and
Literature. This degree is designed for stu-
dents intending to teach modern literature
in interdisciplinary programs or in English
departments. It assumes serious interest in
one or more areas of modern thought: his-
tory, psychology, philosophy, anthropology,
linguistics, political and social thought, re-
ligious studies, the several arts, contempo-
rary culture generally. The term modern is
construed to mean, roughly, from the En-
lightenment 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.

**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 normally be taken in the third year of graduate study.

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.

148. Literature and the Performing Arts—(Same as English 148.)
5 units, given alternate years

160. The Minority Voice in Contemporary Literature—(Same as English 160.)
5 units, given alternate years

169. Literature Under Attack — (Same as English 169.)
5 units, given alternate years

171. “Literary” Criticism and Structural Analysis—(Same as French 117 and Comparative Literature 117.) A critical appraisal of structuralist and post structuralist thought: Barthes, Deleuze, Derrida, Foucault, Girard, Levi-Strauss and others.
4 units, Spr (Harari)

174. Myth and Violence in Literature — (Same as French and Italian 114 and Comparative Literature 114.)
3 to 4 units, given alternate years

177. The Loss of the Self in Modern Theater—(Same as Italian 187 and Comparative Literature 187.) This course will cover a number of works and theories of modern western theater (from Pirandello and Ibsen to Artaud and Beckett) and their relationship to the social structure in which they developed and against which they often reacted. In English.
4 units, Win (Braghieri)

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 under-
graduates 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

210. History of Dramatic Criticism—(Same as Drama 351 and Comparative Literature 351.)
4 units, Win (Chioles)

211. Seminar in Comparative Drama—(Same as Drama 352 and Comparative Literature 356.)
4 units, Win (Lyons)

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)

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)

228. The Culture of England, 1890–1914—(Same as English 218A and Comparative Literature 218A.)
5 units, given alternate years

229. Politics, Society, and Art in Modern European History—(Same as History 229 and 328A.) Explorations of the political and social dimensions of art, 1870–1945. The readings and discussion will concentrate on transnational aesthetic movements and their interaction with political and social forces in particular countries. In 1973–74 the course is devoted to an analysis of the political attitudes expressed in the cartoons of Honoré Daumier.
5 units, Win (Paret)

230. Biography and History—(Same as History 229A and 303.) The course explores techniques of biography, the strengths and limitations of the genre, and the place of biography in history.
5 units, Spr (Paret)

231A,B. Russian Intellectual History—(Same as History 118A,B, Slavic Languages and Literatures 118A,B and Comparative Literature 118A,B.) Study of major trends and documents in the history of Russian thought from the late eighteenth century to the First World War. Readings (in translation) will be drawn from literature, criticism, memoirs and correspondence, political and social theory, philosophy and history. Enrollment limited to 30, permission of instructors required.

8 units, Aut, Win (Brown, Emmons)

240. Conversion and World View Reorganization—(Same as Anthropology 140, 240.) Seminar on the nature of altered states of consciousness, mind-manipulative techniques, and the way in which these are articulated into particular views of the world and the individual. Material from primitive and modern societies will be considered. Limited enrollment. Prerequisite: consent of instructor.
5 units, Aut (H. Whitehead) TTh 3:15–5:05

242. Symbolic Anthropology—(Same as Anthropology 142.) 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, Spr (Whitehead) MWF 9

243. Primitive Religion—(Same as Anthropology 243.) Readings in classical social theory (Weber, Durkheim, Freud, Levy-Bruhl) on the nature of primitive religion, followed by more contemporary works which develop interpretations of such phenomena as religious sects, worship, rites of passage, magic, shamanism, and dreaming. Prerequisite: consent of instructor.
5 units, Aut (R. Rosaldo) TTh 9:00–10:20

245. Language and Social Interaction—(Same as Anthropology 163, 263.) Seminar examining ways in which people use language to signal and create social identities, relationships and meanings. We will explore a number of topics in 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, Aut (M. Rosaldo) TTh 10:20-11:50

246. Time Perspective in Anthropological Studies—(Same as Anthropology 181/281.) Seminar for graduate and undergraduate students on anthropological approaches to the study of historical processes in pre-industrial societies; readings on theory and on the integration of linguistic, archaeological, and ethnohistorical materials; case studies of diachronic re-analysis of selected ethnographies. Prerequisite: consent of instructor.

5 units, Win (O'Laughlin) MW 3:15-5:05

247. Selected Problems in Anthropological Theory—(Same as Anthropology 183.) Advanced undergraduate seminar in anthropological theory; introduction to seminar controversies and opposed traditions in the analysis of society and culture. Lecture and discussion. Prerequisite: 2 or 3 courses in anthropology or sociology and consent of instructor.

5 units, Spr (O'Laughlin) TTh 10:00-11:50

252. Political Thought: Modern Ideas and Doctrines—(Same as Political Science 153.) The development of 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) MTWTh 10

253. Seminar on Freedom and Equality—(Same as Political Science 163, 263.) An analysis of the tensions between these two values, and varied treatment of these concepts, in modern social thought. Readings will be taken from contemporary political philosophers as well as from selected earlier theorists, including Hobbes, Rousseau, and Tocqueville.

5 units, Aut (N. Keohane) W 2:15-4:05


5 units, Win (Drekmeier) T 7:30-9:30 p.m.

255A, B. Theory, Power and Social Science—(Same as Political Science 158A, B and 258A, B.)

258A. The development of modern social science and social philosophy; discussion 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.

258B. 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 other 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. 258A strongly recommended.

5 units, Win, Spr (Drekmeier) MTWThF 10

260A, B. "Modernisms"—(Same as Political Science 160A, B and 260A, B.)

5 units (Rogat) given alternate years

261. The Impressionist and Experimental Novel—(Same as English 235 and Comparative Literature 235.) Critical analysis of impressionist masters (Conrad, Faulkner, Lowry), of major experimental novelists (Joyce, Kafka) and of several living writers (Hawkes, Barthelme, etc.) Prerequisite: 135 or equivalent.

5 units, Aut (Guerard)

262. Nietzsche and the Modern Novel —(Same as English 262 and Comparative Literature 262.)

5 units, given alternate years

263A. Existential and Visionary Literature—(Same as English 263A and Comparative Literature 263A)

5 units, given alternate years

263B. The Existential Hero in Modern Literature—(Same as English 263B and Comparative Literature 263B.)

5 units, given alternate years

264. Poetry and Ideas: Johnson to Blake—(Same as English 254B.)

5 units, Win (Davie)

265. The Feminine Mystique in American Fiction—(Same as English 265.) The presentation of women in some American novels and short stories; also women writers whose
fiction chronicles the struggle toward selfhood.

5 units, Win (Martin)

269A. Toward an Understanding of Romanticism—(Same as English 269A and Comparative Literature 269A.)

5 units, given alternate years

269B. Toward an Understanding of Modernism—(Same as English 269B and Comparative Literature 269B.) Major currents in modern literature such as the Symbolist aesthetic, existentialism, myth, psychoanalysis, and new conceptions of nature and cultural history. Prerequisite: one course in modern literature, either English or European. Reading knowledge of French or German desirable.

5 units, Spr (Foster)

270. Modern Critical Thought: The Symbolist Heritage—(Same as French 270 and Comparative Literature 270.)

3 to 5 units (Cohn) given alternate years


4 units, Spr (Harari)

273. Individu et societe dans le roman francais contemporain—(Same as French 283.)

4 units, given alternate years


3 units (Bertrand) given alternate years

285. Psychology of Biography—(Same as Psychology 285.) Analysis of novelists’ personalities through data from their life histories and creative writing. Lectures, readings, and exercises on analytic methods, including content analysis and relating of social behavior to fantasy and symbolic expressions of motivation. Writing a psycho-biography of a novelist or artist is optional.

4 units, Aut (Sears) TTh 11; T 2-4

291. Workshop in Creation and Criticism—(Same as English 291.)

3 to 5 units, (Guerard) given alternate years

337. Graduate Colloquium: European Intellectual History Since the Enlightenment—(Same as History 337.)

5 units, Aut (Robinson)

360. Seminar: The Enlightenment and Its Literary Traditions—(Same as English 315F and Comparative Literature 315F.)

5 units, given alternate years

361. Seminar: The Modern Tradition—(Same as English 361 and Comparative Literature 361.) Introduction to the interdisciplinary study of modern thought and literature with emphasis on such modern developments as structuralism, phenomenology, and Marxism.

5 units, Spr (Halliburton)

362A. Seminar: Psychology and Literature—(Same as English 362A.)

5 units, given alternate years

362B. Seminar: Problems of Psychological Interpretation—(Same as English 362B and Comparative Literature 362B.)

5 units (Moser) given alternate years

363. Seminar: Romantic Irony—(Same as English 316C and Comparative Literature 316C.) An attempt to define the notion of Romantic Irony by studying the theoretical formulations of F. Schlegel, Schiller, and Coleridge and the ways in which such a philosophical attitude determines the structure and content of the poetry of Blake, Coleridge, Shelley, Byron, Keats, and Yeats, and the novels of Lewis Carroll, Virginia Woolf, and Joyce Cary.

5 units, Spr (Mellor)

364B. Seminar: Capitalism and Literature in the 19th Century—(Same as English 364B.) A study of the theme of money in Victorian and Edwardian fiction with glosses from certain works of psychology, anthropology and economics. (Freud, Marx, Keynes, Veblen, etc.)

5 units, Spr (Stone)

365A. Seminar: The Landscape in American Literature—(Same as English 365A.)

5 units, Win (Momaday)
SCHOOL OF HUMANITIES AND SCIENCES

369. Seminar: Major Modern Critics — (Same as English 369 and Comparative Literature 369.) Reading and discussion of critical writings and theories of influential modern figures such as Auerbach, Kenneth Burke, Spitzer and Lukacs. Emphasis on twentieth century (e.g. existentialism, structuralism, Marxism), but the course will also place modern critics in tradition beginning with Aristotle.
   5 units, Aut (Halliburton)

373. Religionskritik im 19. Jahrhundert — (Same as German Studies 360.)
   4 units, (Bark) given 1974-75

374. German and European Romanticism— (Same as German Studies 382 and Comparative Literature 382.)
   4 units, Win (Mueller-Vollmer) MWF 3:15

376. Phenomenological Approach to Literature — (Same as German Studies 400 and Comparative Literature 400.)
   4 units, Spr (Mueller-Vollmer) Th 4:15-6:05

   5 units (I. Yalom) given alternate years

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

399. Thesis.
   Any quarter, by arrangement

RELATED COURSES

Students of Modern Thought and Literature are referred to the offerings of the several literature departments and of Comparative Literature. A few courses of special interdisciplinary interest are listed below. Consent of the instructor is required for most of these.

ANTHROPOLOGY
245. Political Anthropology.
255. Advanced Psychological Anthropology.
256. Cultural Transmission.

ART
229B. Seminar in Political, Social Caricatures and Satires in England During the Eighteenth Century.

ASIAN LANGUAGES
255. The Nature of Literature: Japanese and Western Views.

COMMUNICATION
180. Broadcasting and Film Criticism.

ENGLISH
266. Romantic Historical Literature.

FRENCH AND ITALIAN
188. Le Surrealisme.
396. Introduction to Existentialism.

GERMAN STUDIES
241. Deutsche Geistesgeschichte I — Von der Aufklärung zur Romantik.
242. Deutsche Geistesgeschichte II — Von der Romantik bis Nietzsche.

HISTORY
153A,B. Cultural History of the United States.
163. The American Character.
463. Graduate Seminar: The American Character.

HUMANITIES

SPECIAL PROGRAMS
251. Basic Humanistic Problems.
253. The Idea of the University.
305. The Early Modern Period.
306. Modernism and the Consciousness of the Humanities.

LINGUISTICS
245. Sociolinguistics.
PHILOSOPHY
103. Philosophy in the Nineteenth and Early Twentieth Centuries.
181. Philosophy of Language.
199. Seminar in Recent Philosophical Literature.

POLITICAL SCIENCE
267. Montesquieu and Rousseau.

PSYCHOLOGY
121. Social Psychology.
132. Theories of Personality.
136. Abnormal Psychology.
146. Language and Thought.
172. Psychology of Perceptual Experience.

RELEVANT STUDIES
(See Humanities Special Programs)
233. Nineteenth and Twentieth Century Religious Thought.

SOCIOLOGY
201. Introduction to Sociological Research.
250. Basic Problems in Sociological Theory.

MUSIC
Emeritus: Putnam C. Aldrich, William L. Crosten (Professors)
Chairman: Albert Cohen
Associate Professors: Imogene Horsley, George Houle (on leave 1973–74)
Senior Lecturers: Arthur P. Barnes (Director of Bands), Marie Gibson (Voice)
Assistant Professor: John M. Chowning. Acting: William H. Mahrt
Lecturers: Martin Bresnick (Theory); Meredith Ellis Little (Early Music Performance); Adolph Baller, Earle Blew, Nathan Schwartz,* Naomi Sparrow (Piano);
* 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 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)
   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 A-B, 103 A-B</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 A-B</td>
<td>6</td>
<td>—</td>
<td>—</td>
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</tbody>
</table>

**Teaching Credential (Secondary) — Internship 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 advanced degrees.

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 investigatory 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 interest. 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 on entrance 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) An advisory examination to be taken toward the end of the student's second quarter in residence, to determine whether he will be recommended to continue work for the degree; (2) a final comprehensive examination to be taken not later than the quarter preceding that in which the candidate expects to receive the degree.

**Doctor of Philosophy**

A limited number of students with superior qualifications are accepted by the Department for work toward the Ph.D. degree in music.

General University regulations regarding this degree are discussed in the section "Degrees" in this bulletin.

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.

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, in the second quarter of the second year of full-time residence; (2) a written examination in the candidate's special area of concentration, in the first quarter of the third year; (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.
MUSIC 389

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 (Staff)
2A. The Symphony.
   3 units (Barnes)
2B. The Concerto.
   3 units (Kuhn)
2C. Opera.
   3 units (____)
2D. Listener's Introduction to Chamber Music.
   3 units (Schwartz)
3A. Renaissance and Baroque Music.
   3 units (Mahrt)
3B. New Music — Instrumental, vocal and electronic music since 1950. New forms and performing media in relation to contemporary aesthetics.
   3 units (____)
4A. The Music of J. S. Bach.
   3 units (Nanney)
4B. The Music of Mozart.
   3 units (Nanney)
4C. The Music of Beethoven.
   3 units (Salgo)
4D. The Music of Stravinsky.
   3 units (Barnes)

FOUNDATION COURSES

FOR A.B. MAJOR

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. No prerequisite for 21 except ability to read music.
   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)
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)
102A. Music History: Classic — Prerequisites: 23.
   3 units, Win (Ratner)
102B. Eighteenth Century Harmonic Practice.
   3 units, Win (Ratner, Staff)
103A. Music History: Romantic—Prerequisites: 102 A-B.
   3 units, Spr (Cohen)
103B. Nineteenth Century Harmonic Practice.
   3 units, Spr (Staff)
104A. Music History: Modern — Prerequisites: 103 A-B.
   3 units, Aut (Smith)
104B. Twentieth Century Techniques.
   3 units, Aut (Staff)
Note: 102 A-B must be taken concurrently—the same applies to 103 A-B and 104 A-B.

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: 103B.
   3 units (Ratner)
127. Orchestration—Prerequisite: 23.
   3 units, Aut (Barnes)

220A. Computer Generated Sound — Introduction to sound synthesis and acoustical analysis using the computer. Problems of circuit design in generating sound after having determined the significant parameters through acoustical analysis. Prerequisite: experience in musical composition or consent of instructor.

4 units, Aut (Chowning)

220B. Compositional Programming Techniques—Use of the Fortran programming language as a compositional tool. Problem solving: given a verbal and/or notational description of some complex musical event, how this event can be characterized in an algebraic language such as Fortran. Prerequisite: 220A.

4 units, Win (Chowning)

220C. Music IV Program — Detailed study of an all-Fortran sound-generating and composing program which can be operated at most university computer installations. Prerequisite: 220B.

4 units, Spr (Chowning)

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)

228. Studies in Thorough-Bass—Prerequisite: 102A,B.

228A. 4 units (Horsley)

228B. 4 units (Horsley)

229. Harmony and Counterpoint—Graduate review of harmonic functions; relation between details of composition and total structure.

4 units (Smith)

HISTORY AND LITERATURE OF MUSIC

Unless otherwise stated, prerequisites for any course in this section are 103A,B.

140. Studies in Medieval and Renaissance Music—Prerequisite: 100.

140A. The Italian Madrigal.

4 units (Horsley)


141A. The Music of Handel.

4 units (Horsley)


142A. String Quartets of Beethoven.

4 units (Ratner)

142C. Chamber Music of the Classic Period.

4 units (Ratner)


4 units (——)

144. Studies in Modern Music — Prerequisites: 104A,B.

144A. Twelve-Tone and Serial Music.

4 units (Smith)

144B. Innovations in Contemporary Music.

4 units (Smith)

150. History of Musical Instruments.

4 units (——)

153. Organ Literature.

153A. Organ Literature (Cabezón to Bach).

4 units (Nanney) given 1974–75

153B. Organ Literature (Bach to Ligeti).

4 units (Nanney)

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 $25 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.
   (Buetens)

74D. Baroque String Performance Class.
   (Buetens)

75A. Wind Instruments Classes.
   (Staff)

75B. Renaissance Wind Instruments Class.
   (Staff)

76. Brass Instruments Classes.
   (Staff)

77. Percussion Class.
   (——)

172, 173, 174, 175, 176, 177, 272, 273, 274, 275, 276, 277. Individual Vocal and Instrumental Instruction—A special fee of $50 per quarter for majors and $100 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)

174B, 274B. Viola.
   (Persinger)

174C, 274C. Violoncello.
   (Hampton)

174D, 274D. Contrabass.
   (Siani)

174E, 274E. Viola da Gamba.
   (Blackman)

   (Buetens)

   (Chauvel)

175, 275. Woodwind Instruments.

175A, 275A. Flute.
   (Bernhard, Duran, Hawley)

175B, 275B. Oboe.
   (Duste)

175C, 275C. Clarinet.
   (Breeden)

175D, 275D. Bassoon.
   (Willoughby)

175E, 275E. Renaissance Wind Instruments.
   (Meyers)

176, 276. Brass Instruments.

176A, 276A. French Horn.
   (Saxton)

176B, 276B. Trumpet.
   (Bubb)

176C, 276C. Trombone.
   (Szabo)

176D, 276D. Tuba.
   (Cooley)

177, 277. Percussion.
   (Staff)

130. Orchestral Conducting—Prerequisite: 127.

130A. 3 units, Win (Salgo)
130B. 3 units, Spr (Salgo)

131. Choral Conducting.
   4 units, Win (Schmidt) given 1974–75

   4 units, Aut (Mahrt)

230. Advanced Orchestral Conducting.
   230A. 4 units, Win (Salgo)
230B. 4 units, Spr (Salgo)

231. Advanced Choral Conducting.
   231A. 4 units, Aut (Schmidt)
231B. 4 units, Win (Schmidt)

251. Choral Repertory (1500–1750).
   4 units, Aut (Schmidt) given 1974–75
252. Choral Repertory (1750 to Present).
   4 units, Aut (Schmidt)

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 peri-
ods. Lectures, individual research, and
practice sessions leading to concert perfor-
manres. May be repeated for credit. Prereq-
quisite: 169.

   269A. Medieval.
   4 units, Aut (Mahrt)

   269B. Renaissance.
   4 units, Spr (Mahrt)

   269C. Baroque.
   4 units, Win (Cohen)

   269D. Classic.
   4 units (Ratner)

279. Opera Workshop — Study of opera
through performance. Coaching in individu-
al roles and repertory, instruction in acting
and dance, and the public performance of
scenes and complete operas.

   4 units, Aut, Win, Spr (Salgo, Gibson,
   Staff)

ENSEMBLE

All courses listed in this section may be
repeated for credit, with a maximum of 24
units allowed toward graduation. Member-
ship 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 admis-
sion to any University musical organization.
Audition schedules will be announced in ad-
ance of each registration period.

158. Renaissance Wind Band.
   1 unit, Aut, Win, Spr (Mahrt) M 2:15–5:05

159. Contemporary Performance Ensemble.
   1 unit, Aut, Win, Spr (Bresnick,
   Chowning) T 4:15–6:05

160. University Orchestra.
   1 unit, Aut, Win, Spr (Salgo) 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 (Schmidt)
   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 per-
forming duties other than those required of
the regular Choir.

   2 units, any quarter (Schmidt) T 4:15–5:30
   and Th 7:00–8:30 p.m. and Sunday
   10–12

165. Stanford Chorale — Small vocal en-
semble specializing in performance of Re-
naissance and contemporary music.
   1 unit, Aut, Win, Spr (Schmidt) MTh 12

166. Chamber Orchestra — Open to ad-
vanced players who have had orchestral ex-
perience.
   1 unit, Aut, Win, Spr (Salgo) TF 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.
   1 unit, Aut, Win, Spr (Schwartz)

171. Chamber Music—Open to any student
with sufficient technical ability to play small combinations for strings, winds, and
keyboard instruments.
   1 unit, Aut, Win, Spr (Hampton, Staff)

271. Performance Special — For student:
who take part in performances organized in
Music 269 or 279 while not enrolled in ei-
the 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—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.
3 units, Aut (Colby)

201. Graduate Review in Musical Analysis.
4 units, Aut (Cohen)

299. Master of Arts Project.
4 units, any quarter (Staff)

300. Seminar in Musical Notation.
300A. 4 units, Aut (Horsley) given 1974–75
300B. 4 units, Win (Horsley) given 1974–75
300C. 4 units, Spr (Horsley) given 1974–75

301. Seminar in Music History and Analysis.
4 units, Aut, Win, Spr (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 (Salgo, Schmidt)

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

COURSES OFFERED OVERSEAS

1. Introduction to Music—(Taught at Stanford in Germany and Stanford in Italy.)
4 units, Spr, Germany
Sum, Italy (Ratner)

3D. Italian Music in the Eighteenth Century—(Taught at Stanford in Italy.)
4 units, Sum (Ratner)

4G. Works of Individual Composers — (Taught at Stanford in Germany.)
3 units, Spr (Ratner)

PHILOSOPHY

Emeriti: John D. Goheen, Jeffrey Smith (Professors)
Chairman: Julius Moravcsik
Director of Graduate Study: To be named
Director of Undergraduate Study: Robert Howell

Professors: Solomon Feferman, Dagfinn Føllesdal (one quarter only), K. Jaakko Hintikka (one quarter only), Georg Kreisel, Julius Moravcsik, John L. Mothershead, Jr., David S. Nivison (on leave 1973–74), Philip H. Rhinelander (winter quarter), Patrick Suppes
Associate Professors: Dov M. Gabbay (on leave winter and spring quarters). Visiting: Julie Jack (autumn quarter)

Assistant Professors: Nancy Cartwright, Robert Howell, Ilene Serene, Michael Tooley, Thomas Wasow (appointment begins winter quarter). Visiting: Ellen Coleman (winter quarter), Kit Fine (winter quarter), Gisella Striker (winter quarter). By Courtesy: Robert McGinn (Humanities Special Programs)

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 of Philosophy courses that have been accepted by the Department and the instructor as meeting the student's A.B. requirements, 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
   b) Ethics, aesthetics, social philosophy, value theory
   c) Epistemology, metaphysics
   d) History of philosophy

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.

HONORS PROGRAM IN PHILOSOPHY

The Honors Program in Philosophy is an integral part of a Tutorial Program. Both juniors and seniors may apply for individual tutorial with a member of the Department. Junior Tutorial will occupy 12 units (4 units each quarter) of the student's academic program and will be devoted to a course of study and research designed in consultation with his instructor. Juniors may, if this is a preferred type of instruction, apply for group tutorial to be conducted by a member of the Department. To be accepted for Senior Tutorial, normally a student must have demonstrated superior ability in Junior Tutorial.

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 stu-
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 Humanities 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. In the case of an exception, the student must petition the Department.

2. A student in the A.M. program, who has not matriculated in Philosophy, may take up to three years to complete the program (subject to the limitation in #1 above).

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.

**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) Greek Philosophy
         Pre-Socratics, Plato, Aristotle
      2) The Rationalists
         Descartes, Spinoza, Leibniz
      3) The Empiricists
         Locke, Berkeley, Hume
      4) 19th and 20th Century Philosophy
         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 one philosopher from each section.

b) Four sections:
   1) elementary logic (157A,B 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.

Course requirements, general and special, in the areas are as follows:

a) History of Philosophy
   1) general: four courses from the following: 100–104, 120, 122, 136, 137, 142, 144, 145, 146, 147, 178, 232, 236, 237 (at most one course in the group 100–104, 120, 122 may be included);
   2) special: two courses from the above list (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: 157A, 157B, 160A, 160B, and three additional courses chosen from the following: 157A, 157B, 160A, 160B, 161, 162, 163A, 163B, 164A, 164B, 165, 166, 188, 193, 201, 205, 206, 207, 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: 157A and 157B.

c) Epistemology and Metaphysics
   1) general: 184 plus three additional courses from the following: 169, 178, 180, 181, 182, 183, 189, 201, 202, 220, 244, 245;
   2) special: 184 plus one additional course from the above list.

d) Value Theory

1) general: 170 or 171 plus three additional courses from the following list: 170, 171, 174, 175, 177, 179, 188, 193, 203, 204, 215;
   2) special: 170, or 171, plus 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 but must be completed before the student is admitted to candidacy for the Ph.D. 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 inform the department secretary, no later than the first Monday in February, of the preliminary examinations they propose to take during that year. Second-year students should inform the secretary, by this same date, 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 examination (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 proposal is required for formal admission to candidacy for the doctoral degree.

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), 164A,B (Philosophy of Science), 166 (Probability and Induction), 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 (Moravcsik) MTWTh 10; section by arrangement

2. **Introduction to Ethics** — This is a systematic treatment of the major problems of ethical theory as these problems arise in the works of classical and contemporary moralists. Several ethical positions are surveyed critically, including intuitionism, utilitarianism, the emotive theory, and various forms of relativism, subjectivism, and absolutism. Among the topics discussed are: How are moral judgments related to scientific judgments? How are moral judgments justified? Are all human acts fundamentally selfish? Can morality be based on some conception of what is natural? What is the relation between value in general, the highest good, and obligation? Are the notions of freedom and responsibility meaningful if human actions are determined? What is the relation between personal value and social value? There are four lectures a week; a fifth hour is given to discussion sections.

   5 units, Aut (Serene) MTWTh 9

4. **Ancient Chinese Philosophy** — Examination of the major Chinese philosophers and the conflict of social and individual values from the Sixth Century through the Third Century B.C., against the background of interstate struggle, social evolution and the emergence of a universal empire.

   4 units, Win (Nivison) MTWTh 9, given 1974–75

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.

5 units, Aut (Mothershead) MTWThF 10; Th or F section

7A, B. Freedom and Authority: An Introduction to Social and Political Philosophy—The course is organized around the problem of institutional justification: By what standard or principle are social institutions—especially political and legal ones—properly justified and criticized? How can political authority be justified and individual liberty justifiably limited? Further topics include the concept of human welfare, distributive justice, the justification of disobedience from “trashing” to tyrannicide, game theory and the analysis of political processes, law and morality, natural law, the appeal to tradition, and others. Attention will also be given to philosophic aspects of certain topics of current social concern, like pollution and population control, sexual perversion and privacy, academic freedom, and peace. This is a two-quarter course, but the student may register for only 7A if he so wishes. Discussion sections are conducted as seminars. Recommended for freshmen.

7A. 3 units, Win (Staff) MW 11; Th or F section

7B. 3 units, Spr (Staff) MW 11; Th or F section


5 units, Aut (Cartwright) MTWTh 2:15

11. Philosophy and Literature—This course will examine some of the principal modern literary works expressing philosophical ideas (selection of reading will be announced later).

4 units, Aut (Howell) MWF 10


5 units, Aut (Gabbay) MTWThF 1:15

57A. Introduction to Logic—Content same as 15A. One hour lecture and four sessions at computer-based terminals at students' convenience. Enrollment in a given term will be restricted to 45 students. (Graduate students enroll in 157A.)

5 units, Aut, Win, Spr (Suppes) T 1:15

UNDERGRADUATE SEMINARS

27. Sophomore Seminar in Philosophy of Religion—A critical examination of the fundamental issues involved in the decision whether or not to believe in God. Attention will center upon: (1) traditional arguments in support of religious belief; (2) the problem of evil as an argument for atheism; (3) the relation between science and religion; (4) the relation between morality and religion; (5) contemporary criticisms of Christian belief. There will be two separate sections: enrollment in each will be limited to 20.

4 units, Aut (Tooley) W 4:15-6:05 or Th 4:15-6:05

28. Sophomore Seminar in Philosophy of History—Does the course of human events have a pattern, goal or “meaning”? Can future events be predicted? Does historical knowledge differ from scientific knowledge? Why do we expect a good historian to have imagination and literary ability? Can we, as historians, be “objective”? Should we be? What is the point of studying history? Are there some things that are eternal—that have no history at all? The seminar will assess various answers to these questions and will search for new ones.

3 units, Spr (Nivison) Th 4:15-6:05, given 1974-75

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 6A.

4 to 5 units, Aut (Mothershead) MTWTh 11

thought. St. Thomas Aquinas and the rise of scholasticism in thirteenth century. William of Occam and the nominalist attack on scholasticism. Philosophic thought in the Renaissance. Prerequisite: 100 or equivalent.

4 or 5 units, Win (Serene) MTWTh 11


4 or 5 units, Spr (Mothershead) MTWTh 11

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, Bradley, Nietzsche, Bergson, James, and Dewey. Prerequisites: two philosophy courses. Recommended: 102.

4 or 5 units, Win (Mothershead) MTWTh 9

104. Contemporary Philosophy—Some principal developments in contemporary philosophical thinking. Prerequisites: a total of two philosophy courses.

4 units (——) MTWTh 9, given 1974–75

106. Introduction to Philosophy—For graduate students. Lectures same as 5.

4 units, Aut (Mothershead) MTWThF 10; Th or F section

120. Ancient Chinese Philosophy—For advanced students. Lectures same as Philosophy 4, with special section.

4 units, Win (Nivison) MTWTh 9; F section; given 1974–75

122. Chinese Philosophy Since Classical Times — The major philosophers since the third century B.C. with emphasis on the period from Sung through middle Ch'ing. Buddhism will be reviewed but not treated in depth in this course. Prerequisite: 120 or equivalent.

4 units, Spr (Nivison) given 1974–75

English translation, including *Being and Nothingness*, and several of Sartre's novels and plays.

3 units (Føllesdal)

**SYSTEMATIC PHILOSOPHY**

**115A. Introduction to Logic**—For graduate students. Lectures same as 15A.

**156. Introduction to Ethics**—For graduate students. Lectures same as Philosophy 2. Special section for graduate students.

4 units, Aut (Serene) MTWTh 9

**157A. Introduction to Logic**—For graduate students. Lectures same as Philosophy 57A.

**157B. Introduction to Logic**—Continuation of 157A. Completeness proof, decidability, compactness and basic model theory; the axiomatic method. 157B bridges the gap between 157A and other courses in mathematical logic.

3 units, Win (Staff) MWF 1:15

**160A,B. Symbolic Logic**—Thorough treatment of validity, provability, consistency, completeness, definability and decision problems for logical calculi, and axiomatic theories.

160A. 3 units, Win (Staff) MW 11:00–12:15

160B. 3 units, Spr (Staff) MW 11:00–12:15

**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: 157B or 160A or equivalent.

3 units, Aut (Staff) MWF 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) MW 1:15; F section

**163A. Fundamental Concepts of Intuitionistic Logic**—Constructive operations applied to concrete and abstract objects, examples of intensional and extensional constructions, notion of free choice sequence, the concept of idealized mathematician. Role of Church's thesis. Derivation of formal laws from analysis of basic notions. Prerequisite: 157B or 160A or equivalent.

3 units, Aut (Kreisel) by arrangement, given 1974–75


163B. 3 units, Win (Fine) MTWTh 12

163C. 3 units, Spr (Fine) MWF 12

**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, Win (Cartwright) MW 1:15

**166. Wittgenstein's Philosophy of Logic**—An examination of Wittgenstein's views on the nature of mathematics and mathematical reasoning.

3 units, Spr (Kreisel) TTh 4:15–5:30

**167. Elementary Proof Theory.**

4 units, Win (Kreisel) TTh 4:15–5:30

**168. Philosophy of History**—Nature and limits of our knowledge of the past, the categories of explanation used by historians, and the aims of historical inquiry; relation of these problems to speculation about the "meaning" of history and the structure of historical process.

4 units, Aut (Nivison) MWF 2:15, given 1974–75

**169. Philosophy of Religion: A Critical Survey**—An examination of a number of central problems in the philosophy of religion with emphasis upon their relations to the issue of belief versus unbelief. Among the topics considered will be: (1) traditional arguments in support of religious belief; (2) arguments for atheism, with emphasis upon the problem of evil; (3) the relation between science and religion; (4) the relation between morality and religion; (5) the nature of religious experience; (6) philosophical criticisms of theological method; (7) contemporary criticisms of Christian belief.

4 units, Win (Tooley) MWF 3:15
PHILOSOPHY

170. Fact and Value—A discussion of some of the main problems connected with the nature of values and value judgments, especially as they arise in the twentieth century literature of value theory and "meta-ethics." Specific topics include the Naturalistic Fallacy, non-cognitivism, intrinsic and extrinsic value, the derivability of an "ought" from an "is," and the nature of ethical disagreement.

4 units, Win (Staff) TTh 11:00-12:15

171. Moral Obligation—A critical examination of the most prominent theories of moral obligation and a discussion of the problems an adequate theory must solve. Attention will be focused on the relation of duty to interest, the question whether moral obligations are essentially other-regarding, the connection between rectitude and goodness, the question "Why shouldn't I be moral?" and the generalizability of ethical judgments. In the forefront of the entire discussion will be the question, "What does 'What does moral obligation mean?' mean?"

4 units, Win (Staff) MTWTh 1:15

172. Psychology of Perceptual Experience—(Enroll in Psychology 172.)

173. Philosophy of Human Life—(Same as Human Biology 173.) This course in bioethics and philosophy of medicine is designed to relate moral philosophy (including ethics, value theory, and social philosophy) to the interests of the Human Biology Program. Its goals are to help students acquire the intellectual skills of the philosopher and to increase students' sensitivity to certain normative and conceptual issues. Topics include: (1) health, welfare, and the Good of Man; (2) moral obligation and its relation to social and individual welfare; (3) human life (including the meaning of life, the point of death, abortion, and personal identity; (4) human and social engineering; and (5) the distribution of medical and other welfare services.

3 units, Aut (Cartwright), given 1974-75

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 (Howell) TTh 2:15

175A,B. Freedom and Authority: An Introduction to Social and Political Philosophy—Lectures same as Philosophy 7A,B. For graduate students and advanced undergraduates. Special section. Units negotiable.

175A. 3 units, Win (Staff) MW 11; Th or F section

175B. 3 units, Spr (Staff) MW 11; Th or F section


3 units, Win (——) MWF 2:15, given 1974-75

179. Philosophy of Law—The nature and function of law, the relation of law to ethics, and the judicial process.

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, Win (Moravcsik) MTWTh 11

182. Metaphysics—An examination of some problems of ontology and essentialism. Prerequisite: 2 courses in Philosophy.

4 units, Win (Moravcsik) MTWTh 11

184. Theory of Knowledge—A survey of classical problems in epistemology. Attention will center upon: (1) nature of perceptual experience; (2) knowledge of the physical world; (3) knowledge of other minds; (4) knowledge of the past; (5) the problem of induction.

4 units, Win (Tooley) MTWTh 1:15

187. Moral Principles and Political Advocacy—An analysis of the manner in which individual moral principles may be brought to bear on evaluating alternative positions on complex social and political issues. Problems in separating moral and factual issues, clarifying the moral issues and evaluating factual evidence will be exemplified by an in-depth analysis of three relatively complex issues of current interest chosen from the list below. The course will have a seminar format. Instructors choose the first issue (to be announced before advanced registration)
and initiate discussion of it by presenting position papers for criticism. Students choose the two remaining issues to be considered, prepare position papers for prior distribution and criticism by the seminar, and re-write one paper in response to criticism as a term paper. Reading list on issues will be provided.

—Is there a “right to privacy” and if so what does it include?
—Should abortion on demand be legal?
—Should sale and use of marijuana be legal?
—Is there a moral basis for capitalism?
—Should capital punishment be outlawed?
—Should decisions about how to treat people be based on psychological tests?
—How much income redistribution is desirable?
—Is population control immoral?
—Should medical care be free to everyone who needs it?
—Should members of minority groups be compensated for past injustices?
—Should child care be free?
—Should deserters and draft resisters receive amnesty?

3 units, given 1974-75

188. Induction and the Theory of Rational Behavior—Subjective probability and utility; foundations of statistical decision theory; relation between subjective probability and frequency probability.

3 units, given 1974-75

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, Spr (Tooley) MTWTh 1:15


4 units, Aut (Tooley) by arrangement

192A,B,C. Undergraduate Colloquium — Group tutorial for undergraduates on topics chosen by the undergraduate student association.

192A. Aut (Staff) by arrangement
192B. Win (Staff) by arrangement
192C. Spr (Staff) by arrangement

193. Theory of Social Decision Making—An in-depth survey of social choice theory. An interdisciplinary subject belonging to social welfare economics, political science, political philosophy, and other disciplines concerned with decision making or public policy analysis. A systematic (formal models) approach will be taken to such topics as majoritarianism, Arrow’s paradox, “rationality” and the foundations of pure choice theory, the nature and measurement of human welfare, distributive justice, the nature and rationale of democratic political processes, act- vs. rule-utilitarianism, and fair solutions to conflicts of interest. Prerequisite: some acquaintance with naive set theory and axiomatic method. Consult instructor for details.

3 units, Spr (Fine) MW 2:15–3:30

196. Tutorial—Senior year.

5 units, any quarter (Staff) by arrangement

197. Individual Work for Undergraduates.

Any quarter (Staff) by arrangement

199A,B,C. Seminar in Recent Philosophical Literature—Open to junior and senior students with consent of instructor.

199A. Topic: Causality and Events.

3 units, Aut (Jack) T 4:15–6:05
199B. Topic: Philosophical Logic.

3 units, Win (Fine) T 4:15–6:05
199C. Topic: Philosophy of Religion.

3 units, Spr (Tooley) T 4:15–6:05

**Courses Intended Primarily for Graduate Students**

201. Mathematical Linguistics — Construction of categorical grammars as well as phrase-structure grammars. Introduction to probabilistic grammars. Main emphasis, however, on model-theoretic semantics of natural languages. Extension of model-theoretic semantics to procedural semantics. Recommended: 162.

3 units, Win (Suppes) MW 1:15


3 units, Win (Moravcsik) W 4:15–6:05, given 1974-75

203. Seminar in Ethical Theory—Analyses of texts by Moore, Ross, Stevenson, Hare, Dewey, and a selection of recent papers in
ethical theory will serve as the basis for discussion. One term paper or several short papers. Prerequisite: 2 or consent of the instructor.

3 units, Spr (Mothershead) T 2:15-4:05

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) MWF 1:15

210. Seminar in Mathematical Models of Learning and Instruction—(Same as Education 483.) Discussion of current work in mathematical models, with emphasis on theoretical concepts and problems of data analysis. For advanced students.

1 to 3 units, Win (Suppes) M 12 and by arrangement

215. Philosophy, Education, and Society—(Same as Education 405.) A detailed philosophic examination of some aspects of the relationship between school and society. Seminar designed for majors in philosophy of education; others admitted on consent of instructor.

4 units, Spr (Pacheco) T 7-10 p.m.

220. Epistemology—A survey of the central problems of epistemology emphasizing the uses of modern techniques in clarifying classical epistemological issues.

4 units (Hintikka) given 1974-75


3 units (Hintikka) given 1974-75

236. Seminar in the Philosophy of Plato—A study of metaphysical and epistemological themes in the later Platonic dialogues.

3 units, Win (Moravcsik, Striker)

M 4:15-6:05


3 units, Spr (Moravcsik, Striker, Suppes)

T 4:15-6:05

239. Teaching Methods in Philosophy.

1 to 3 units, any quarter (Staff) by arrangement

240. Individual Work for Graduates.

Any quarter (Staff) by arrangement

241. Seminar in the Philosophy of Language —This is a seminar that is organized to cover the most important contemporary literature in the philosophy of language. It is understood that students involved will play an important role in organizing the work of the seminar.

1 to 6 units, Spr (Moravcsik, Suppes, Wasow) W 4:15-6:05

242A,B,C. Seminar in the Philosophy of Science.


3 units, Aut (Cartwright, Suppes)

M 4:15-6:05


3 units, Win (Suppes) M 4:15-6:05

242C. Topic: (to be determined.)

3 units, Spr (Suppes) M 4:15-6:05

244. Seminar in Metaphysics. Topic: Perception and the Objects of Perception.

3 units, Aut (Howell) Th 4:15-6:05


Any quarter (Staff) by arrangement

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)

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.)

295. Advanced Automata Theory—(Enroll in Electrical Engineering 484.)
299A,B,C. Advanced Seminar in Recent Philosophical Literature—See 199A,B,C.

299D. Seminar in Modal Logic.
3 units, Aut (Gabbay) by arrangement


391A. Units by arrangement, Win (Kreisel) W 4:15–6:05
391B. Units by arrangement, Spr (Kreisel) W 4:15–6:05
391C. Units by arrangement, Spr (——) T 4:15–6:05, given 1974–75

PHYSICAL SCIENCES
(GENERAL PROGRAM)

Emeritus: Julien A. Ripley, Jr.
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

50. 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) MWF11

75, 76, 77. Introduction to the History of Science—A study of the principal facts of the history of science and some inferences that may be drawn from these facts, such as the factors involved in the genesis of scientific ideas, the putative character of science as progress, and the relation of science to activities such as technology, politics, art, philosophy, and religion. Main emphasis will be on the physical sciences, but biology and psychology will also be considered.
PHYSICS

Emeriti: Felix Bloch, Paul H. Kirkpatrick, David L. Webster (Professors)


Associate Professors: William A. Bardeen, Alexander L. Fetter, Theodor W. Hansch, H. Alan Schwettman (on leave autumn quarter, 1973), Robert V. Wagoner, Stanley G. Wojcicki (on leave)


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 Biophysics Laboratory) form a closely related complex housing a range of physics activities from general courses through advanced research. The facilities include an 18MeV 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 1.5-BeV electron-positron storage ring.

Professor Robert Hofstadter is the Director of the High Energy Physics Laboratory; Professors Fairbank, Schwartz, Schwettman, Wojcicki, and Yearian are on the staff of the Laboratory. The staffs of the other branches of the W. W. Hansen Laboratories of Physics and of the Stanford Linear Accelerator Center are mentioned elsewhere in this catalog (see Applied Physics Department, Biophysics Program, 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 now offers courses in gravitation. Students who wish to specialize in this field or in astronomy, astrophysics, or space science should 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, 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, 1974, for the following autumn. Graduate students may normally enter the Department only at the beginning of autumn quarter.

PHYSICS 407
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, 101, 110, 111, 120, 121, 122, 130, 131, 132, 161, 170, 171, 200, 201. The Department strongly advises the study of Chemistry 4 and 5 and also the study of a modern language.

Students may reach the level of the 200-series courses via a normal or an advanced sequence. Exceptionally able students with an especially good preparation in physics will find the advanced sequence advantageous. It requires fewer courses and provides more opportunity for electives in either physics or other fields. Admission to the advanced sequence from the normal sequence requires A grades in 51 and 53 and permission of the Physics Department Undergraduate Study Committee; students must previously have taken Mathematics 41, 42, and 43.

The advanced sequence, Physics 59 and 60, is available to students with at least a year of high school physics and some calculus. Incoming students should apply directly to the Department before entering Stanford for permission to take 59 and 60. For these students the first year would be Physics 59, and 60, and perhaps 55, 56. Students who decide to enter the physics program after the freshman year can do so by taking Physics 55, 56, 59, and 60, 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 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 degree in Physics. This should be carefully studied by prospective majors, especially 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.

NORMAL SEQUENCE

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<th>First Year*</th>
<th>Subject</th>
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<tr>
<td>Physics 51, 53. Mechanics, Electricity</td>
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<tr>
<td>Physics 54. Electricity Laboratory</td>
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<tr>
<td>Math. 41, 42, 43. Analytic Geometry and Calculus</td>
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<th>Second Year*</th>
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<tr>
<td>Physics 55, 57. Light and Heat, Atomic Physics</td>
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<tr>
<td>Physics 56, 58. Light and Heat, and Atomic Physics Laboratory</td>
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<td>Physics 110, 111. Int. Mechanics</td>
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<td>Math. 44, 45, 46. Advanced Calculus</td>
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<td>Math. 130, 131, 132. Ordinary Differential Equations, Partial Differential Equations</td>
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<th>Third Year*</th>
<th>Subject</th>
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<tr>
<td>Physics 100. Int. Physics Laboratory†</td>
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<tr>
<td>Physics 120, 121, 122. Int. Electricity and Magnetism</td>
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<td>Physics 130, 131, 132. Atomic and Nuclear Structure</td>
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<td>Physics 161. Int. Optics</td>
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<tr>
<td>Math. 106. Complex Variables (3)†</td>
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<tr>
<th>Fourth Year*</th>
<th>Subject</th>
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<tbody>
<tr>
<td>Physics 170, 171, 172. Thermodynamics, Kinetic Theory and Introduction to</td>
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*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 an outside of the sciences.
† Not required for degree in physics.
‡ Students who have not taken Physics 58 must take Physics 101.
Statistical Mechanics, Physics of Solids 3 3 (3)†
Physics 200, 201, 202. Advanced Physics Laboratory 3 3 (3)†
Physics 210, 211. Introductory Theoretical Physics (3 3)†
Math. 113, 114, or 120. Linear Algebra and Matrix Theory or Modern Algebra (3 3)†

ADVANCED SEQUENCE

First Year*

Course No. Subject A W Sp
Physics 55, 59, 60. Light and Heat, Advanced Fresh. Physics 8§ 4
Physics 56. Light and Heat Laboratory 1§
Math. 43, 44, 45. Analytic Geometry, Calculus, Advanced Calculus 5 3 3
Math. 130, 131. Ordinary and Partial Differential Equations 3 3

Second Year*

Course No. Subject A W Sp
Physics 110, 111. Int. Mechanics 3 3
Physics 100, 101. Int. Physics Laboratory 2 2
Physics 120, 121, 122. Int. Electricity and Magnetism 3 3 3
Physics 161. Int. Optics 3
Math. 46. Advanced Calculus (3)†
Math. 106. Complex Variables (3)†
Math. 132. Partial Differential Equations (3)†

Third Year*

Course No. Subject A W Sp
Physics 130, 131, 132. Atomic and Nuclear Structure 3 3 3
Physics 170, 171, 172. Thermodynamics, Kinetic Theory and Introduction to Statistical Mechanics, Physics of Solids 3 3 (3)†
Physics 210, 211. Introductory Theoretical Physics (3 3)†
Math. 113, 114, or 120. Linear Algebra and Matrix Theory or Modern Algebra (3 3)†

Fourth Year*

Course No. Subject A W Sp
Physics 200, 201, 202. Advanced Physics Laboratory 3 3 (3)†
Physics 220, 221. Classical Electrodynamics (3 3)†
Physics 230, 231, 232. Quantum Mechanics (3 3 3)†

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, 202, 210, 211, and, if no thesis is submitted, at least 9 additional units of course work above the 200 level (not including 260, 261, 262, 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 (202, 203), 210, 211, 220, 221, 230, 231, 232, 260, 261, 262, 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 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: 206, 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.

‡Physics 55, 56 may be taken in the second year.

§Physics 55, 56 may be taken in the second year.
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 also 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, 1974.

**Courses**

There are four series of beginning courses. The Ten Series (10, 11, 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 (55, 56, 59, 60) is for the exceptionally well-prepared student who wishes to advance rapidly in physics.

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 8 p.m.

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).
10. Special Topics in Physics—This course proposes to familiarize the humanities or social science student with part of modern physics. In 1973–74 the subject will be The Astronomical Universe. Observations of very distant objects will be used to set the framework for a discussion of the contents of the universe, including galaxies, quasars, black holes, and radiation. A feeling for astronomical distances and times will be developed in order to consider the human perspectives provided by cosmology. The laws which are commonly thought to govern the cosmos will be discussed, and big-bang and steady-state models of the universe considered in particular. No prerequisite. One term paper will be required.

3 units, Win (Wagoner) M 2:15–4:05, discussion W 2:15

11. The World of Physics: Nuclei and Particles — This course proposes to familiarize the humanities or social science student with part of modern physics. Starting with the discovery of X-rays, of radioactivity, and of the neutron, the concept of the atom and the nucleus will be considered. A general discussion of nuclear structure and nuclear reactions leads into a review of stellar processes, fission and applications of nuclear 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. One term paper will be required.

3 units, Spr (Hanna) M 2:15–4:05; discussion W 2:15

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 (Yearian) MW 2:15, one hour discussion by arrangement

21. Mechanics and Heat—Equilibrium, uniform 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 (West) lec. MWF 10 or 11 and lab.  
Sum (——) 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 (Hanna) 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 (Fairbank) lec. MWF 9 or 10; discussions (Yearian)

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 (Schwettman) lec. MWF 10 or 11 and lab.

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 (Fairbank) lec. MWF 9 or 10; discussions (Yearian)

54. Electricity Laboratory — Concurrent registration in 53 is required.

1 unit, Spr (Yearian)

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 (Schwartz) lec. MWF 9 or 10; discussions (Hitlin)

56. Light and Heat Laboratory — Concurrent registration in 55 is required.

1 unit, Aut (Yearian)

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 (Rand) TTh 11:00–12:15

58. Atomic Physics Laboratory — Concurrent or prior registration in 57 is required.
1 unit, Win (Yearian)

59,60. Advanced Freshman Physics—An introduction to Newtonian mechanics, special relativity and electricity and magnetism from an advanced viewpoint. The format will be lectures and small discussion sections, which will require a considerable amount of outside reading and homework. Successful completion of the course entitles the student to enter the Advanced Sequence. Prerequisites: advanced placement in mathematics and in the Physics 50 series, prior or concurrent registration in Math. 43, and consent of the instructor.

59. 4 units, Aut (Hitlin) TTh 9:00–10:50
60. 4 units, Win (West) 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, Win (Giffard, Ritson) by arrangement
101. 2 units, Spr (Giffard) by arrangement

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 (Bardeen) MWF 9
111. 3 units, Spr (Bardeen) 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 (Hansch) MWF 10
121. 3 units, Win (Hansch) MWF 10
122. 3 units, Spr (Hansch) 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 (Calarco) MWF 11
131. 3 units, Win (Calarco) MWF 11


3 units, Spr (Hitlin) MWF 11

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.

3 units, Spr (Schawlow) MWF 9

170,171. Thermodynamics, Kinetic Theory, and Statistical Mechanics — Derivation of laws of thermodynamics from basic postulates; determination of relationship between atomic substructure and macroscopic behavior of matter. Temperature, equations of state, heat, internal energy, entropy, reversibility, applications to various properties of matter, absolute zero and low temperature phenomena. Distribution functions, transport phenomena, fluctuations, ensembles and entropy, statistical mechanics of a gas and a crystal, quantum statistics, Bose-Einstein and Fermi-Dirac Statistics. Prerequisites: 55,
or admission to Advanced Sequence, and Mathematics 130.

170. 3 units, Aut (Bardeen) TTh 11:00–12:15

171. 3 units, Win (Fairbank) TTh 11:00–12:15

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 (Giffard) TTh 11:00–12:15

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 — Special topics in physics of interest to senior students.

1 unit, offered occasionally

200, 201, 202, 203. 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. Physics 202 and 203 consist of experiments chosen by the student who wishes to do more advanced work in one or more special areas. Prerequisites: for Physics 200 and 201: 100, 101, 121, and 131; for Physics 202: 201 or consent of instructor; for Physics 203: 202. (Note—Any of 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 (Calarco, Hanna, Little, Ritson) by arrangement

201. 3 units, Aut, Win, Spr by arrangement

202. 3 units, Aut, Win, Spr (——) by arrangement

203. 3 units, Aut, Win, Spr (——) by arrangement


3 units, Aut (Bars) 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 (Bars) MWF 10

220, 221. Classical Electrodynamics—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. Nonrelativistic 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. 3 units, Aut (Fetter) MWF 9

221. 3 units, Win (Fetter) MWF 9

230, 231, 232. 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 scat-
tering 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.

230. 3 units, Aut (——) TTh 9:00–10:50
231. 3 units, Win (——) TTh 9:00–10:50
232. 3 units, Spr (——) TTh 9:00–10:50

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 (Slater) MWF 11
241. 3 units, Win (Slater) MWF 11

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 interactions (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 (Ritson) MWF 10
251. 3 units, Spr (Perl) MWF 11

260, 261, 262. Research Activities at Stanford—Review of research activities in the Department of Physics at a level suitable for entering graduate students. Each research group will give a presentation of its work for approximately one-half quarter. The research groups have been divided as follows: Nuclear physics, High energy and elementary particle physics, Elementary particle physics, Low temperature physics, Quantum electronics, Theoretical physics.

260. 3 units, Aut (Fairbank, Schwartz, Schwettman, Yearian, Staff)
       TTh 1:15
261. 3 units, Win (Hansch, Schawlow, Little, Hanna, Staff) TTh 1:15
262. 3 units, Spr (Bardeen, Fetter, Wagoner, Walecka, Staff)
       TTh 1:15


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. Prerequisite: graduate standing.

0 or 1 units, Aut, Win, Spr (Hitlin, Yearian) 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 (Walecka)
       TTh 9:00–10:50
331. 3 units, Win (Walecka) TTh 9:00–10:50
332. 3 units, Spr (Walecka) TTh 9:00–10:50


336. Advanced Topics in Theoretical Physics — Discussion of selected topics of cur-
rent interest in theoretical physics. Prerequisite: 330.

3 units, offered occasionally


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 1973-74
342. 3 units, Spr (Donnelly) TTh 1:15-3:05; alternate years, given 1973-74

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 (Gilman) MWF 11
351. 3 units, Win (Brodsky) MWF 11

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 (Bars) MWF 11


368. 3 units, Aut (Wagoner) MWF 11
369. 3 units, Apr (Wagoner) MWF 11


370. 3 units, Win, alternate years, given 1974-75
371. 3 units, Spr, alternate years, given 1974-75

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 quarter per research group with an overall limitation 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 distinguished 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 the supervision of a faculty member outside the Department, approval of the Physics Graduate Study Committee is required.

Any quarter (Staff) by arrangement

Emeriti: Thomas S. Barclay, Philip W. Buck, Anthony E. Sokol, Graham H. Stuart, James T. Watkins IV (Professors)

Chairman: Heinz Eulau

PROGRAMS OF STUDY

BACHELOR OF ARTS

Major in Political Science

The minimum requirements for recommendation for the degree of Bachelor of Arts with political science as the major are:

1. Registration as a major student in the Department for at least one quarter, and a minimum of 15 units of work offered by this Department.

2. The completion of 45 units of political science, including:
   
   a) An advanced course or seminar (numbered 100 or above) in at least three of the following fields: public administration, 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 requirement 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 program of interdisciplinary study in social sciences with an emphasis on Political Science may enroll as a major in Social Sciences (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; 30 units must be in Political Science and the remaining 20 must be selected (in consultation with the adviser) from the course offerings of the departments of Anthropology, Communication, Economics, History, Psychology, and Sociology.

HONORS PROGRAM IN POLITICAL SCIENCE

The Honors Program provides qualified majors with an opportunity to write a thesis on a subject of individual interest, for which up to 15 units of credit will be given in the honors candidate’s senior year.

Application for admission to the Honors Program should be made in the third quarter of the junior year. Applicants must have at least a 3.0 grade point average in all University work and at least a 3.3 average in political science courses; and must secure the agreement of a regular faculty member to be their thesis adviser.

Graduation with Honors in Political Science will require: (1) completion of all requirements for a major in political science; (2) at least a 3.0 average in all University work; (3) at least a 3.3 average in political science; (4) 55 units of political science, including up to 15 units of Political Science 199 (honors thesis); (5) submission of an acceptable honors thesis. Students who successfully complete the program will graduate “with Honors in Political Science.” Interested students should consult the adviser of the Honors Program in their junior year.

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-
January 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.

Graduate applicants aged 40 and over will not be considered.

**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, except that they need not submit a "statement of purpose." 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 (i.e., seminars numbered 200 or above). 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.

**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 student 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 Study 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 Graduate Student Adviser, 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, including courses listed under 2A. For a minor, the applicant should have completed 24 units, including course 10.

ASSISTANTSHIPS, SCHOLARSHIPS, AND PRIZES

The Department uses teaching assistantships in connection with a number of courses. These customarily are granted to applicants only after they have been at Stanford for one year.

A number of scholarships and fellowships are also available. Graduate students, specializing in comparative politics, may apply for fellowships under the National Defense Education Act. 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.

INTRODUCTORY COURSES

1. Major Issues of American Public Policy—Alternative public policies in selected areas, including control of monopoly, social
welfare, poverty, foreign policy. Political process; influence of cultural, economic, political factors on determination of public policy.

5 units, Aut (Marshall) MTWThF 10

5. Issues of American Domestic Policy — Content of domestic policy in selected areas, such as education, revenue sharing, social welfare, and transportation. The policy process with emphasis on the state and local levels.

5 units, Win (Goldenberg) MTWThF 11

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 national policy-making from the New Deal to the present.

5 units, Win (Manley) MWF 10

Spr (Horn) MTWThF 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 1974-75

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, Win (Steiner) given 1974-75

20Q. Introduction to Comparative Politics.

4 to 5 units, Win (Quick) MTWThF 10

83. Urban Politics—Urbanization, machine politics, the reform era, federalism, conventional and non-conventional forms of political participation, metropolitanism and local control; primary emphasis on American urban areas.

5 units, Spr (Goldenberg) MTWThF 9

ADVANCED COURSES AND UNDERGRADUATE SEMINARS

Advanced undergraduate courses are open to undergraduates who have the necessary prerequisites and also graduates where advisable. Undergraduate seminars are open, with the consent of the instructor, to juniors and seniors and to graduates where advisable. Enrollments will be limited. Some graduate seminars also may be open with consent of instructor to seniors.

ADMINISTRATION

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 159.)

4 units, Spr (March) MW 1:30–3:05

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 161.)

4 units, Win (March) MW 8:30–10:00

106. Seminar on Government Performance: Evaluating Federally-Funded Manpower Programs — How should one evaluate government programs in general and social service programs in particular? What factors account for failure to reach stated goals? How might goals be more readily attained? The seminar will consider these questions while examining the manpower training and public service employment programs established during the past decade. Preference given juniors and seniors.

5 units, Win (Abernethy) W 2:15–4:05

107. Seminar in 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. (Graduate students enroll in 207.)

5 units, Win (Marshall) given 1974-75

108. Seminar in 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. (Graduate students enroll in 208.)

5 units, Spr (Marshall) given 1974–75

109. Directed Reading in Administration—Advanced individual study in public administration.

Any quarter (Staff) by arrangement

110. Administrative Behavior — Environment of administrative action; political, social, psychological factors in management; problem of incentives. (Graduate students enroll in 210.)

5 units, Spr (Walker) MTWTh 11

For graduate courses in Administration, see Graduate Courses.

COMPARATIVE POLITICS

111A. 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, Aut (Almond) MTWTh 1:15

111B. European Politics: Government and Politics in Germany — Governmental institutions and the political process in the Federal Republic of Germany; determinants of domestic and foreign policies; processes of political socialization. Desirable prerequisites: 15, or 20, and reading knowledge of German.

4 to 5 units, Spr (Weiler) TTh 1:15

111C. European Politics: The Austrian Political System — The development of the Austrian political system; the demographic, economic, and institutional framework of politics; political culture; and the performance of political functions in contemporary Austria. Desirable prerequisite: 15 or 20.

4 to 5 units, Win (Steiner) given 1974–75

111D. European Politics: Scandinavian Political Systems — The political systems of Denmark, Norway, and Sweden treated from a comparative perspective; historical background; present social, economic, and institutional contexts; political cultures and processes. Desirable prerequisite: 15 or 20.

4 to 5 units, Spr (Rose) MWF 11

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, Win (Ike) MTWTh 9

114. Government and Politics in Japan—Governmental institutions and the political process in prewar and postwar Japan; the influence of tradition and social change; the impact of the occupation. (Graduate students enroll in 214.)

4 to 5 units, Win (Ward) TTh 11

115. Government and Politics in China—An overview of Chinese politics from 1800 to the present, with particular emphasis on the politics of the People's Republic of China. The course has three themes: the origins of revolution in modern China, the politics of modernization in China since 1949, and the processes by which policies are made and implemented. Particular emphasis is given to the Cultural Revolution as the reflection of major issues and interests in Chinese politics.

5 units, Win (Harding) given 1974–75

116. Revolution, Protest, Reform: Communist Parties—Examination of selected non-ruling communist parties (Italian, Japanese, Venezuelan, Israeli, Finnish, etc.) in terms of their development, recruitment, membership, style, function, and structure patterns. Emphasis is on the distinctions among these parties, their causes and consequences. Desirable prerequisite: 20 or 126.

4 to 5 units, Spr (Triska) given 1974–75

117. Government and Politics of Africa South of the Sahara—Examines the colonial situation, the growth of nationalism, the one-party state, the role of the military, the politics of ethnicity, problems in development planning, and racial conflict in southern Africa. The evolution of U.S. policy toward Africa will also be considered.

5 units, Aut (Abernethy) MTWThF 10

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, Staff) MTW 10, Sections WThF by arrangement

118L. Political Leadership.

5 units, Win (Lewis) MTWThF 9

119. The Transition to Socialism in Cuba and Chile—An examination of the two socialist experiences in Latin America, with emphasis on the Cuban case. The interrelationships between political, economic, and cultural change will be stressed.

5 units, Aut (Fagen) TTh 2:15-3:30

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

119B. International Communism—(Same as History 123B.)

5 units, Aut (Dallin) given 1974-75

119W. Seminar in Comparative Urban Politics—A series of case studies of important foreign cities and urban regions will be examined to show, first, how different historical experiences have led to different groupings of contemporary urban problems, and second, how industrialization has tended to produce a common sequence of urban crises. Special attention will be given to the ways different political systems have helped or hindered solution of urban problems.

5 units, Win (Weiss) W 4:15-6:05

120A. Seminar in Comparative Politics: Japan—(Graduate students enroll in 220A.)

5 units, Spr (Ward) W 2:15-4:05

122A. Seminar in Comparative Politics: Modernization and Democracy in Asia—Political change in Japan, Philippines and India.

5 units, Spr (Ike) Th 2:15-4:05

124D. Colloquium: Conflict and Cleavage in Communist Societies—(Same as History 220A, 320A.) After a general introduction regarding (1) concepts of cleavage, tension, social stratification, and functional differentiation, and (2) social structure and social change in communist societies, readings and discussions will center on the role of particular groups in latent or manifest conflict, such as ethnic and racial minorities, religious groups, women, the intelligentsia, as well as occupational groups such as managers, the military, the bureaucracy. An attempt will be made to compare the nature of conflicts and cleavages in different communist societies and to explain them, and to assess the significance and limits of such phenomena. (Graduate students enroll in 224D.)

5 units, Aut (Dallin, Labedz) Th 2:15-4:05

125. Seminar in the Politics of China—(Graduate students enroll in 225.) Prerequisites: 115 or the equivalent and consent of instructor.

5 units, Aut (Lewis, Li) MW 2:15-4:05

125A. Seminar in Comparative Politics: Vietnam.

5 units, Spr (Lewis) Th 2:15-4:05

126. Comparative Politics: Eastern Europe and the USSR—Systematic examination of the USSR and the eight East European systems in terms of their historical development, the policy-making processes, and their system maintenance and adaptation. Desirable prerequisite: 15 or 20.

4 to 5 units, Win (Triska) given 1974-75

126B. Seminar: Soviet Politics and Society Since 1917—(Same as History 219S.)

4 to 5 units, Aut (Dallin) given 1974-75

126C. Colloquium: Problems in Soviet History and Politics—(Same as History 219.) Prerequisites: History 123A, Political Science 119A or equivalent. (Graduate students enroll in 226C.)

5 units, Spr (Dallin) T 2:15-4:05

127A. Seminar in Comparative Politics: West Germany—Case studies and analyses of data on voting behavior, political attitudes, political socialization. Reading knowledge of German desirable. (Graduate students enroll in 227A.)

5 units, Spr (Dallin) T 2:15-4:05

127B. Seminar on Education and Politics in Europe—(Same as Education 108.) The politics of educational innovation in selected countries of Western Europe; education and political socialization and recruitment. Desirable prerequisite: reading knowledge of a
European language other than English. (Graduate students enroll in 227B.)

5 units, Aut (Weiler) W 2:15–4:05
and by arrangement

127M. Political Deviancy—This undergraduate seminar will examine infringements of the normative foundations of political order. The concept of political deviancy covers explicitly political infringements like treason, political assassination, corruption in government, guerrilla movements and revolution. But the seminar will also pay some attention to forms of deviancy which, though not themselves involving conscious political aims, have their origins in the system of political stratification in a given society. The seminar will also pay attention to international forms of political deviancy, with special reference to international terrorism and politically-motivated sky-jacking. Although Professor Mazrui’s own illustrations of domestic forms of deviance will be drawn mainly from Africa, students will be encouraged to look also at deviant phenomena in other parts of the world, including the United States and Canada.

5 units, Win (Mazrui) M 4:15–6:05

128B. Seminar in Comparative Politics: The Prospects of Democracy—Crises of industrialized democracies; political alternatives in The New Nations; democratic impulses in authoritarian systems.

5 units, Spr (Almond) Th 10–12

128C. Seminar in Comparative Survival Strategies—A systematic comparison of how different human societies go about meeting their basic survival and reproductive needs. The overall configuration of survival strategies and behaviors will be considered, and students will be required to take a holistic approach, drawing upon data and research from a variety of disciplines. However, particular emphasis will be given to the role of politics and political systems. (Graduate students enroll in 228C.)

5 units, Win (Corning) MWF 10

129. Directed Reading in Comparative Politics — Advanced individual study in comparative politics.

Any quarter (Staff) by arrangement

For graduate courses in Comparative Politics, see Graduate Courses.

INTERNATIONAL LAW AND RELATIONS

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, Spr (Triska) given 1974–75

130C. Seminar: Problems in International Communism — (Same as History 218S.) (Graduate students enroll in 230C.)

5 units, Aut (Dallin) given 1974–75

131. Control of American Foreign Policy—How American foreign policy is made; problems of administrative coordination, public opinion, decision-making process. Special attention to State Department and the Foreign Service. Prerequisite: 10 or equivalent.

4 to 5 units, Spr (Brody) given 1974–75

131A,B. Case Studies and Theory Development in International Relations — (See 231A,B.)

132C. Human Aggression—An evolutionary and interdisciplinary approach to a major class of social behaviors. Students will survey the status of theory and research on violent aggression in various disciplines, although the emphasis will be upon individual and collective aggression in human societies. (Graduate students enroll in 232C.)

5 units, Win (Corning) MWF 10

133. The International System and Comparable Systems—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. (Graduate students enroll in 233.)

5 units, Spr (North) T 4:15–6:05

133C. International Organizations in World Politics — Analysis of the role of international organizations in contemporary world politics, with particular reference to transnational relations. 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.

5 units, Win (R. Keohane) MWTh 9
134. Seminar on Panafrikanism and Interstate Relations in Africa — Analysis of emerging patterns of interstate relations, regional cooperation, and interstate conflict in Africa. (Graduate students enroll in 234.)

5 units, Spr (Weiler) given 1974–75

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, Spr (George, Staff) MWTh 11

135C. How Nations Deal With Each Other—
(=Same as History 135C.) 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 (R. Keohane) MWTh 11

136A,B. Colloquium and 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. (Graduate students enroll in 236A,B.)

5 units, Aut (Triska) given 1974–75

136B. Seminar—Students research papers.

5 units, Win (Triska) given 1974–75

137C. 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 ocean and waterway problems. Desirable prerequisite: 135C.

5 units, Spr (Corning) T 2:15–4:05

138A,B. Problems of Arms Control and Disarmament — General international politics; international law and relations, stressing political, legal, and technological problems of arms control. 138A is a prerequisite to 138B; the second quarter will provide for individual research.

138A. 5 units, Win (Lewis, Barton, Staff) MTWTh 1:15

138B. 5 units, Spr (Lewis, Barton, Staff) MTWTh 1:15

139. Chinese Foreign Policy — Analysis of China’s goals and conduct in world affairs. Special attention will be given to China’s relations with the United States and the Soviet Union; her policy toward the Third-World and national liberation movements; and her role in the emerging multipolar international system.

5 units, Aut (Weiss) MTWTh 9

140A,B. Seminar on Political Leadership—
See 240A,B.


142A. Public Opinion and Foreign Policy—
This seminar will examine the several roles that the citizen can play in the process leading to the formulation of U.S. foreign policy. Special attention will be paid to the distinctions between decision processes, policy processes and bureaucratic problem solving, with an eye to examining the potentiality for citizen inputs. Questions of opinion formulation and the interaction between formed opinion and policy will dominate the seminar discussions. (Graduate students enroll in 242A.)

5 units, Win (Brody) M 4:15–6:05

142C. Seminar on Nuclear Proliferation.

5 units, Spr (Brody) W 2:15–4:05

143A. Seminar on the 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

143B. Seminar in the 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 (Czechoslovakia, Hungary, and Yugoslavia) will be available for the seminar participants. (Graduate students enroll in 243B.)

5 units, Win (Triska) given 1974–75

143C. Seminar in International Relations Theory—See 243C.


144A. 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. (Graduate students enroll in 244A.)

5 units, Aut (George) given 1974–75

144B. Student Research—(Graduate students enroll in 244B.) Prerequisite: 144A or 244A.

5 units, Win (George) given 1974–75

145. Seminar in the Dynamics of International Conflict—See 245.

145A,B. Seminar on Force and Diplomacy in the Modern Era.

145A. Critical examination of theories of force as an instrument of foreign policy; evaluation of crises and conflicts in the post–World War II era with reference to lessons for theory and practice. (Graduate students enroll in 245A.)

5 units, Win (George) given 1974–75

145B. Student research — Prerequisite: 145A or 245A. (Graduate students enroll in 245B.)

5 units, Spr (George) given 1974–75

145C. Seminar on Human Aggression—An exploration of linkages between the psycho-biological substrate of individual behavior and collective forms of human aggression, particularly revolution and warfare. Desirable prerequisites: courses in Human Biology, Psychology and 132C.

5 units, Spr (Corning) Th 2:15–4:05

146H. Seminar in Chinese Foreign Policy—Discussion of major issues in Chinese foreign policy, particularly her relations with the United States, Japan, and the Third World. Evaluation of the application of international systems theory, interactional analysis, and models of comparative foreign policy to the study of China’s foreign relations. Prerequisite: 139 or the equivalent, or the consent of the instructor. (Graduate students enroll in 246H.)

5 units, Win (Harding) given 1974–75

147. Seminar on Soviet-Chinese Relations. See 247.

147L. Chinese Perspectives on International Law—(Same as Law 291.)

3 units, Win (Li)

148A,B. Seminar on U.S. Foreign Policy-Making—See 248A,B.

149. Directed Reading in International Law and Relations—Advanced individual study in international law and relations.

Any quarter (Staff) by arrangement

For graduate courses in International Law and Relations, see Graduate Courses.

POLITICAL THEORY

150. Political Thought: Greek and Roman Theory—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, Win (Drekmeier) given 1974–75

152. Political Thought from Machiavelli to Rousseau—Liberty, authority and participation in the work of selected theorists of the early modern era. Their attempts to establish grounds for political obligation and to define the means and goals appropriate in political action will receive special attention.

5 units, Win (N. Keohane) MTWTh 10

153. Political Thought: Modern Ideas and Doctrines—The development of 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, along with briefer selections from other work.

5 units, Spr (N. Keohane) MTWTh 10

156. 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, Aut (Drekmeier) given 1975–76

157. Theory of Revolution—Modern revolutions are multistratified phenomena and their theoretical treatment in political sciences is correspondingly confused. The present Colloquy has the purpose of disentangling the strata. There will be treated, first, the complex of economic grievances and social injustice. This is the body of issues dealt with by classical politics. The second stratum to be separated will be the hope of a perfect society. This is the complex that goes back to the Jewish and Christian Apocalyptic of Antiquity. The third stratum is the modern transfer of apocalyptic hope to the expectation of a perfect society to be realized by immanent man within history. The interplay of economic grievance, social injustice, hope of a perfect society, and immanentist politics characterizes the contemporary debate. (Graduate students enroll in 257.)

5 units, Win (Voegelin) given 1974–75

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. (Graduate students enroll in 258A.)

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. (Graduate students enroll in 258B.)

5 units, Spr (Drekmeier) MTWThF 11

159. Utopias — A study of the psychology and institutions of utopia. We will read descriptions of ideal societies from Plato to Skinner, analyze modern anti-utopias, and draw upon several recent attempts to understand and criticize the utopian impulse as a special form of thinking about politics. (Graduate students enroll in 259.)

5 units, Win (N. Keohane) given 1974–75

160A,B. "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. (Graduate students enroll in 260A,B.)

160A. 5 units, Aut (Rogat) given 1974–75

160B. 5 units, Win (Rogat) given 1974–75

161. Seminar in Power, Authority, and Disobedience. (Graduate students enroll in 261.)

162. Seminar in Political Theory and Method: Thought and Action — (Graduate students enroll in 262.)

5 units, Win (Drekmeier) T 7:30–9:30 p.m.

163. Seminar on Freedom and Equality—An analysis of the tensions between these two values, and varied treatment of these concepts, in modern social thought. Readings will be taken from contemporary political philosophers as well as from selected earlier theorists, including Hobbes, Rousseau and Tocqueville. (Graduate students enroll in 263.)

5 units, Aut (N. Keohane) W 2:15–4:05
164. 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. (Graduate students enroll in 264.)

5 units, Aut (N. Keohane) given 1974-75

165. Plato—See 265.

166. Aristotle’s Politics—See 266.


169. Directed Reading in Political Theory — Advanced individual study in political theory.

Any quarter (Staff) by arrangement

For graduate courses in Political Theory, see Graduate Courses.

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. (Graduate students enroll in 270.)

5 units, Aut (Horn) MTWThF 1:15

171. Seminar in American Federalism—Evolution and current condition of U.S. federal system. Relationship of constitutional developments to political, economic, and cultural change. Enrollment limited to 15 juniors and seniors. Prerequisite: 170 or consent of instructor.

5 units, Win (Horn) given 1974-75

172. The Constitution and Economic Justice—Changing concepts of private property rights and governmental powers over the economy in American constitutional law; Supreme Court interpretation of the contract and due process clauses versus state police powers; expansion of congressional currency, commerce, taxing and spending powers. Current developments in the "new" property and equal protection. Prerequisite: third-year standing. Recommended: 170. (Graduate students enroll in 272.)

5 units, Spr (Horn) given 1974-75

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. (Graduate students enroll in 273.)

5 units, Spr (Horn) MTWThF 1:15

174. The Criminal Law and the Criminal System—(Same as Law 107.) 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, Spr (Kaplan) by arrangement


179. Directed Reading in Public Law — Advanced individual study in public law.

Any quarter by arrangement with Public Law faculty

For graduate courses in Public Law, see Graduate Courses.

AMERICAN POLITICS

181E. Seminar in Empirical Political Theory—See 281E.

182. Introduction to Political Psychology—An introduction to the dynamics of public opinion and attitude change; the study of personality and politics; the analysis of social conformity and deviance; and the sources and consequences of alienation and political disaffection in America.

5 units, Aut (Sniderman) MWF 10

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 11; section by arrangement

183E. Seminar in the Politics of American Federalism—See 283E.

184. Legislative Behavior — Congressional elections, constituent relations, policy making and leadership, relations between Congress and administrative and executive agen-
ties; the committee system, seniority and procedure; Congress as an element in the party system. Prerequisites: third-year standing and 10 or equivalent.

5 units, Spr (Manley) MWF 10

184D. The American Presidency—Resources, constraints, and techniques of American presidential power. Examines the office from biographical, historical, theoretical, social scientific, and psychoanalytic dimensions. Analyzes the supportive and adversary relationships between the Presidency and other forces and institutions, such as Congress, public opinion, and the executive bureaucracy.

5 units, Win (Barnum) MTWThF 10

185A. Introduction to Models in Social Science—(Same as Education 110 and Sociology 119.) 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 or 11

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) MW 11; section by arrangement

187A. Presidential Voting in the American Political System.

5 units, Spr (Brody) T 2:15-4:05

187C. Seminar on Politics and the Mass Media—Will explore a number of topics relating to the role of the mass media in American politics, including such things as license challenges, public broadcasting, community-media relations, media and elections, media and protest, media and race, and prospects for the future.

5 units, Aut (Goldenberg) W 4:15-6:05

188C. Seminar on Pressure Group Politics: The Case of Public Welfare—Will study in depth both the content and process of public welfare policy with considerable focus on interest group activity at the national, state and local levels.

5 units, Spr (Goldenberg) W 4:15-6:05

189. Modes of Political Analysis—See 289.

191. Seminar on Civil Liberties and the Warren Court—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) M 2:15-4:05

192A,B. Urban Structure and Policy—An in-depth analysis of the interaction of urban social structure, urban economic trends, and urban government in terms of the resulting impact on political order and the quality of urban life. This two-quarter seminar will provide a thorough introduction to the literature and will emphasize papers and presentations rather than individual research. Limited to undergraduates with a strong interest in urban studies. (Same as Urban Studies 100A,B.)

192A. 5 units, Aut (Mollenkopf) Th 2:15-4:05

192B. 5 units, Win (Mollenkopf) Th 2:15-4:05

193A,B. Seminar in American National Government: 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. Among the topics covered are systems theory, exchange theory, role theory, policy analysis, participant observation, and the fundamentals of research design. Prerequisites: consent of instructor. Students should plan to take both A and B. (Graduate students enroll in 293A,B.)

193A. 5 units, Win (Manley) W 2:15-4:05

193B. 5 units, Spr (Manley) W 2:15-4:05

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 1974-75


196A. Analysis of cognitive limits and other constraints on rational decision-making
by political executives that generate stress and lead to adoption of various coping strategies. Relationship between political executives, their small advisory groups, and organizational behavior as it affects rational decision-making. Enrollment limited to 20 juniors and seniors. Desirable prerequisite: previous courses in American government, policy-making, organization theory, psychology. (Graduate students enroll in 296A.)

5 units, Win (George) Th 2:15-4:05

196B. Student Research — Prerequisite: 196A or equivalent. (Graduate students enroll in 296B.)

5 units, Spr (George) Th 2:15-4:05

197. Seminar on Technology and Political Order—Analysis of the effects of technology on elite and mass political behavior and the transformation of political institutions. The implications of technology for political values and ideology with an emphasis on developments in the United States.

5 units, Spr (Eulau) M 7:30-9:30 pm

198. Directed Reading in American Politics—Advanced individual study in politics. Prerequisite: 10 or equivalent.

Any quarter (Staff) by arrangement

For graduate courses in American Politics, see Graduate Courses.

UNDERGRADUATE HONORS

199. Senior Honors Thesis.

15 units maximum, any quarter (Staff) by arrangement

GRADUATE COURSES

Conducted as seminars or reading and discussion groups. Courses numbered 200–299 are limited to graduates and, with the consent of the instructor, to qualified seniors. Courses numbered 300 and above are limited to graduates. All students should consult the instructor before enrolling in any graduate course.

207. Seminar in Government and Natural Resources—See 107.


209. Directed Reading in Public Administration.

Any quarter (Staff) by arrangement

210. Administrative Behavior—See 110.

211A. Theories in Comparative Politics—Concepts, models, theoretical frameworks, and typologies in comparative politics; theoretical approaches to political development; methodology in cross-national research.

5 units, Win (Almond) T 4:15-6:05

211B. 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 4:15-6:05


220. Seminar in 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 1974-75

220A. Seminar in Comparative Politics: Japan—See 120A.

221. Seminar in Comparative Politics: Parties and Party Systems—Development and functions of parties; typologies of parties and of party systems; parties and political participation.

5 units, Spr (Steiner) given 1974-75

222. Education and Political Development—(Same as Education 306B.) 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 (Weiler) TTh 1:15-3:05

224. Seminar in 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, Spr (Steiner) given 1974-75
224D. Conflict and Cleavage in Communist Societies—See 124D.


226C. Problems in Soviet History and Politics—See 126C.

227. Seminar in Comparative Politics: Africa—Examines the effect of external influences (diplomatic, military, financial, technological, cultural, etc.) on the domestic political process in several African countries. Open to selected undergraduates who have taken an Africa-related course.

5 units, Win (Abernethy) M 2:15-4:05

227A. Seminar in Comparative Politics: West Germany—See 127A.

227B. Seminar on Education and Politics in Europe—See 127B.

228C. Seminar in Comparative Survival Strategies—See 128C.

229. Directed Reading in Comparative Politics.

Any quarter (Staff) by arrangement

230C. Problems in International Communism—See 130C.

231A,B. Case Studies and Theory Development in International Relations.

231A. Critical review of efforts to employ case studies for developing international relations theory with special attention to the emergence in political science of the method of structured, focused comparison of multiple cases. In this context specific attention will be given to research strategies for bridging the gap between theory and practice of foreign policy. (Undergraduates enroll with consent of instructor in 131A.)

5 units, Win (George) given 1974–75

231B. Student research. (Undergraduates enroll with consent of instructor in 131B.) Prerequisite: 231A (131A).

5 units, Spr (George) T 2:15-4:05

240A. 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. (Undergraduates enroll with consent of instructor in 140A.)

5 units, Aut (George) T 2:15-4:05

240B. Student research. (Undergraduates enroll with consent of instructor in 140B.) Prerequisite: 240A (140A).

5 units, Win (George) T 2:15-4:05

241C. Seminar on Transnational Relations—Critical analysis of traditional state-centric assumptions about world politics, through an examination of the importance of transnational relations. The focus will be not only on transnational organizations, such as the multi-national business enterprise of the Roman Catholic Church, but also on analysis of world politics, transnational as well as state-centric, by issue-area.

5 units, Spr (R. Keohane) T 4:15-6:05


5 units, Spr (R. Keohane) Th 4:15-6:05

242A. Public Opinion and Foreign Policy—See 142A.

243B. Seminar in the Politics of Development—See 143B.

243C. Seminar in 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. (Undergraduates enroll in 143C.)

5 units, Aut (North) T 4:15-6:05

244A,B. Seminar on the U.S. Foreign Policy-Making Process—See 144A,B.
245. Seminar in the Dynamics of International Conflict — Expansion, competition, arms races, conflicts, and crises. (Undergraduates enroll in 145.)

5 units, Win (North) T 4:15–6:05

245A,B. Seminar on Force and Diplomacy in the Modern Era — See 145A,B.

246H. Seminar in Chinese Foreign Policy — See 146H.

247. Seminar on Soviet-Chinese Relations — (Undergraduates enroll in 147.)

5 units, Win (North) Th 4:15–6:05


248A. Focus on problems of foreign policy-making and decision-making in the Executive Branch. Critical examination of theories of rational decision-making, organizational behavior, and “bureaucratic politics” as they bear on the organization and performance of presidential-level decision-making in the foreign policy sphere. (Undergraduates enroll with consent of instructor in 148A.)

5 units, Aut (George) given 1974–75

248B. Student research. (Undergraduates enroll, with consent of instructor, in 148B.)

5 units, Spr (George) given 1974–75

249. Directed Reading in International Law and Relations.

Any quarter (Staff) by arrangement


5 units, Spr (Drekmeier) M 4:15–6:05


258A,B. Theory, Power, and Social Science — See 158A, B.

259. Utopias — See 159.

260A,B. “Modernisms” — See 160A, B.

261. Seminar in Power, Authority, and Disobedience — See 161.

262. Seminar in Political Theory and Method — See 162.

263. Freedom and Equality — See 163.

264. The Public Interest — See 164.

265. Plato — Study of several of Plato’s political dialogues, including the Apology, Crito, Gorgias, Republic, and parts of the Statesman and the Laws. The seminar will attempt to understand Plato’s analysis of human nature and of assorted political devices, and to assess his recommendations for political life and structure. (Undergraduates enroll, with consent of instructor, in 165.)

5 units, Aut (N. Keohane) T 2:15–4:05

266. Aristotle’s Politics — A close reading of Aristotle’s major treatise with a view towards appreciating it as a seminal influence on thinking about politics. Aristotle’s vision of a good political community, his schemes for classification and suggestions for determining the conditions important for the success of different sorts of polities, will receive attention. Modern work that appears to have built upon his findings will also be included. (Undergraduates enroll, with consent of instructor, in 166.)

5 units, Aut (N. Keohane) given 1974–75

267. Montesquieu and Rousseau — The two great Enlightenment theorists of politics studied and compared. The seminar will ask why, given important similarities in their work, their long-run influence on the development of political thought was so divergent. Several major works by each thinker will be read, as well as selected works of commentary. (Undergraduates enroll, with consent of instructor, in 167.)

5 units, Win (N. Keohane) T 2:15–4:05

269. Directed Reading in Political Theory.

Any quarter (Staff) by arrangement

270. The Supreme Court and the Constitution — See 170.


5 units, Aut (Horn) T 4:15–6:05

276. Seminar on the Constitutional Scope and Limits of “Free Speech” — The seminar will consider the historical origins and the
279. Directed Reading in Public Law.  
Any quarter (Staff) by arrangement

280A. Contemporary Problems in Social Institutions—(Same as Education 202 and Sociology 134.) 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) given 1974–75

281E. Seminar in Empirical Political Theory—An inquiry into the logics, psychologies and sociologies of elitist and pluralistic as well as representative and participatory theories of democracy. Limited enrollment; open to graduate students and advanced undergraduates. (Undergraduates enroll in 181E.)

5 units, Aut (Eulau) T 4:15–6:05

283E. Seminar in the 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. (Undergraduates enroll in 183E.)

5 units, Win (Eulau) M 7:30–9:30 p.m.

287A,B. Voting Behavior Seminar.

287A. 5 units, Win (Brody) given 1974–75

287B. 5 units, Spr (Brody) given 1974–75

288. Seminar on 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, Win (Casper) M 2:15–4:05

289. Modes of Political Analysis — (Undergraduates enroll in 189.)

5 units, Aut (Eulau) given 1974–75

290. Introduction to Political Data Analysis.

5 units, Aut (Brody) M 2:15–4:05

291. Seminar: Participation and Democratic Theory — This seminar will center on an examination of democratic theorists, both classical and contemporary. In particular, it will focus on the implications of democratic theory and of modern scientific studies of political participation in an attempt to obtain a better grasp of the democratic idea in America.

5 units, Aut (Sniderman) given 1974–75

293A,B. Seminar in American National Government—See 193A,B.

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, Aut (Sniderman) F 2:15–4:05

294B. 5 units, Win (Sniderman) F 2:15–4:05

296A,B. Seminar on Presidential Decision-Making—See 196A,B.

298. Directed Reading in Politics.

Any quarter (Staff) by arrangement

300. Thesis.

Any quarter (Staff) by arrangement

304A,B,C. Advanced Research in Organization Theory—(Same as Education 418A, B,C, and Sociology 289A,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 Organization Theory, I.

4 units, Aut (March, Staff) M 3:15–5:05

304B. Advanced Research in Organization Theory, II.

4 units, Win (March, Staff) M 3:15–5:05

304C. Advanced Research in Organization Theory, III.

4 units, Spr (March, Staff) M 3:15–5:05

311. Soviet Domestic and Foreign Policies.

5 units, Spr (Dallin) given 1974–75

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 ad-
vanced 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) Th 2:15-4:05
313B. 5 units, Spr (Fagen) Th 2:15-4:05
Continuation of 313A. Cannot be taken without 313A.

322. Research Topics on the Performance of European Political Systems — The interaction of politics and public policy in Britain, France and Germany.
5 units, Win (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) M 2:15-4:05

325. Advanced Seminar in Reform and Revolution in Twentieth Century China and Japan.
5 units, Win (Ike) Th 2:15-4:05

5 units, Aut (Ike) given 1974-75

336. Research Seminar in 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 1974-75

365. Alienation and Detachment.
5 units, Spr (Drekmeier) given 1974-75

384A. Seminar in 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.
5 units, Win (Manley) given 1974-75
384B. 5 units, Spr (Manley) given 1974-75

Courses Offered Overseas

111G. German Political Parties—(Taught at Stanford in Germany.)
4 units, Spr (Steiner)

128G. Politics in Germany — (Taught at Stanford in Germany.)
4 units, Spr (Steiner)

Psychology

Emeriti: Paul R. Farnsworth, Ernest R. Hilgard, Maud Merrill James, Quinn McNemar, Lois Meek Stolz (Professors)
Chairman: Richard C. Atkinson
Vice Chairman: Douglas H. Lawrence


Visiting: Ervin Staub


Lecturers: Norman H. Mackworth, 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.


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.

No more than 10 units of independent study (104 and 188) may be counted toward the 40 units.

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.

A student must have taken at least 15 units in the department in order to receive the Departmental recommendation for graduation.

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 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 equiva-
lent 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 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.

**Minor for the Degree of Doctor of Philosophy**—Candidates for the degree of Doctor of Philosophy in other departments who elect a minor in psychology will be expected to complete the equivalent of an A.B. in psychology, of which at least 15 units must be taken as a graduate student at Stanford. Of these 15 units in the Department at least two courses must be from those numbered 200 or above. The program to be followed will be adapted to the needs of each candidate and will be under the direction of the Department's Committee on Minors.

**The Doctoral Training Program**

As indicated by the requirements described above, a student may concentrate in any one of several areas within psychology. Regardless of area, however, the training program places emphasis on the development of research competence, and students are encouraged to develop those skills and attitudes that are appropriate to a career of continuing research productivity.

Two kinds of experience are necessary for this purpose. One involves the learning of substantial amounts of technical information. A number of courses and seminars are provided to assist in this learning, and a student is expected to work out a program, with
his or her adviser, that will permit the student to secure such knowledge in the most stimulating and economical fashion.

A second aspect of training is one that cannot be gained from courses or seminars. This is the firsthand knowledge of, and practical experience with, the methods of psychological investigation and study. These methods do not exist in the abstract; they are ways of behaving with the people or animals who are being studied. They are skills, and they require guided practice for their perfection. Students are provided with whatever opportunities they need to reach those levels of competence representative of doctoral standing. Continuing research programs, sponsored by members of the faculty, offer direct opportunities for experience in the fields represented by the faculty's several research interests.

Each student will achieve competence in somewhat unique ways and at a somewhat unique rate. Each student and adviser share in planning a program which will lead to the objectives discussed.

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 Foundation, the Danforth Foundation, the Ford Foundation, and the United States Public Health Service. Applications may be made by college seniors planning to work for a higher degree. Students should apply early in the fall of the senior year. For information concerning application forms and procedures consult representatives from the financial awards office of your home institution.

All prospective Ph.D. candidates, regardless of the source of financial support, are expected to gain teaching experience as an integral part of their graduate training. Each student is required, as part of his or her graduate training, to participate in four quarters of teaching while at Stanford, normally one quarter each year. The student progresses from closely supervised teaching to more and more independent work. Typically, this might involve giving a section in statistics or a laboratory course during the first year, leading a section of introductory psychology during the second year, co-teaching a small advanced course during the third year, and giving a supervised but essentially independent seminar during the fourth year.

Psychology Colloquium

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, 1974.

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 (Smith, Horowitz) MWF11
Win (Zimbardo) MWF 2:15
Spr (Sakitt) MWF10
(primarily intended for freshmen and sophomores)

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, any quarter (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 (Ross) MTWThF 9
Win (Thomas) MTWThF 9
Spr (Horowitz) MTWThF 9

61A. Statistical Methods — ACCELERATED — Designed for undergraduates who have not had psychological statistics, who have had some background in advanced mathematics, and whose plans call for advanced knowledge of statistics. The course will begin with basic statistical concepts, and move rapidly through the design and analysis of factorial experiments. The course will include an introduction to standard computer programs for statistical analysis.

5 units, Aut (Calfee) 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, except on special arrangement with the instructor. Can be repeated for credit. Prerequisites: 1 and 60, and consent of instructor.

3 to 6 units, any quarter (Staff) by arrangement

106. Human Memory — A survey and analysis of the major topics in human memory, with an emphasis on contemporary research and theory. Related topics in perception and thought will also be presented. Prerequisites: 1 and 60.

3 units, Spr (Smith) TTh 11:00

106A. Human Memory Laboratory — Optional supplement to 106. Laboratory demonstrations and experiments on varied topics in human memory, including substantial opportunity for original research. Prerequisite: concurrent enrollment in 106.

2 units, Spr (Smith) by arrangement

107. Physiological Psychology: Basic Mechanisms — A survey of neural interactions underlying behavior. Connecting patterns of nerve cells and synaptic mechanisms will be stressed. Prerequisite: 1 or equivalent.

4 units, Aut (Wine) MWF 9

108. Physiological Psychology: Brain Structures and Mental Processes — An orientation in those facts of brain anatomy and physiology relevant to the analysis of behavioral processes. Prerequisites: 1 or equivalent, and elementary biology.

4 units, Win (Pribram) MWF 8

109. Physiological Psychology: Brain Structures and Perceptual Processes — An analysis of the structure of our sensations as it is determined by physiological encoding mechanisms. We will examine neuronal machines which produce our perception of color, brightness, movement, and shape. Prerequisite: 1 or equivalent.

4 units, Spr (Ganz) MWF 9, given 1974–75

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.

5 units, Aut (Maccoby) 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.
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, Win (Lepper) TTh 9–11

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, Spr (Feldman) TTh 9

117. Observation of Children—Enrollment limited to 16. Prerequisites: 111 or equivalent, and consent of instructor.
3 to 5 units, Aut, Win, Spr (Dowley) 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, Win, Spr (Dowley) T 2:15–4:05 and by arrangement

120. Developmental Lab—Experience in designing, executing, and criticizing experiments in developmental psychology will be provided. The sequence of experiments carried out by the students will be designed to clarify a complicated issue in development: Children’s changing conception of the physical world around them. Prerequisites: 111, Human Bio 3B.
3 units, Aut (Osherson) 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: I or equivalent.
4 units, Spr (D. Bem) TTh 3:15–4:45

123. Communication and Community Psychology I—(Same as Communication 123.) This course is designed for undergraduates interested in relating theory and action with respect to community involvement activities. Primary emphasis is placed on student initiative in selecting community-related projects which will be the basis of a two-quarter written report. Students will be expected to survey both the theoretical and practical literature dealing with the theory of social organization and community development.
4 units, Aut (C. Clark, McGee) TTh 10

124. Communication and Community Psychology II—(Same as Communication 123.) This is a continuation of 123. Prerequisite: 123.
4 units, Win (C. Clark, McGee) TTh 10

125. Psychology and Law—Legal, psychological, and popular views of morality, responsibility, equity, intention, insanity, evidence, crime and punishment; the police; psychological processes in jury deliberation; homicide and aggression; treatment of accused persons. Prerequisite: 1.
4 units, Spr (Diebold) MWF 11

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, Win (Ross) TTh 2:15–4:05 and by arrangement

128. Research Methods in Social Psychology—An examination of the practical problems of designing, conducting, and interpreting research and of the theoretical foundations of experimentation in social psychology. Laboratory research projects will supplement lectures and discussions. Prerequisite: 121 or equivalent.
5 units, Aut (Lepper) TTh 9:30–11:00

129. Theories in Child Development—The relation between theory and data will be stressed in evaluating prestigious theories of language acquisition, cognitive development, and perceptual development. Theorists to be examined include Bruner, Piaget, Skinner, E. J. Gibson, and Chomsky. Prerequisites: 111 and Human Bio 3B.
3 units, Win (Osherson) MWF 10

130. Psychology of Sex Roles—An examination of the antecedents and consequences of sex-role differentiation. Representative
topics include: theories about sex differences, biological and environmental causes of sex differences, sex-role socialization, achievement motivation in women, and the effects of maternal employment. Prerequisite: 1 or equivalent.

3 to 4 units, Spr (S. Bem) MWF 10

131. Personality: Theory and Research — The course will concern itself with determinants of human behavior and individual differences among people. Several theories of personality will be considered, with emphasis on those that have greatest current influence. Contemporary research on topics in personality (stress, anxiety, self control, aggression and prosocial behavior) will be examined. Personality development (hereditary, child rearing, cultural influences, etc.) will be examined at length, and personality change, primarily through psychotherapy, will be considered. Through examples and case histories an attempt will be made to relate knowledge gained from theory and research to people's functioning in everyday life.

4 units, Aut (Staub) MWF 1:15

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, Win (H. Mischel) TTh 10:30–12:00

133. Psychology of Biography—Analysis of novelists' personalities through data from their life histories and creative writing. Lectures, readings, and exercises on analytic methods, including content analysis and relating of social behavior to fantasy and symbolic expressions of motivation. Students are required to write a 25-page psychological biography of a novelist of their choice. Recommended: 1 or 111.

4 units, Aut (Sears) TTh 11

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 (Rosenhan) TTh 9:00–10:15

137. Personality and Positive Social Behavior—The course will concern itself with determinants of positive social behavior and with individual differences in positive social behavior (helping, sharing, cooperation, as well as behaving positively toward others in everyday life situations). The determinants of prosocial behavior in everyday life (including extreme forms such as heroic self sacrifice) and personality characteristics associated with prosocial behavior will be examined. The manner in which individual differences in values, role taking capacity, the ability to react with empathy to others, competence, etc., relate to prosocial behavior will be explored. How external influences and personality characteristics combine in determining prosocial behavior will be examined. The influences that lead to the development of a tendency by children to behave prosocially will be considered in detail.

4 units, Spr (Staub), MWF 1:15

138. Selected Topics in Personality — In-depth exploration of some particular area of research in personality, e.g., defensiveness. Specific topic may change from year to year. Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 to 4 units, Win (S. Bem) by arrangement

139A. Behavior Modification: Introduction — (Same as Education 136A.) Rationale, concepts and issues in application in educational settings. Implementations of behavioral change program.

3 units, Aut (Staff) by arrangement

139B. Behavior Modification: Review of Literature and Research Methodology — (Same as Education 136B.) Intensive design methodologies and their rationale. Review of literature in areas of interest (settings or behavior change strategies). Development of research project.

3 units, Win (Staff) by arrangement

139C. Behavior Modification: Application in Educational and Related Settings—(Same as Education 136C.) Practical experience in program design, application and construction. Visits to behavior modification settings.

4 units, Spr (Staff) by arrangement

141. History of Psychology—Prerequisites:
three courses in psychology and junior standing.

4 units, Spr (Hastorf) TTh 11:00–12:20

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: 1 and 60 or equivalents.

3 units, Spr (Calfee) MWF 9

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 (Gage) TTh 3:15–5:05

Spr (Gage) by arrangement

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 (H. Clark) MWF 1:15

147. Behavior from a Biological Perspective — Ethological viewpoints of behavior will be presented, with an emphasis on recent advances in understanding their physiological substrates. Prerequisites: 1 or equivalent, and either 107, 108, 109, or Bio 153.

4 units, Spr (Wine) by arrangement

148. Chemical Mechanisms in Behavior — The course will discuss recent advances in our knowledge of the neurochemical basis and psychopharmacology of mood, alertness, perceptual and behavior modifications and their disorders. Prerequisites: 1 or equivalent, and either 107, 108, or 109.

4 units (Wine, Pribram) by arrangement, given 1974–75

151. Statistical Methodology — Prerequisite: 60 or equivalent.

4 units, Win (Horowitz) MWF 9

152. Analysis of Data — Prerequisite: 151 or consent of instructor.

4 units, Spr (Carlsmith) MWF 9

155. Human Abilities — (Same as Education 255.) The nature, development, and measurement of intellectual abilities. Prerequisites: 1 and 60, or equivalent.

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) MW

163. Mathematical Psychology — (See 215.)

164. Mathematical Representation of Structures in Psychological Data — Theory and methods of multidimensional scaling, hierarchical clustering, and related methods for discovering and representing structures underlying psychological data (with particular attention to data from experiments on perception and cognition). Prerequisite: consent of instructor.

4 units, Aut (Shepard) TTh 3:15–5:00

165. Mathematical Theories of Learning and Memory — Mathematical models of psychological processes are introduced, and their applications to memory, learning, and cognition are illustrated. Prior familiarity with probability theory and the psychology of learning is desirable, though not required.

4 units, Win (Atkinson, Bower)

TTh 11:00–12:20

166. Mathematical Theories of Perception and Psychophysics — A survey of mathematical theories and methods in the area of sensory and perceptual processes, with special emphasis on Information Processing Models. Prior familiarity with probability theory and the psychology of perception is desirable, though not required.

4 units, Aut (Atkinson, D. Nagel)

MW 11:00–12:30

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 (Hilgard, Morgan)
T 1:15–3:05
Win (Hilgard, Morgan)
T 1:15–3:05

172. Psychology of Perceptual Experience
— An examination of phenomena of normal perception, illusions, imagery, dreaming, electrically and hypnotically induced hallucinations, and dissociation (including that demonstrated in "split-brain" patients) for what these phenomena can tell us about the mechanisms underlying our conscious experience of the external world. (The title has been changed from the previously listed "Psychology of Mental Phenomena" to reflect the course's relative emphasis on primarily perceptual phenomena.) Prerequisite: 1 or equivalent.

4 units, Win (Shepard) MWF 1:15–2:45

173. Seminar on Mental Images—An intensive study of psychological research bearing on the nature and voluntary control of mental images (particularly visual images), and on the relationship of imagery to perception, memory, thinking, problem solving, semantics, and psychopathology. Graduate students may enroll in 278. Prerequisites: at least junior standing in psychology and consent of instructor. Recommended: 172.

3 units, Spr (Shepard) by arrangement, given 1974–75

175. Brain and Choice: the Neuropsychology of Skill—Theories and experimental research concerned with the psychology of skills will be reviewed. Emphasis will be placed on an analysis of skills in terms of information processing models and their relation to brain function. Prerequisite: consent of instructor.

3 units, Aut (Mackworth) M 2:15–4:05

176. Psychology of the Reading Process—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) TTh 1:15

180. Undergraduate Seminar on 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. Awalt 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

185. Undergraduate Seminar on Psychological Issues in Criminology — The seminar will explore the field of criminology, seeking to identify major issues of practical and theoretical importance. The nature and usefulness of a psychological approach to issues will be considered. Students will read pertinent materials and prepare brief position papers to serve as the basis for seminar discussion. Simultaneously field problems will be selected for investigation by student teams. Field observations will form the basis for seminar deliberations and the preparation of a final paper which will designate either research or public policy needs.

3 units, Aut (Blum) M 3:15-5:05

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

189A. Endocrines and Behavior — This course focuses on the influence of gonadal hormones on behavior. In particular, reproduction and reproductive behavior, maternal behavior, courtship and aggression will be discussed in terms of hormonal influences. The neural regulation of these hormonal systems will be discussed.

3 units, Aut (Levine) TTh 8

189B. Endocrines and Behavior — This course focuses on the relationship between stress and behavior. In particular, the influence of the pituitary-adrenal system will be discussed in detail. In addition, we will examine the role of thyroid hormones on behavior. The neural regulation of hormonal systems will also be discussed.

3 units, Win (Levine) TTh 8

190A. Undergraduate Seminar in Early Experience — Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Win (Levine) T 8:00-9:50, alternate years, given 1974-75

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 (Mitler) by arrangement

191. Undergraduate Seminar in 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 on Aggression — Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Spr (Bandura) M 2:15-4:15

193. Undergraduate Seminar on Shyness — This seminar will explore the basis of shyness through surveys, interviews, library research and personal experience. Prerequisite: consent of instructor.

3 units, Spr (Zimbardo) by arrangement

194A. Undergraduate Seminar in Sex Typing — Prerequisite: consent of instructor.

3 units, Spr (Maccoby) by arrangement

194B. Undergraduate Seminar in Moral Development — Prerequisite: consent of instructor.

3 units, Spr (Maccoby) by arrangement

194C. Undergraduate Seminar in Parent-Child Interaction — Prerequisite: consent of instructor.

3 units, Spr (Maccoby) given 1974-75

195. Undergraduate Seminar in Personality — Open to both non-majors and majors in psychology. Prerequisite: consent of instructor.

3 units, Spr (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. Prerequisite: 117 and 118 and consent of instructor.
3 units, Spr (Shepard) TTh 1:15

198. Undergraduate Seminar on Experimental Studies of Selective Perception — Primarily intended for majors in psychology. Prerequisite: consent of instructor.
3 units, Aut (Lawrence) 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 backgrounds. Required of and limited to first-year graduate students in psychology.
3 units, Aut (Atkinson, Staff) TTh 11:00–12:20

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 (Pibram, Wine) by arrangement

209. Perception — A survey of theoretical models governing the perception of forms, colors, surfaces, space, brightnesses, movement, and objects. Prerequisite: graduate standing in psychology or consent of instructor.
3 units, Aut (Sakitt) MWF 9

210. Memory and Learning—Prerequisite: graduate standing in psychology or consent of instructor.
3 units, Aut (Bower) MWF 10

211. Developmental Psychology—Prerequisite: graduate standing in psychology or consent of instructor.
3 units, Win (Maccoby, Osherson) by arrangement

212. Social Psychology—Prerequisite: graduate standing in psychology or consent of instructor.
3 units, Spr (Lepper and Carlsmith) TTh 1:15–2:45

213. Personality — Prerequisite: graduate standing in psychology or consent of instructor.
3 units, Aut (W. Mischel) M 2:15–5:05, given 1974–75

214. Psycholinguistics—Prerequisite: graduate standing in psychology or consent of instructor.
3 units, Win (H. Clark) by arrangement

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 (Atkinson, Thomas) by arrangement

222. Mathematical Theories of Perception —Prerequisite: consent of instructor.
4 units, Spr (——) by arrangement

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) MWF 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.
4 units, Win (Dewson) by arrangement

230. Seminar in Neural Substrates of Human Communication — (Same as Hearing and Speech Sciences 390.) Prerequisite: consent of instructor.
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 sen-
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 to 4 units, Aut (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 to 4 units, Spr (Schubert) by arrangement

235A. Seminar in African Psychology I— This course, the introductory part of a three-part seminar, is designed for graduate students interested in the field of human consciousness: its origin, its nature, and its relationship to overt behavior. Particular attention will be paid to the African origins of consciousness. Various branches of the "occult" and original African sciences will be examined in relationship to current African (Black) behavior. Prerequisites: non-psychology students should have a strong background in philosophy, physics, or anthropology, and/or an interest in the philosophy of science.

3 units, Aut (C. Clark, McGee) TTh 3-5

235B. Seminar in African Psychology II— This course is a continuation of 235A. Students will begin research on specialized topics relating to: (a) the history and/or philosophy of Western science; or (b) to African conceptions of space and time. Prerequisite: 235A.

3 to 4 units, Win (Schubert) TTh 3-5

235C. Seminar in African Psychology III— This course is a continuation of 235B. Students will complete research connected with projects initiated during the previous quarter. Prerequisite: 235B.

3 to 5 units, Spr (C. Clark, McGee) TTh 3-5

240. Child Language I— (Same as Linguistics 300.) Review of present knowledge of processes of language acquisition from a linguistic point of view. Survey of recent and past literature. Prerequisite: Linguistics 100 or 210, or consent of instructor.

4 units, Aut (E. Clark) TTh 10:00-11:30

241. Child Language II— (Same as Linguistics 261.) Variable topics selected from semantics, syntax, or phonology. Topic for 1973-74: acquisition of basic grammatical categories.

4 units, Win (Ferguson) by arrangement

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 (Dowley) MW 4:15-5:30

244. Advanced Seminar in Developmental Theory— This will be a detailed and critical examination of much of Piaget’s theory. Topics include naturalistic thinking, logical thinking in children and adolescents, and spatial concepts. The relation of Piaget’s theory to the data will be emphasized. If time permits, the cognitive developmental theory of J. S. Bruner will be similarly examined.

3 units, Win (Osherson) by arrangement

245. Socialization of Pre-Adults in Contemporary U.S. Society — (Same as Education 389.) Study of socialization of children into systems of society with special attention to the school as a socializing institution. Particular attention will be given to social class
and ethnic differences in socialization processes and outcomes.

3 units, Spr (Staff) TTh 9

247. Physical Growth and Maturation—The course will deal with the physical growth of the human and his organs from early embryonic life to post-adolescence. Emphasis will be placed on the biology of growth and environmental effects on growth and development. Some functional inter-relationships during development will be considered with special concentration on the nervous system. Prerequisites: graduate standing, or senior standing in psychology and consent of instructor.

3 units, Aut (Kretchmer) by arrangement, alternate years, given 1974–75

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. Prerequisite: Statistics 160 or Psych. 60.

3 to 4 units, Aut (Cronbach) MW 2:15–4:05

249. Problems in Measurement — (Same as Education 353.) For prospective research workers. Survey of alternative mathematical models used in test construction and analysis covering such topics as profile analysis, measurement of gains, factor analysis, theory of personnel decisions. Prerequisites: 152 and 248, or Education 250B and 252, or equivalent.

3 to 4 units, Spr (Cronbach) MW 2:15–4:05

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 (Thomas) by arrangement

252. Seminar in Psychology and Law — (Same as Law 336.) — 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; the social psychology of institutions; the implications of dissonance theory for torts and bankruptcy.

3 units, Aut (Rosenhan, Diebold) by arrangement

254. Principles of Personality Change — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (Bandura) M 1:15–3:05

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

263. Seminar in Perception — Prerequisite: consent of instructor.

3 units, Win (Ganz) by arrangement, given 1974–75

264. Seminar in Learning Theory—Prerequisite: consent of instructor.

3 units, Spr (Bower) by arrangement

265. Seminar in Mathematical Theories of Learning and Memory — Prerequisite: consent of instructor.

3 units, Win (Atkinson) by arrangement

266. Seminars in Developmental Psychology—(Same as Human Biology 165.) Prerequisite: consent of instructors.

267. Seminar in Person Perception — Prerequisite: consent of instructor.

3 units, Spr (Hastorf) alternate years, given 1973–74

270. Graduate Seminar on the Psychology of Altruistic and Prosocial Behavior—This seminar will be concerned with theory and research on behavior that benefits other people: helping, sharing, cooperation, etc. Prosocial behaviors will be considered that vary in the degree of benefit they produce, in the degree of sacrifice that is demanded from the actor, and in the motivation of the actor. Social psychological influences on prosocial behavior, personality characteristics associated with prosocial behavior, and the
development of prosocial behavior in children will all be discussed.

3 units, Win (Staub) by arrangement

272. Seminar on Topics in Psycholinguistics — Prerequisite: consent of instructor.

3 units, Spr (H. Clark) by arrangement

273. Seminar in Personality Differences and the Prediction of Behavior — Prerequisite: consent of instructor.

3 units, Win (D. Bern) by arrangement

274. Graduate Seminar in Semantics and Memory — Prerequisite: consent of instructor.

3 units, Win (Smith) by arrangement

275. Research — Research of intermediate nature, whether or not to be used toward Master's thesis, to be undertaken with members of Department faculty. Prerequisite: consent of instructor.

(Staff) by arrangement

277. Seminar on Sex Roles and the Psychology of Women — Prerequisite: consent of instructor.

3 units, Aut (S. Bern) by arrangement

278. Seminar on Mental Images — See 173. Prerequisite: consent of instructor.

3 units, Spr (Shepard) by arrangement

280. Doctoral Research — For dissertation. Prerequisite: consent of instructor.

(Staff) by arrangement

285. Psychology of Biography — (Includes Psychology 133.) (Same as Modern Thought and Literature 285.) Analysis of novelists' personalities through data from their life histories and creative writing. Lectures, readings, and exercises on analytic methods, including content analysis and relating of social behavior to fantasy and symbolic expressions of motivation. Writing a psychobiography of a novelist or artist is optional.

4 units, Aut (Sears) TTh 11:00; T 2-4

302. Graduate Seminar on Madness — This seminar will explore the social psychological/cultural dimensions of "madness" (or if you prefer, mental illness, insanity, emotional instability, etc.). A major focus of the class activity will be an elaboration and search for evidence to support or refute a model of madness being developed by Zimbardo. The class will be limited to 15 advanced graduate students who already have some scholarly, clinical or personal knowledge of "madness" and an attempt will be made to have the class composition be as interdisciplinary as possible. Prospective students should confer with the instructor prior to registering for the course. Prerequisite: consent of instructor.

3 units, Spr (Zimbardo) by arrangement

303. Research Seminar in Hypnosis — Primarily for graduate students doing research in hypnosis and related areas. Can be repeated for credit. Prerequisite: consent of instructor.

1 to 3 units, Aut, Win, Spr (Hilgard, Morgan) F 3:15-4:30

305. Research Seminar in Cognitive and Mathematical Psychology — Can be repeated for credit. Prerequisite: consent of instructors.

1 unit, Aut, Win, Spr (Staff) F 3:15-4:30

308. Research Seminar in Neuropsychology — Can be repeated for credit. Prerequisite: consent of instructor.

1 to 3 units, Aut, Win, Spr (Pribram) F 10-12

311. Research Seminar in Developmental Psychology — Can be repeated for credit. Prerequisite: consent of instructors.

1 unit, Aut, Win, Spr (Maccoby, Sears, Osherson, Lepper, Feldman) by arrangement

312. Graduate Seminar on Penal and Therapeutic Institutions — An examination of two somewhat different types of "Total Institution": the Prison and the Mental Hospital. We will discuss the legal and other problems relating to the treatment, custody, discipline and legal rights of prisoners and mental patients. Emphasis will be on the common problems and the differences in treatment of inmates in the two types of institutions as well as upon the burgeoning field of legal controls of their administrators.

2 units, Aut (Rosenhan) by arrangement

RELIGIOUS STUDIES

Chairman: William A. Clebsch

Associate Professor: Lawrence V. Berman
Assistant Professors: Jerry A. Irish (on leave autumn, 1973), Nancy R. Lethcoe, Lee H. Yearley. Acting: Winston B. Davis
Lecturer: Robert Hamerton Kelly (autumn, spring)

Oferings and Facilities

As one of the humanities, the study of religion aims to understand religious works of 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).
5. At least 12 units in cognate courses in other departments (from an approved list).
6. The Senior Seminar (200).

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 the approval of a faculty member designated as the adviser. One advanced seminar in preparation for each part of the preliminary examinations must be completed satisfactorily before those examinations are taken.

Examinations: Written preliminary examinations are set for all students at the end of the second year of graduate study, save those whose performance during the first four quarters warrants the terminal A.M. degree at the end of the second year. These preliminary examinations test students' ability to approach their fields of concentration in the following ways: the interpretations of religious texts, the histories of religious movements, the systems of religious thought, and the comparisons of religious traditions. A student may petition to substitute a group of approved courses for only one of the four examinations. The preliminary examinations may be retaken only once, during the third year of graduate study. After passing these examinations, 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 preliminary examinations have been passed without conditions. 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. Prior to written preliminary examinations, students must demonstrate reading knowledge of ancient or other modern languages if relevant to the field of concentration. Knowledge of
additional languages may be required for certain areas of concentration.

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

21. Jesus in the Gospels—Varying interpretations of Jesus and his teaching.
   3 units, Aut (Kelly) TWTh 11

47. Christian Ethics—The ethics of Augustine, Aquinas, Calvin, Kant, Rauschenbusch, and Niebuhr; their theological context and uses in decision-making.
   5 units, Spr (Irish) MTWTh 9

61. Old Testament—Styles of varying parts, ideas, cultural and religious settings.
   5 units, Aut (Good) MTWTh 10

69A,B. Hebrew—Introduction to classical Hebrew language.
   5 units, Win, Spr (Staff) given 1974-75

73. The Ecumenical Movement.
   5 units (Brown) given 1974-75

77. The Comparative Study of Religions.
   5 units (Yearley) given 1974-75

RELIGIOUS TRADITIONS

113. Hinduism.
   5 units (Lethcoe) given 1974-75

114. Buddhism — History of Buddhist thought and practice; selected scriptures.
   5 units, Aut (Lethcoe) MTWTh 9

115. Confucianism and Taoism — Writings from the classic period: Confucius, Mencius, the Tao Te Ching, and others.
   5 units, Win (Yearley) MTWTh 9

117. Shinto—Indigenous religious traditions of Japan: folk religion, the rituals and outlook of the court, sectarian Shinto.
   5 units, Spr (Davis) MTWTh 8

123. Judaism—Talmudic and post-Talmudic Jewish thought: Midrash, Mishnah, and Talmud; codification of the law; Karaism; theology and philosophy; Kabbalah and Hasidism.
   5 units, Aut (Berman) MW 2:15-4:05

   5 units, Spr (Clebsch) MTWTh 11

127. Islam—Analysis of the Koran; traditional literature; basic concepts of law; sects; theology and philosophy; mysticism.
   5 units, Win (Berman) TTh 11-12:40

RELIGIONS AND CULTURES

131. Indian Buddhism.
   5 units, Aut (Lethcoe) given 1974-75

132. Religion in the Ancient Near East — Social functions and literary expressions of religion in ancient Mesopotamian, Hittite, Egyptian, and Northwest Semitic cultures. Prerequisite: at least one course in Religious Studies.
   5 units, Win (Good) MTWTh 9

   5 units, Spr (Lethcoe) MTWTh 10

137. Religion in Japan—Religious life in Japan: Shinto, Buddhist sects, Confucian schools; religious outlook of the folk, court, and the learned.
   5 units, Aut (Davis) MTWTh 10

138. Hellenistic Religions—Major religions of the eastern Mediterranean world in the Greco-Roman period: Judaism, Christianity, Gnosticism, Mithraism, Isis, and the ruler cults.
   5 units, Spr (Kelly) TTh 4:15-6:05

141. Christian Theology since the Enlightenment.
   5 units, Win (Irish) TTh 2:15-4:05
142. Foundations of Modern Jewish Thought — Talmudism, Hasidism, and Enlightenment; origins of Zionism and other secular trends; European Jewry and the Holocaust.
5 units, Spr (Berman) MW 4:15–6:05
143. Modern European Theologians—Barth, Bultmann, Buber, Tillich, Teilhard de Chardin, Bonhoeffner, and Rahner.
5 units, Win (Irish) MTWTh 8
145. Theology and Contemporary Literature.
5 units (Brown) given 1974–75
5 units, Spr (Clebsch) given 1974–75
148A. American Religion.
5 units (Clebsch) given 1974–75
148B. American Religious Thought.
5 units, Spr (Irish) TTh 4:15–6:05

RELIGIOUS THINKERS
161. Wisdom in the Ancient Near East.
5 units (Good) given 1974–75
163. Prophets of Israel — Hebrew prophets as poets and religious functionaries.
5 units, Win (Good) MW 4:15–6:05
164. Muhammad and the Koran.
5 units (Berman) given 1974–75
165. Islamic Theology and Philosophy — The thought of leading theologians and philosophers.
5 units, Spr (Berman) TTh 11:00–12:40
171. Augustine.
5 units, Aut (Yearley) given 1974–75
172. Maimonides — Scripture and its interpretation; concept of God and universe; prophecy; the political role of the law.
5 units, Win (Berman) TTh 2:15–4:05
173. Aquinas—The thought in its historical setting.
5 units, Aut (Yearley) TTh 4:15–6:05
174. The Protestant Reformers — Life and work of Luther, Melanchthon, Zwingli, Bucer, Calvin, Cranmer, Muntzer, Menno Simons, Schwennckfeld.
5 units, Win (Pauck) MWTThF 11
175. Representative Protestant Thinkers.
5 units, Win (Pauck) given 1974–75
177. Religious Existentialism — Faith and reason in Kierkegaard, Bultmann, and Buber.
5 units, Spr (Diamond) TTh 2:15–4:05
5 units, Win (Diamond) MTWTh 10
182. Medieval Jewish Thought.
5 units (Berman) given 1974–75
185. Modern Catholic Thought.
5 units (Yearley) given 1974–75
186. Verification and Theology — The challenge to religious language launched by positivists and their analytic successors among English-speaking philosophers.
5 units, Win (Diamond) TTh 4:15–6:05
187. Modern Protestant Theologians — Topic for 1973–74: The thought of Paul Tillich. The major philosophical, theological, political, and economic themes; the influence of other thinkers (historical and contemporary).
5 units, Aut (Pauck) TTh 2:15–4:05
188. Christian Theology.
5 units (Brown) given 1974–75

ADVANCED COURSES
200. Senior Seminar—Major works on the theory of religion. Limited enrollment. Prerequisites: senior standing and five previous courses in Religious Studies.
5 units, Spr (Good) MW 2:15–4:05
211. Buddhist Sutras—Critical examination of The Perfection of Wisdom Literature. Prerequisite: one course in Buddhism.
5 units, Aut (Lethcoe) TTh 2:15–4:05
213. Problems in Buddhology — Historical and doctrinal analysis of subjects in Buddhist thought: theories of knowledge, faith, grace, meditation. Prerequisite: one course in Buddhism.
5 units, Win (Lethcoe) MTWTh 11
215. Chinese Religious Thought—Prerequisite: Consent of instructor.
5 units, Win (Yearley) MW 2:15–4:05
233. Religion, Society, and Politics in Japan—Development of a religio-political order from shamanistic and tribal leadership to the emperor-system of modern, pre-war Japan. Relations between sacredness and au-
thority. Prerequisite: one course in Japanese History, or Social Science, or Religious Studies.

5 units, Win (Davis) MTWTh 10

245. Philosophical Theology: Existence of God—Teleological, ontological, and cosmological arguments; contemporary criticisms and defenses. Prerequisite: consent of instructor.

5 units, Spr (Diamond) MW 4:15–6:05

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, Aut (Good) MW 4:15–6:05

273. Pietistical Religious Movements — Sociological comparison of European pietism, Indian bhakti, and Chinese and Japanese Pure Land sects. Prerequisite: one course in European, Indian, Chinese, or Japanese culture or religion.

5 units, Spr (Davis) TTh 2:15–4:05

276. Topics in Religious Thought.

5 units (Irish) given 1974–75


5 units, Aut (Davis) MW 4:15–6:05

278. Problems in Religious Thought—Topic for 1973–74: The communication of religious knowledge in Kierkegaard, Mencius, Aquinas, and others. Prerequisite: consent of instructor.

5 units, Spr (Yearley) MW 2:15–4:05

299. Individual Work.

(Staff) by arrangement

GRADUATE COURSES

301. Interpretations of Religious Texts — Required of all doctoral students in Religious Studies; may be repeated for credit.

4 units, Aut (Staff) given 1974–75

303. Histories of Religious Movements — Topic for 1973–74: Pietistic enthusiasm in 17th and 18th Century Protestantism. Required of all doctoral students in Religious Studies; may be repeated for credit. Prerequisite: consent of instructor.

4 units, Aut (Clebsch) MW 2:15

305. Systems of Religious Thought — Required of all doctoral students in Religious Studies; may be repeated for credit.

4 units (Staff) given 1974–75

307. Comparisons of Religious Traditions—Topic for 1973–74: Pietistic movements in Eastern and Western Religions. Required of all doctoral students in Religious Studies; may be repeated for credit. Prerequisite: consent of instructor.

4 units, Win (Lethcoe, Davis) MW 2:15–4:05


(Lethcoe) by arrangement

313. Buddhism.

(Davis, Lethcoe) by arrangement

317. East Asian Religions.

(Davis, Lethcoe, Yearley) by arrangement


(Davis) by arrangement

343. Medieval Religious Thought and Movements.

(Berman, Yearley) by arrangement

345. Medieval Jewish Thought.

(Berman) by arrangement

346. Medieval Islamic Thought.

(Berman) by arrangement


(Good) by arrangement

363. Judaism.

(Berman) by arrangement

364. Islam.

(Berman) by arrangement

365. Arabic Philosophical and Theological Texts.

(Berman) by arrangement

366. Hebrew Philosophical and Theological Texts.

(Berman) by arrangement


(Good) by arrangement

368. Ancient Near Eastern Religions.

(Good, Berman) by arrangement

375. Modern Theology.

(Irish, Yearley) by arrangement

376. Nineteenth and Twentieth Century Religious Thought.

(Clebsch, Irish, Yearley) by arrangement
377. Topics in Theology.
   *(Irish, Yearley)* by arrangement

   *(Clebsch)* by arrangement

390. Teaching in Religious Studies—Supervised internship. Limited to graduate students in Religious Studies who have passed all preliminary examinations. Prerequisite: consent of instructor.
   2 to 5 units, Aut, Win, Spr (Staff) by arrangement

   *(Staff)* by arrangement

399. Directed Reading for Graduate Students.
   *(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:

History/Slavic 117A: Slavic Civilization to 1700.
5 units, Aut (Vucinich, Staff)

History/Slavic 117B: Slavic Civilization from 1700 to 1914.
5 units, Win (Todd, Staff)

History/Slavic/Political Science 117C: Slavic Civilization from 1914 to the Present.
5 units, Spr (Dallin, Staff)

SLAVIC LANGUAGES and LITERATURES

Emeriti: Jack A. Posin (Professor); Sarra Kliachko, Elisabeth Stenbock-Fermor (Assistant Professors), Nicholas S. Pashin (Senior Lecturer)

Chairman: Joseph A. Van Campen
Professors: Edward J. Brown, Joseph A. Van Campen
Associate Professor: Lawrence L. Stahlberger. Visiting: Richard Sheldon (spring quarter, 1974)
Assistant Professors: Dina B. Crockett, Richard Schupbach, William Mills Todd, III
Lecturer: Anya Motalygo Kroth

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 Translator’s 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 63, 111, 112, 113, 114, 115, 116, 161, 162, 163, and 192, with the remainder to be selected from the following: 145, 146, 147, 148, 170, 191, 198, 201. In addition, candidates are required to produce a publishable translation of a Russian book or monograph not previously translated into English.

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: 191, 196, 197, 198, 201, 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 100, 200, 206, 208, 215, 230, 240, 252, 253; Mathematics 1, 3; Philosophy 15A, 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.

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 following choice of patterns 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, it should be equivalent to the course requirements for the degree of Master of Arts. Students wishing to do advanced work in Polish should consider spending a year abroad under the Stanford-Warsaw exchange. Students considering minors in other areas, such as Asian Languages, English, or Comparative Literature, should consult with their adviser and the chairman of the Slavic 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.

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, (1) adequate performance on an informal oral exam based on course materials to be held during the second quarter of the second year, and, (2) for literature students, 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.

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 — Selected novels and short fiction of Pushkin, Lermontov, Gogol, Goncharov, Turgenev,
Saltykov-Schedrin and Chekhov. Readings in English. Undergraduate majors will take this course in conjunction with 147.

3 units, Aut (Todd) MWF 11

146. Russian Literature of the Twentieth Century—Selected works of Bely, Mayakovskyy, Gorky, Zamiatin, Pasternak, Sholokhov, Olesha, Solzhenitsyn, and some others. Stylistic and thematic developments in the twentieth century will be emphasized. Readings in English. Undergraduate majors will take this course in conjunction with 148; graduate students will take the course in conjunction with 222.

3 units, Win (Brown) MWF 11

149. Introduction to the Culture and Literature of the Slavic Peoples—No foreign language required.

3 units (Stahlberger) given 1974–75

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.

3 units, Win (Stahlberger) MWF 1:15

151. Dostoevsky—Reading of major works in English translation with reference to related developments in European literatures. Open to all students except freshmen. Undergraduate majors and graduate students in Slavic will do assigned portions of the reading in Russian.

3 units (Todd) given 1974–75

152. Gogol—Reading of major works in English translation with reference to related developments in European literatures. Open to all students except freshmen. Undergraduate majors and graduate students in Slavic will do assigned portions of the reading in Russian.

3 units (Todd) given 1974–75

153. Leo Tolstoy—Reading of major works in English translation with reference to related developments in European literatures. Open to all students except freshmen. Undergraduate majors and graduate students in Slavic will do assigned portions of the reading in Russian.

3 units, Aut (Stahlberger) MWF 1:15

154. The Russian Drama.

3 units (Stahlberger) given 1974–75

155. Chekhov—A study of Chekhov, whose work made a lasting impact on the modern short story and drama. Films of the major short stories and plays will be studied in conjunction with the texts. Reading will be in English, but students who know Russian will, for additional credit, be given some assignments that require working with that language.

3 units, Spr (Sheldon) MWF 1:15

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 8, 12, and 1:15

2. First-Year Russian—Continuation of 1.

5 units, Win (Crockett, Staff) MTWThF 8, 12, and 1:15

3. First-Year Russian—Continuation of 2.

5 units, Spr (Crockett, Staff) MTWThF 8, 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—Systematic review of first-year materials. Controlled expansion of first-year vocabulary through limited reading of selected texts and introduction to study of word formation.

5 units, Aut (Van Campen, Kroth, Staff) MTWThF 12 and 1:15


5 units, Win (Van Campen, Kroth, Staff) MTWThF 12 and 1:15

5 units, Spr (Van Campen, Kroth, 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 111–116 in conjunction with this series. Prerequisite: 53 or equivalent.

3 units, Aut, Win, Spr (Schupbach)
MWF 9

114–116. Third-Year Russian Conversation and Composition—Coordinated with and to be taken in conjunction with 111–113.

2 units, Aut, Win, Spr (Kroth) 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. 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, Aut, Win, Spr (Staff) MTW 10

118A,B. Russian Intellectual History — 
(Same as History 118A,B.) Study of major trends and documents in the history of Russian thought from the late 18th century to the First World War. Attention will focus on the development of “general ideas” about man’s ethical, moral, and aesthetic nature, society, and politics. Readings (in translation) will be drawn from literature, criticism, memoirs and correspondence, political and social theory, philosophy and history. A two-quarter course open to advanced undergraduate and graduate students. Enrollment limited to 30, permission of instructors required.

8 units, Aut, Win (Brown, Emmons)
TTh 4:15–6:05

147. Russian Nineteenth-Century Prose —
Discussion of selected problems, based on readings in Russian. This course must be taken concurrently with General Course 145.

3 units, Aut (Todd) M 4:15–6:05

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.

SECOND-YEAR LEVEL

63. Second-Year Russian (for Translators) —
Analysis and translation of short glossed texts of moderate difficulty. Emphasizes accurate understanding of Russian original. Prerequisites: 51 and 52, and concurrent enrollment in 53. Students who have already completed the second year must take an examination before being allowed to enroll.

3 units, Spr (Van Campen) MWF 2:15

THIRD-YEAR LEVEL

Students who have not had Slavic 63 or its equivalent must demonstrate adequate competence by an examination given at the beginning of the autumn quarter.

161. Third-Year Russian (for Translators) —
Reading and translation of unglossed texts from contemporary Soviet journals plus written and oral drills on constructions presenting particular difficulty to the translator.

3 units, Aut (Van Campen) TTh 11

162. Third-Year Russian (for Translators) — (Continuation of 161.) Reading and translation of more specialized texts in areas corresponding to the interests of individual students. Emphasis on style and fluency of English translation.

3 units, Win (Van Campen) TTh 2:15

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 (Schupbach) MWF 8:00

FOURTH-YEAR LEVEL

192. Advanced Translation—Specialization in areas selected by the student. May be taken more than once for credit.

1 to 5 units, Aut, Win, Spr (Van Campen, Schupbach) by arrangement

ADVANCED AND GRADUATE COURSES

165. Introduction to the Structure of Russian—(Same as Linguistics 165.) An outline of the phonology, morphology, and syntax of contemporary Russian. Prerequisite: Linguistics 100 or Slavic 112 or its equivalent.

3 units (Crockett) given 1974–75

167–169. Fourth-Year Russian — Reading and discussion in Russian of literary texts, with compositions on material discussed.

2 units, Aut, Win, Spr (Kroth) 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 2:15–4:05

Win, Spr, TTh 2:15–3:45

172. Pushkin.

3 units (Stahlberger) given 1974–75

185. Nabokov—A study of Nabokov’s prose, from Mary to Ada, with emphasis on the development of Nabokov as a master of form and style. Attention will be paid to the Russian antecedents that he claims do not exist. Films of Lolita and Laughter in the Dark will be studied in conjunction with the texts. Reading will be in English, but students who know Russian will, for additional credit, be given some assignments that require working with that language.

3 units, Spr (Sheldon) TTh 4:15

187. Russian Poetry of the Nineteenth Century—Sentimentalism, Romanticism, “Realism.”

3 units, Win (Stahlberger) MWF 11:00

188. Russian Poetry of the Twentieth Century — Futurism, Symbolism, Acmeism, Imagism.

3 units, Spr (Stahlberger) MWF 11:00

199. Russian Literature of the Middle Ages —Interested students from other departments should consult with instructor before registering for the course.

3 units, Spr (Todd) MWF 12

190. Russian Literature of the Eighteenth Century — Emphasis on poetry: theory of genres, the satire, the ode, the mock-epic.

3 units (Stahlberger) given 1974–75

191. Derivational Morphology.

3 units (Schupbach) given 1974–75

196. Russian Pronunciation — Prerequisite: 53 or equivalent.

3 units (Staff) given 1974–75

197. Russian Lexicology and Phraseology.

3 units (Staff) given 1974–75

198. Russian Syntax — Study of sentence structure and word order in contemporary Russian with emphasis on differences from English. Focus on the relationship between syntax and semantics.

3 units, Win (Crockett) by arrangement

199. Individual Work — Open to Russian majors or students working on special projects. May be repeated for credit.

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. Required of all entering graduate students; recommended for others.

3 units, Aut (Brown) M 2:15–4:05

201. Synchronic Morphology of Russian Conjugation and Declension.

3 units (Crockett) given 1974–75

211. Introduction to Old Church Slavonic and Early Russian Texts.

3 units, Aut (Van Campen) 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 (Schupbach) MWF 8

220. Problems of Literary Translation.

3 units, Spr (Brown) M 2:15–4:05

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.

3 units (Brown) given 1974–75

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.

3 units, Win (Brown) by arrangement

230. 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, Spr (Brown) W 4:15–6:30

277. Gogol — Also open to qualified undergraduate students.

3 units (Todd) given 1974–75

299. Individual Work — Exclusively for graduate students in Slavic working on thesis or engaged in special work.

1 to 12 units, any quarter (Brown, Crockett, Pashin, Schupbach, Stahlberger, Todd, Van Campen) by arrangement

300. Graduate Seminar—Subjects to be announced in the Time Schedule.

3 units, Win (Todd) by arrangement

Spr (Stahlberger) by arrangement

For additional offerings in literature, see Comparative Literature.
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

101. Honors Seminar.
4 units, Aut (Staff) by arrangement

102. Honors Seminar—Continuation of 101.
4 units, Win (Staff) by arrangement

103. Honors Seminar—Continuation of 102.
4 units, Spr (Staff) by arrangement

111. Introduction to Peace Studies
4 units, Aut (Staff) by arrangement

112. Introduction to Peace Studies—Continuation of 111.
4 units, Win (Staff) by arrangement

113. Introduction to Peace Studies—Continuation of 112.
4 units, Spr (Staff) by arrangement

186. Nonviolence and Liberation.
4 units, Aut (Staff) by arrangement

193. Senior Thesis and Directed Reading.
1 to 5 units, any quarter (——) by arrangement

SOCILOGY

Emeriti: Richard T. LaPiere, Charles N. Reynolds (Professors)
Chairman: W. Richard Scott
Associate Professor: Elizabeth G. Cohen, John W. Meyer
Senior Research Associate: C. Norman Alexander

PROGRAM OF STUDY

BACHELOR OF ARTS

OFFERINGS AND FACILITIES

The Department of Sociology offers courses of general cultural and educational value appropriate for all 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.

The Department also prepares students for professional work in Sociology. Students may pursue degrees in Sociology at the Bachelor, 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, 100, three courses chosen from the sequence Sociology 102 through 109 and at least 3 units of Sociology 90 or Sociology 190. The requirement of Sociology 90 or Sociology 190 is intended to give each student individual experience with faculty research or intensive "tutorial" contact on a subject of mutual faculty-student interest. 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 advisor, may fulfill up to 15 units for the degree. Students are encouraged to arrange tutorials and to work closely with individual advisers.

**Honors Program in Sociology**

The Honors Program is designed for those energetic and interested students who are capable of carrying out an intensive, individualized 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, and takes Sociology 80, 100, and any three courses from the 102-109 sequence; one course in statistics, logic, mathematics or computer science as appropriate to the student's special interests or research. 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 (Sociology)**

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 100, 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. 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 100 or greater and at least 30 of the course units must be taken within the Department.

**Doctor of Philosophy**

The goal of Ph.D. training is the preparation of persons who may be expected to make significant contributions to the advancement of sociological knowledge. Students normally apply for candidacy for the Ph.D. between the 6th and 9th quarter of residence in graduate school. For 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: Basic Problems in Sociological Theory, Theory Construction, Statistics for Sociological Analysis, Research Design, and Problems in Sociological Measurement. 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.

After admission to candidacy, 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.

**INTRODUCTORY COURSES**

1. **Introduction to Sociology**—A systematic introduction to sociology focusing on the development of principles for explaining social behavior in varying contexts. Topics to be covered include the analysis of social interaction; emergence of status and role; how status and role organize interaction; deviance and social control processes; complex organizations and the process of institutionalization.

   5 units, Aut (Staff) MWF 11; sections by arrangement

1A. **Social Problems: A Sociological Approach**—Specific social problems are examined from the perspective of sociological concepts and theory. The particular problems to be considered vary from year to year but include such topics as social inequality,
crime, racial conflict, over-conformity, and bureaucratic inefficiency.

5 units, Spr (Dornbusch) MWF 11; sections by arrangement

2. Introduction to Social Psychology and Interpersonal Behavior—Review and discussion of current problems, theories, and research in social psychology; social perception, development of self-conceptions, socialization, attitude change, and small group behavior. Prerequisite: 1, 1A, or consent of instructor.

5 units, Win (McMahon, Staff) MTWThF 11

3. Introduction to Social Organizations and Institutions—Analysis of social order with attention to its variety of forms. Primary group structure, family structure, communities; bureaucratic organizations; selected social institutions. The regulation and integration of behavior in families, peer groups, and other organizations which mediate between individuals and the institutional order. Prerequisite: 1, 1A, or consent of instructor.

5 units, Spr (Staff) MWF 9

24. Deviance and Social Control — Deviance as socially created, defined and organized. Its uses in society and its relation to systems of regulation. Emphasis on crime, illness and disorder—their social creation and social reactions to them.

5 units, Aut (Rosenblum) MWF 1:15

45. 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, Win (Rosenblum) TTh 11-12:15

50. 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.

5 units, Win (Scott) MWF 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 (Scott) W 4:15-6:05

90. Undergraduate Directed Research. 1 to 6 units (Staff) by arrangement

INTERMEDIATE LEVEL COURSES

Note—These courses normally assume some previous background in Sociology. The student who wishes to enroll in one of these intermediate courses without such background should consult the instructor before registering.

100. 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; lab. T, W or Th 2:15-5:05

102. Introduction to Comparative Sociology — A consideration of the major approaches to the study of human society and its development, with emphasis on evidence from all types of society. Prerequisite: previous work in the Social Sciences.

3 to 5 units (Olsen) given 1974-75

103. 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 (McMahon) given 1974-75

104. 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

105A. 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: 3 or consent of instructor.

5 units, Aut (Scott) MWF 9

105B. 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: 105A or consent of instructor.

5 units, Spr (McMahon) MWF 10

106. 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, Win (Cancian) MWF 9

108. Class, Status, and Power — Analysis of stratification in simple and complex groups and societies. General theories of stratification are analyzed and evaluated.

5 units, Aut (Zelditch) MWF 1:15

109. 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, Win (Tuma) MWF 11:00–12:15

110. Religious Institutions and Behavior — A sociological approach to organized religion, emphasizing the interaction between the church and its social setting.

5 units (Dornbusch) given 1974–75

115. Interpersonal Processes in the Family — Consideration of small group processes in the context of family interaction.

3 to 5 units, Win (Barchas) MWF 10

117. 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, Win (Meyer) MWF 1:15

119. Introduction to Models in Social Science — (Same as Education 110 and Political Science 185A.) 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 or 11

120. Human Ecology — Introduction to the use of ecological theory in the study of human social organization. Principles of ecology are presented in the context of four applications: family organization, urban structure, ethnic group relations, and societal evolution.

5 units, Spr (Hannan) MWF 9

121. Aggressive Behavior 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 units (Barchas) given 1974–75

122. Political Behavior.

5 units, Spr (Cohen) MWF 11

123. Political Institutions and Behavior — 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 10

124. Collective Behavior and Social Move-
ments—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, Spr (Rosenblum) MWF 10

125. 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 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 to 5 units, Aut (Friedman)


5 units (Barchas) given 1974–75

127. The Community—A comparative view of the social organization of communities having widely different economic, spatial, and cultural bases. An attempt to understand the changing significance of local community in relation to national structures of power, identification, and movement.

5 units (Olsen) given 1974–75

128. Field Study of Childhood, the Family, and Society—This seminar will study childhood and the institutions and interactions which define it in contemporary American society. The main activity of the seminar will be doing research and seeing how the roles of child, parent, and spouse are socially constructed in different communities in the vicinity of Stanford. Open only to students enrolled in Sociology 129 or attending lectures in Sociology 129.

5 units (Olsen, Cancian) given 1974–75

129. 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. This course will be integrated with Sociology 128.

5 units (Cancian, Olsen) given 1974–75


5 units, Win (Kirk) MTWTh 9

133. Socialization—Theories and evidence on the ways people are incorporated in society. Freud and Erikson on the construction of personality and identity. Mead and the interactionists on the development of roles. Labeling and linguistic theories on the creation of membership. Emphasis on the family and education as institutional settings.

5 units, Spr (Meyer) MWF 1:15

134. Contemporary Problems in Social Institutions—(Same as Education 202 and Political Science 280A.) 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) given 1974–75

136. Comparative Urbanism—(Same as Anthropology 136.) 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, Spr (Drake) MWF 2:15

137. Alcohol, Drinking and Alcoholism—Deals with the use of alcohol in the United States and its effects on interaction in large and small groups.

3 units, Aut (Barchas) TTh 11

138. Interpersonal Evaluation—Evaluation of yourself and of others as a fundamental process. It affects our conception of ourselves. It is central to informal groups and
bureaucracies, and it is the basis of many moral choices. This course will attempt to bring together knowledge from psychology, anthropology and sociology in order to try to develop an integrated theory across levels and fields. Members of the class will participate actively in this interdisciplinary approach.

5 units, Aut (Dornbusch) W 2:15-5:05

139. Power and Conflict in Education: An Experiential Course in Sociology — (Same as Education 114.) An experiential course in the sociology of education open to both graduate and upper division undergraduates dealing with power, stratification, and conflict in American society as these are reflected in the educational system.

5 units, Win (Baldridge) given 1974-75

142. Theories of Interpersonal Processes—Nonmathematical introduction to the major approaches to interpersonal behavior, applying these to such topics as power, affiliation, and coalition formation.

4 units (Barchas) given 1974-75

143. Sociology of War—A sociological analysis of the causes and consequences of war, focusing on such questions as the following: What is the nature of war? How is war related to other forms of collective violence? What processes of interaction between nations lead to war? What effect does war have upon the structure of society and upon the international system?

5 units, Win (Conner) TTh 11:00-12:15

146. Field Work Methodology—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, Win (Rosenblum) MW 12-2

147. Physiological Correlates of Social Behavior—Prerequisite: junior or senior undergraduate standing.

2 units, Aut (P. Barchas, J. Barchas) T 12:15

Advanced Level Courses—Open to Advanced Undergraduates and to Graduates

149. 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. The additional (optional) unit is given for computer exercises illustrating the practical usage of various statistical methods. Prerequisite: 40 or equivalent.

5 or 6 units, Spr (Tuma) MWF 11:00-1:00

Note—Students can usually obtain more detailed descriptions of the following courses from the Department Office on registration days.

154. Laboratory Research: Organizations—the advantages and limitations of laboratory research on sociological issues will be discussed. The main work of the course will consist of the discussion and planning of an experimental investigation, including—if time permits—pretests of an experiment.

5 units (Zelditch) given 1974-75

155. Research 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. In addition to lecture and discussion sessions, students will participate in working on on-going experimental research.

3 to 5 units, Win (Berger) M 2:15-5:05

157. The Criminal Law and the Criminal System—(Same as Law 107 and Political Science 174.)

5 units, Spr (Kaplan) MWF 1:15

159. 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 1:30-3:05

161. 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 8:30-10:00

163. Comparative Social Analysis — Cross-cultural approach to the study of social behavior and institutions. Emphasis is placed on methods of understanding and explaining social phenomena cross-culturally and on the cumulation of research. Prerequisite: several previous courses in the social sciences.

5 units, given 1974-75

171. Introduction to Computer Methods in the Social Sciences—Generalized computer techniques and their application on social science research. Intended for students with no familiarity with the use of computers, but with previous courses in the social sciences. Exercises making use of the computer are assigned.

5 units, Win (Staff) given 1974-75

173. 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, given 1974-75

174. Seminar on Small Groups—A systematic review of research on social influence, conformity, cohesion, exchange, power, status, roles, and rewards in small groups. Includes a preliminary discussion of the current status of the field, its use of experimental methods, and the relation of small groups research to macro-sociology.

5 units, Spr (Conner) T 2:15-5:05

176. 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 4:15

177. Values, Identities and Social Structure —A research seminar that will explore how norms and values affect action, and how the kind of person that you are supposed to be is related to social structure. Our main activity will be doing research. Possible topics include: (1) What is the effect of family and school on an adolescent’s identity and actions? (2) How does being a man vs. a woman or a parent vs. an employer affect the kind of person that you are supposed to be in a particular situation? Open to advanced undergraduates and graduates in the social sciences.

5 units; Aut (Cancian) T 2:15-5:05

180. 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

190. Individual Study.
(Staff) by arrangement

192. Senior Thesis.
3 to 10 units (Staff) by arrangement

Courses Primarily for Graduates

200A,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

201. Introduction to Sociological Research —Graduate students attend lectures in 100, but have special laboratory sessions.

5 units, Aut (Cohen) MWF 11; labs. by arrangement

203. Fundamentals of Organization Theory
—(Same as Education 329.) A survey course dealing with sociological theories about complex organizations and bureaucracies. Topics include: descriptive and normative classical theories of organization; decision-making and choice processes; professionals in organizational settings; organizations and conflict; environmental pressures on organizations; radical critiques of the role of bureaucracies in the larger society; etc.

5 units, Aut (Baldridge) MW 9–11; section by arrangement

213. 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, Spr (Baldridge) MW 9–11

215. 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

217. Problems in Theoretical Analysis—Prerequisites: 253 and consent of instructor.

5 units, given 1974–75

219. Change and Innovation Processes in Complex Organizations—(Same as Education 328.) A study of organizational change which focuses both on deliberate and non-deliberate types of change. Particular attention will be paid to administrative strategies for promoting desired changes in professional organizations, such as schools, universities, welfare agencies. Topics about change will include structural design, human relations strategies, evaluation processes, long-range strategic planning, political dynamics, etc. Prerequisite: Ed. 329 (Soc. 204) or Soc. 105a or 150b.

4 units, Win (Baldridge) M 2–5

220. Research Problems in the Sociology of Education—(Same as Education 310/210.) Prerequisite: consent of instructor.

4 to 6 units, Aut (E. Cohen) MW 9–11

230. Population Problems—(Same as Food Research 235.) For graduate students. See 130.

231. Seminar: Demography of the Developing Countries—(Same as Food Research 255.) 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: 230 or consent of instructor.

5 units, Spr (Kirk) MW 1:15–3:05

234. Graduate Colloquium: Community and Society in America—(Same as History 364.) The structure and functioning of communities, their relationship to the family and the individual, and problems of social mobility and power.

5 units, Win (B. Bernstein) W 2:15–4:05

248A. 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 class presentations, Education 310 or its equivalent is a prerequisite.

4 units, Spr (E. Cohen) M 7–9 p.m. and by arrangement

248B. Interaction Processes in Education—
(Same as Education 312B.) With increased use of group work as a class-room 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 heterogenous 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 (E. Cohen) TTh 3:15–5:05

250. 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, Win (Zelditch) T 2:15-5:05

253. Theory Construction — Prerequisite: consent of instructor.

5 units, Spr (Berger) M 2:15–5:05

260. Design and Analysis of Sociological Research—A consideration of the principles of experimental and nonexperimental design and analysis from a causal inference perspective. Prerequisites: 100, 149.

5 units, Aut (Hannan) MW 2:15–4:05

261. Causal Models in Social Research—Sociological applications of structural equations methods with special emphasis on path analysis, confirmatory factor analysis, and models with unobservable variables. Prerequisite: 260.

5 units, Win (Hannan) MW 2:15–4:05


5 units, Spr (Cohen) F 2:15–5:05

276. 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

286. 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 (Staff) by arrangement

289A,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 (Staff) M 3:15–5:05

Graduate Individual Study

290. Graduate Individual Study. (Staff) by arrangement

296. Special Colloquia. (Staff) by arrangement

300. Graduate Research. (Staff) by arrangement

308. Teaching Apprenticeship. (Staff) by arrangement

309. Research Apprenticeship. (Staff) by arrangement

310. Thesis. (Staff) by arrangement
COURSES OFFERED OVERSEAS

75A. Comparative Social Structure I—(Taught at Stanford in France.)
   4 units, Aut (Olsen)

75B. Comparative Social Structure II—(Taught at Stanford in France.)
   4 units, Win (Olsen)

86. French Regionalism—(Taught at Stanford in France.)
   4 units, Aut (Olsen)

87. Social Change in Modern France—(Taught at Stanford in France.)
   4 units, Win (Olsen)

129. Family and Kinship—(Taught at Stanford in Italy.)
   4 units, Spr (Cancian)

143. Social Structure of Modern Britain—(Taught at Stanford in Britain.)
   3 to 5 units, Spr (Zelditch)

147. English Society in Literature—(Taught at Stanford in Britain.)
   5 units, Spr (Zelditch)

152. European Social Theory—(Taught at Stanford in Italy.)
   4 units, Sum (Cancian)

SPANISH and PORTUGUESE

Emeriti: Aurelio M. Espinosa, Jr., Juan B. Rael, Isabel Magaña Schevill (Professors);
Grace Knopp (Assistant Professor)

Chairman: Bernard Gicovate

Professors: Fernando Alegria, Jean Franco, Bernard Gicovate, Ronald Hilton

Associate Professor: Joaquim-Francisco Coelho

Senior Lecturer: Phillip Petersen

Assistant Professors: Rubén A. Gamboa, 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 Doctor of Philosophy in Spanish, 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. Courses are to be selected with the guidance of the student's adviser. 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 in another department such as Classics, French, German, Italian, Oriental, or Slavic.

Combined Major with 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 courses both at the University and with the faculty supervisor who accompanies the group. Application forms may be obtained from the Department.

The Stanford Latin American Studies Program also admits students majoring in Spanish. See Latin American Studies.

Intensive Summer Program

Stanford University offers intensive study at various levels in both Spanish and Portuguese during the summer. Application forms for fellowships for this special program may be obtained from the Department.

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, page 47.

Specific requirements:

- Language Study: Spanish 164, 165, 166, 185, 190, 201, 202
- Literature: Chosen from courses in Hispanic Literature or Civilization numbered from 180 up
- Language Laboratory 215
- Methods: Spanish 210

Courses in Education

- 23 units
- 6 units
- 2 units
- 12 units

45 units

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” in this bulletin.

Students who choose a minor in Comparative Literature should consult Professor Herbert Lindenberger, 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

To be accepted as a candidate for the degree of Master of Arts in Spanish, a student needs to establish that he or she has completed creditably either an A.B. degree with a major in Spanish or an equivalent of this work. Stanford University requires a minimum residence of three full quarters before any degree can be granted. A student with graduate work taken at another university, in this country or abroad, is advised that this work will not reduce the three-quarter requirement; it will, however, if he or she continues his or her studies, shorten the time needed for completion of the Ph.D. degree. A total of 45 units is required for the Master of Arts degree of which 36 must be taken at Stanford. The Department requires a B average.

Requirements:

1. A reading knowledge of one foreign language other than Spanish or Portuguese.
2. 203. Advanced Grammar and Stylistics (3 units)—Prerequisite: 202 with grade of B or placement test.
3. 248 and 249 or two seminars (Span. 250, 251; Port. 250) (6 units).
4. 6 units to be chosen in the field of linguistics and philosophy.
5. 30 units of courses in Spanish or Portuguese above 180 chosen with the approval of the student's adviser, of which 6 units may be in related fields dealing with the area.
6. 299. Optional thesis (5 units). If a thesis is chosen, the preceding course requirement is reduced to 25 units.

DOCTOR OF PHILOSOPHY IN SPANISH

Students should read carefully the University regulations governing the conferring of this degree as described in the section “Degrees” in this bulletin.

No student is accepted for candidacy unless he or she has completed the equivalent of the requirements for the Master of Arts degree in Spanish as described above, and taken a preliminary examination in the first quarter of the second year of residence.

Requirements—All candidates for the Ph.D. degree must fulfill the following requirements:

1. Have a reading knowledge of Portuguese and one other foreign language. This knowledge must be demonstrated by examination.
2. Nine units in the field of linguistics and philosophy. No more than three units of similar work done elsewhere will be accepted as partial fulfillment of this requirement.
3. Complete a minimum of 15 units of graduate study or pass a written examination in each one of two of the following fields:
   a) Philology and Linguistics, Medieval Literature and Civilization.
   b) Spanish Literature and Civilization from 1500 to the Present.
c) Spanish American Literature and Civilization.
d) Portuguese or Brazilian Literature and Civilization.

No more than six units of similar work done elsewhere will be accepted as partial fulfillment in each one of these two fields.

4. Complete a minimum of 15 units of graduate study and pass a written examination in one other field of the above four, followed by an analysis of a prose passage and a poem. This field will be the field of specialization of a candidate, and this examination will have to be taken after completion of all course work.

5. Pass an oral or written examination in a more narrowly defined field within the candidate’s field of specialization—the historical or genre limitations of this field to be decided by agreement between the candidate and his dissertation adviser. The student will also submit a list of reading done in this area and take this examination at least four months after passing requirement 4.

6. Write a dissertation that embodies such results of research as would merit publication.

7. Pass a final University oral examination in defense of the dissertation.

8. Satisfactory teaching experience. Teaching fellowships are available to enable candidates to fulfill this requirement, which will be waived in the case of students who have teaching experience in other institutions.

9. Ph.D. candidates, except those in the Graduate Humanities Program, are required to present no less than 18 units of graduate work in a related field chosen with the consent of the adviser.

**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.

**151. Spanish Literature in Translation**
- Analysis, discussion of representative works.
  - Subject to be announced in *Time Schedule.*
  - 3 units

**152. Spanish American Literature in Translation**
- Analysis, discussion of representative works.
  - Subject to be announced in *Time Schedule.*
  - 3 units, Aut (Valadez) MWTThF 1:15

**153. Portuguese Literature in Translation**
- Analysis, discussion of representative works.
  - Subject to be announced in *Time Schedule.*
  - 3 units

**154. Brazilian Literature in Translation**
- Analysis, discussion of representative works.
  - Subject to be announced in *Time Schedule.*
  - 3 units

**171, 172. The Civilization of Spain and Latin America**
- Under the direction of the instructor, students select reading material describing the civilization, in any of its aspects, of Spain and Latin America or of an individual country or area. Open to Spanish majors.
  - 3 to 4 units (Hilton)

**SPANISH COURSES**

**FIRST- AND SECOND-YEAR**

(Under the Direction of Gustavo Valadez)

*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.

Students who have taken the Advanced Placement Test do not have to take the Stanford Placement Test.

1. **First-Year Spanish.**
   - 5 units, Aut, Win, Spr, Sum (Staff)
   - MTWTThF, plus additional work in the Language Laboratory

2. **First-Year Spanish—Continuation of 1.**
   - 5 units, Aut, Win, Spr (Staff) MTWTThF

3. **First-Year Spanish—Continuation of 2.**
   - 5 units, Aut, Win, Spr (Staff) MTWTThF, plus additional work in the Language Laboratory

4. **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. Elementary Spanish — Accelerated
course for beginners, particularly for those
seeking to fulfill the University requirement
of a reading knowledge for the Ph.D. de-
gree. Open to seniors and graduate students
only.
4 units, Spr (Staff) MTWTh 1:15
Sum (Staff) MTWThF 10

22. Second-Year Spanish—Prerequisite: 3.
3 units, Aut, Win, Spr (Staff) MWF, plus
additional work in the Language
Laboratory

23. Second-Year Spanish — Continuation of
22.
3 units, Aut, Win, Spr (Staff) MWF, plus
additional work in the Language
Laboratory

24. Second-Year Spanish — Continuation of
23.
3 units, Aut, Win, Spr (Staff) MWF, plus
additional work in the Language
Laboratory

29. Intensive Second-Year Spanish—Read-
ing, grammar, composition, and conversa-
tion. Enrollment is limited.
9 units, Sum (Staff) MTWThF 8 and 11

52. Intensive Second-Year Spanish.
5 units, Aut (Staff) MTWThF, plus
additional work in the Language
Laboratory

52BL. Intensive Second-Year Spanish—Es-
pecially designed for bilingual students.
5 units, Aut (Staff) MTWThF, plus
additional work in the Language
Laboratory

53. Intensive Second-Year Spanish — Con-
tinuation of 52.
5 units, Win (Staff) MTWThF, plus
additional work in the Language
Laboratory

53BL. Intensive Second-Year Spanish—Es-
pecially designed for bilingual students.
Continuation of 52BL.
5 units, Aut (Staff) MTWThF, plus
additional work in the Language
Laboratory

54. Intensive Second-Year Spanish — Con-
tinuation of 53.
5 units, Spr (Staff) MTWThF, plus
additional work in the Language
Laboratory

54BL. Intensive Second-Year Spanish—Es-
pecially designed for bilingual students.
Continuation of 53BL.
5 units, Spr (Staff) MTWThF, plus
additional work in the Language
Laboratory

99. Individual Reading — Enrollment only
by special consent. Prerequisite: 23.
1 to 5 units, any quarter (Staff) by
arrangement

THIRD- AND FOURTH-YEAR

100. Advanced Spanish Conversation —
May be repeated for credit. Prerequisite:
24 or equivalent.
3 units, Aut, Win, Spr (Staff) MWF 1:15

111. Third-Year Spanish—Prerequisite: 24.
3 units, Aut (Staff) MWF 9 or 10

111BL. Third-Year Spanish — Prerequisite:
24.
3 units, Aut (Staff) MWF

112. Third-Year Spanish — Continuation of
111.
3 units, Win (Staff) MWF 9 or 10

112BL. Third-Year Spanish — Continuation
of 111BL.
3 units, Win (Staff) MWF

113. Third-Year Spanish — Continuation of
112.
3 units, Spr (Staff) MWF 9-10

113BL. Third-Year Spanish — Continuation
of 112BL.
3 units, Spr (Staff) MW 10

121. Spanish American Cultural Readings
—Prerequisite: 23 or equivalent.
3 to 5 units

125. Spanish Cultural Readings—Prerequi-
site: 23 or equivalent.
3 to 5 units, Aut (Staff) MWF 1:15

130. Cervantes—Don Quixote. Prerequisite:
23 or equivalent.
3 to 5 units

131. Selected Works of Spanish Literature I
—Readings of poetry, drama, and novels of
the Golden Age. Prerequisite: 23 or equivalent.

3 to 5 units

132. 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

151. Selected Works of Spanish American Literature I—Prerequisite: 23 or equivalent.

3 to 5 units

152. Selected Works of Spanish American Literature II—Prerequisite: 23 or equivalent.

3 to 5 units

164, 165, 166. Spanish Conversation — Discussion in Spanish of present-day problems. Enrollment limited to 15. Students in the short-term program should enroll in 164A, 165A, or 166A for 2 units.

4 units, Sum (Staff)

ADVANCED AND GRADUATE

185. Spanish Phonetics.

3 units, Spr (Petersen) TTh 10

Sum (Petersen) MWF 10

186L. Spanish American Literature I—Colonial epoch. Open only to graduate and advanced undergraduate students.

3 to 5 units (Gamboa)

187L. Spanish American Literature II—Romanticism. Open only to graduate and advanced undergraduate students.

3 to 5 units (Gamboa)

188L. Spanish American Literature III—Modernismo. Open only to graduate and advanced undergraduate students.

3 to 5 units, Win (Valadez) MWFTh 1:15

189L. Spanish American Literature IV—Twentieth Century. Open only to graduate and advanced undergraduate students.

3 to 5 units, Spr (Gamboa) MWFTh 1:15

186S. Spanish Literature I—From its origins to end of fifteenth century.

3 to 5 units, Aut (Ball)

187S. Spanish Literature II—Sixteenth and early seventeenth centuries.

3 to 5 units, Win (Ball)

188S. Spanish Literature III—From 1650 to 1998.

3 to 5 units, Spr (Ball)

189S. Spanish Literature IV—Twentieth century.

3 to 5 units

190. Spanish Linguistics—(Same as Education 283.)

3 units (Petersen)

193A. Historical Spanish Phonology.

3 units (Petersen)

193B. Historical Spanish Morphology and Syntax.

3 units (Petersen)

193C. History of the Spanish Language.

3 units (Petersen)

195. Chilean Literature of the Twentieth Century.

3 to 5 units (Alegria)

195A. Argentine Literature of the Twentieth Century.

3 to 5 units (Alegria)

195B. Mexican Literature of the Twentieth Century.

3 to 5 units (Alegria)

195C. Peruvian Literature of the Twentieth Century.

3 to 5 units (Alegria)


3 to 5 units (Ball)

199. Individual Work — May be repeated for credit. Open only to majors in Spanish.

1 to 12 units, any quarter (Staff) by arrangement

GRADUATE COURSES IN SPANISH AND SPANISH AMERICAN LITERATURE


3 units, Aut (Staff) MWF 3:15

Sum (Staff) MTWF 2:15

202. Advanced Grammar and Composition—Analysis of structural patterns. Translation and free composition. Prerequisite: 201 with grade of B or equivalent.

3 units, Win (Staff) MWF 3:15

Sum (Staff) MTWF 2:15

203. Advanced Grammar and Composition—Prerequisite: 202 with grade of B or equivalent.

3 units, Spr (Staff) MWF 3:15
210. Methods of Teaching Spanish—(Same as Education 292.) See also Language Laboratory 215.
  2 units, Aut (Petersen)
  Sum (Petersen) MTWThF 11
217. Spanish Theater of the Golden Age.
  3 to 5 units
218. Spanish Renaissance Prose.
  3 to 5 units
220. Cervantes.
  3 to 5 units
223. The Modern Spanish Novel.
  3 to 5 units
  3 to 5 units (Gamboa)
228. 20th Century Spanish Poetry.
  3 to 5 units, Spr (Gicovate)
232. The Spanish Epic Tradition.
  3 to 5 units
240. Spanish Versification.
  3 to 5 units
249. Proseminar: Problems and Methods of Research in Hispanic Literatures II.
  3 to 5 units, Win (Gicovate)
250. Graduate Seminar in Spanish Literature—Subject to be announced in Time Schedule.
  3 to 5 units, Win (Gicovate)
251. Graduate Seminar in Spanish American Literature
  3 to 5 units
255. Contemporary Novelists of Spanish America.
  3 to 5 units (Alegria)
257. The New Novel in Spain and Spanish America—(Same as Comparative Literature 257.) Seminar on the narrative which will examine concepts such as “character,” “plot,” and “structure.”
  4 units, Aut (Franco) given 1974–75
258. The Shorter Narrative—(Same as Comparative Literature 258.) A seminar on critical approaches to the shorter narrative with special reference to Spanish American writers.
  4 units, Win (Franco) given 1974–75
259. Galdós, Eca de Queiros and Machado de Assis.
  3 units, Spr (Coelho, Franco) given 1974–75
260, 261. Spanish and Spanish American Poetry Since Modernism — A seminar on modern movements in poetry. The course will concentrate on Spanish and Spanish American poetry in relation to European movements including Symbolism, Dada and Surrealism.
  4 units, Aut, Win (Franco) T
262. North American and Latin American Poetry—(Same as Comparative Literature 259B.) Selected poets from the twentieth century. Reading knowledge of Spanish required.
  5 units, Spr (Felstiner, Franco) MW
  4 units, Aut (Franco) M
271, 272. Cooperative Seminar on Spain and Latin America.
  3 to 5 units, Aut, Win, Spr (Hilton)
299. 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) MWTThF 1:15, plus additional work in the Language Laboratory
2. First-Year Portuguese—Continuation of 1.
  5 units, Win (Staff) MWTThF 1:15, plus additional work in the Language Laboratory
3. First-Year Portuguese — Continuation of 2.
  5 units, Spr (Staff) MWTThF 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 (Coelho)

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: 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 (Coelho) MWF 1:15

182. Advanced Portuguese — Continuation of 181.

3 units, Win (Coelho) MW 2:15

185. Historical Portuguese.

3 to 5 units (Petersen)

186. Portuguese Phonetics.

3 to 5 units (Petersen)

191. Portuguese Literature I—Survey of literary trends and authors of Portuguese Literature.

3 to 5 units (Coelho)

192. Portuguese Literature II — Survey of literary trends and authors of Portuguese literature.

3 to 5 units (Coelho)

195. Brazilian Literature I—Survey of literary trends and authors of Brazilian literature.

3 to 5 units (Coelho)

196. Brazilian Literature II—Survey of literary trends and authors of Brazilian literature.

3 to 5 units (Coelho)

199. Individual Work—May be repeated for credit.

1 to 12 units, any quarter (Staff) by arrangement

250. Graduate Seminar—Subject to be announced in Time Schedule.

3 units, Spr (Staff)

251. Introduction to the Lyrical Poetry of Camoes—Study of the most significant lyrical poems of Camoes, with emphasis on the Sonnets.

3 to 5 units, Spr (Coelho) given alternate years

252. Fernando Pessoa—A study of the poetry of Fernando Pessoa as well as the poems of his "heteronimos" Alberto Caeiro, Ricardo Reis, and Alvaro de Campos.

3 to 5 units, Spr (Coelho) given alternate years

253. Individual Work.

1 to 12 units, any quarter (Staff) by arrangement

STATISTICS

Emeritus: Quinn McNemar (Professor)
Chairman: Ingram Olkin


Professor of Biostatistics: Byron W. Brown, Jr.

Visiting Professors: Somesh Das Gupta, Ulrich Dieter, Sudhish Ghurye

Associate Professor: Paul Switzer

Assistant Professors: Louis Gordon, Sidney Resnick, Thomas W. Sager

Assistant Professor of Educational Statistics: Janet D. Elashoff

Visiting Assistant Professors: Lynne Billard, N. A. S. Crowther
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.

Introductory courses for general students with an interest in the problems of statistical inference are: Statistics 40, 50, 60, 61, 62, 70. 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, 62 emphasizes mainly the techniques and methods of statistical inference. Statistics 70 is designed for students interested in biological and medical applications of statistics. These courses do not require any knowledge of calculus; the higher-numbered courses in the catalog all have some 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. The sequence 116, 119, 120 is a basic one-year course in mathematical statistics; the sequence 116, 217 and 218 is a basic one-year course in probability theory.

Students interested in computing and data processing have access to the Stanford Computation Center.

The requirements for a degree in statistics are flexible, depending on the needs and interests of the student. Among the courses which may be counted toward a degree in Statistics are certain courses offered by the Departments of Mathematics, Computer Science, Operations Research, Economics, Psychology, Electrical Engineering, Industrial Engineering, and the Graduate School of Business.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE IN
MATHEMATICAL SCIENCES

The Statistics Department participates with the Departments of Mathematics, Com-
puter Science, and Operations Research in a program leading to the degree of Bachelor of Science in Mathematical Sciences. See Program in Mathematical Sciences on page 555 of 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 through 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). Students can receive credit toward fulfilling this requirement for, at most, one of the following courses: Statistics 40, 50, 60, 61, 62, 70, or 110.
4. Four additional courses chosen from offerings in the Statistics Department or from authorized courses in other departments.

MASTER OF SCIENCE

In addition to the University's basic requirements for the Master's degree, 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.

Programs are ordinarily arranged to provide specialization in mathematical statistics, mathematical models in behavioral science, and operations research. Each student will normally fulfill the following requirements for the Master of Science degree:

2. Mathematics 113; and Computer Science 106 or an additional course in Mathematics at the 100 level or above.
3. Three additional courses from offerings in the Statistics Department.
4. Additional units to complete the requirements chosen from offerings in the Statistics Department or from authorized courses in other departments.

Requirements "3" and "4" enable the student to specialize in mathematical statistics, mathematical models in behavioral science, operations research, or other disciplines.

Students who are interested in mathemati-
cal statistics should concentrate on more advanced courses in the Department.

Students interested in mathematical models in behavioral sciences can take 208 and 209 offered 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 240, 250, 251, 252, and 257 within the Department, as well as authorized courses from other departments.

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 Philosophy**

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.

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 six quarter courses from the advanced courses offered in specialized fields such as Decision Theory, Sequential Analysis, Large Sample Theory, Multivariate Analysis, Non-parametric Inference, and Time Series.

3. Two written examinations in 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.

4. 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 his 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, teaching sections of undergraduate courses, research and computation assistance to investigators. A smaller number of assistantships are available in Summer Session. All applicants for financial assistance are required to take the Aptitude Test and the Advanced Test in Mathematics of the Graduate Record Examination. 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.

**Courses**

40. Introduction to Probability and Its Applications — Basic probability theory, com-
binatorial problems, random variables, laws of large numbers, random walks, Markov chains, with applications drawn from decision theory, statistical inference, and games of chance.

3 units, Aut (Staff) MWF 10
Sum (—) by arrangement

50. Elementary Decision Theory—An introduction to statistics for the general student, with emphasis on concepts of decision making in the face of uncertainty.

5 units, Aut (Staff) MTWThF 11
Win (Staff) MTWThF 9

60. Introduction to Statistical Methods I—Especially designed as a nonmathematical study of statistical methods used in the social 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 introduction to probability theory, including tests of hypotheses, estimation, and confidence intervals.

5 units, Aut (Chernoff) MTWThF 2:15
Spr (Staff) MTWThF 1:15
4 units, Sum (——)

61, 62. Introduction to Statistical Methods II, III—This two-quarter sequence is planned as a continuation of Statistics 60 and will treat 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.

61. 4 units, Win (Anderson) MTWF 2:15
62. 4 units, Spr (Anderson) MWF 2:15

70. Biostatistics—(Enroll in 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 1:15–2:05

104. Sampling from Human Populations (Elementary)—Theory of sampling from finite populations; efficiency of various survey designs; application. Prerequisite: elementary course in statistics.

3 units, given 1974–75

110. Statistical Methods in Engineering and the Physical Sciences—Use of statistical methods in research, production. Measurement errors, comparison of two or more means, curve fitting, correlation, design of engineering experiments. Prerequisite: calculus.

4 units, Aut (Lieberman) TTh 10 and
MW 4:15
Spr (Lieberman) MTWF 9
Sum (——) MTWThF 9


4 units, Aut (Efron) MTWF 10
Win (Stein) MTWF 10
Spr (Dieter) MTWF 9
Sum (——) MTWThF 11

116E. Theory of Probability—A course similar to 116 for engineering students. Prerequisite: Mathematics 45.

3 units, Aut (Cover) MWF 11


4 units, given 1974–75

119. Elementary Statistical Inference—Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. Prerequisite: 116.

4 units, Win (Billard) MWF 9
Sum (Haley) MTWThF 8:00–9:50

120. Statistical Inference—Point estimation; interval estimation; tests of hypothesis; linear hypothesis; distribution free methods; sequential analysis. Prerequisite: 119.

4 units, Spr (Billard) MWF 9
Sum (Haley) MTWThF 8:00–9:50

136. Introduction to the Theory of Games—Two person-zero sum games; strategy; minimax solutions; infinite games. Pre- or Corequisites: 116 and Mathematics 113.

3 units, Aut (Johns) MWF 3:15

140. Introduction to Probability and Its Ap-
Applications—For graduate students. Lectures same as 40.

3 units, Aut (Staff) MWF 10

150. Elementary Statistics — For graduate students. Lectures same as 50.

4 units, Aut (Staff) MTWThF 11
Win (Staff) MTWThF 9

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 (Cottle) TTh 4:15–5:30

153. Introduction to Operations Research II

3 units, Spr (Jacobs) TTh 4:15–5:30

160. Introduction to Statistical Methods I
—For graduate students. Lectures same as 60.

4 units, Aut (Chernoff) MTWThF 2:15
Spr (Staff) MTWThF 1:15

161. 162. Introduction to Statistical Methods II, III — For graduate students. Lectures same as 61, 62.

161. 4 units, Win (Anderson) MTWF 2:15
162. 4 units, Spr (Anderson) MWF 2:15

180. Statistical Computer Packages — It is customary for users of data to apply one of several statistical packages to analyze his data. Special attention will be paid to BMD (biomedical computer programs) and SPSS (Statistical Packages for Social Scientists). Some time will be spent on the implementation of packages. Most emphasis will be on the statistical implications of the methods applied. Some attention will be given to bugs and to numerical analysis problems. Preferably for current or prospective users of packages. Prerequisite: 50 or consent of instructor.

3 units, Aut (Chernoff) TTh 9

199. Independent Study — For undergraduates.

(Staff) by arrangement

204. Sampling from Human Populations—
Theory of simple and complex sample survey designs. Limiting distributions. Estimate theory for finite populations. The sampling of experiments. Prerequisites: completion of or concurrent registration in 120.

3 units, Spr (Staff) TTh 10

208. Mathematical Models in Behavioral Sciences: Psychometrics — Examination of mathematical models in factor analysis, mental testing, latent structure analysis, scaling theory, and related topics.

3 units, given 1974–75


3 units, given 1974–75

217, 218. Introduction to Stochastic Processes—The theory and application of stochastic processes as models for empirical phenomena, with special emphasis on the following processes: Wiener, Poisson, stationary, normal, counting, renewal, Markov, birth and death. Prerequisite: 116.

217. 3 units, Aut (Ghurye) MWF 2:15
Win (Miller) MWF 3:15

218. 3 units, Win (Ghurye) MWF 2:15
Spr (Miller) MWF 3:15

217, 218. 6 units, Sum (—)
MTWTh 10:00–11:50

219. Elementary Statistical Inference—For graduate students. Lectures same as 119.

3 units, Win (Billard) MWF 9
Sum (Haley) MTWThF 8:00–9:50

220. Statistical Inference — For graduate students. Lectures same as 120.

3 units, Spr (Billard) MWF 9
Sum (Haley) MTWThF 8:00–9:50
221. Analysis of Variance I—Theory of general linear hypotheses; important special cases of analysis of variance; case of unequal class frequencies. Prerequisite: 120 and some knowledge of matrix algebra, or consent of the instructor.
3 units, Win (Das Gupta) MWF 10

222. Analysis of Variance II—Special topics under Model I; consequences of relaxing assumptions; randomization basis of inference; components of variance; applications. Prerequisite: 221.
3 units, Spr (Das Gupta) MWF 10

223. Data Analysis — Statistical analysis of actual case material. Illustrative topics include: bioassay, mortality studies, multidimensional contingency tables, multiple regression, transformations combining independent tests and estimates. Prerequisite: 222 or consent of instructor.
3 units, Spr (Moses) MWF 8

230A,B,C. Advanced Probability — Mathematical foundations, beginning with development of Lebesgue measure and integration. Fundamental concepts of probability, limit laws, laws of large numbers, convergence theorems, infinitely divisible distributions, conditional expectations, martingales. Prerequisite: Mathematics 116 or equivalent.
230A. 3 units, Aut (Resnick) MWF 1:15
230B. 3 units, Win (Resnick) MWF 1:15
230C. 3 units, Spr (Resnick) MWF 1:15

236A,B,C. Mathematical Statistics — A survey of classical and modern statistics from an advanced mathematical point of view. Probability, games and decision theory, estimation, testing hypotheses, confidence intervals, Neyman-Pearson theory, large sample theory, non-parametric inference, sequential analysis, design of experiments. Prerequisites: 220; completion of, or concurrent registration in 221 and Mathematics 205A.
236A. 3 units, Aut (Sager) MWF 11
236B. 3 units, Win (Sager) MWF 11
236C. 3 units, Spr (Sager) 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 (Cottle) TTh 1:15–2:30
Sum (—-) TTh 1:15–3:00

3 units, Win (Eaves) TTh 4:15–5:30

3 units, Spr (Iglehart) 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, Aut (Hillier) MW 3:15–5:05
Win (Jacobs) TTh 4:15–6:05
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 (Shedler) TTh 2:45–4:00

260A,B,C. Workshop in Biostatistics—Techniques useful in biological applications including bioassay, quantal response, epidemiology. Informal training in medical science by medical school faculty. Open to doctoral students in Statistics.
260A. 2 to 5 units, Aut (Brown, Miller) Th 1:15–3:05
260B. 2 to 5 units, Win (Brown, Miller) Th 1:15–3:05
260C. 2 to 5 units, Spr (Brown, 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. Open to doctoral students. Prerequisite: consent of instructor.

261A. 2 to 3 units, Aut (Olkin) T12
261B. 2 to 3 units, Win (Olkin) T12
261C. 2 to 3 units, Spr (Olkin) T12

280. Statistical Computer Packages — For graduate students. Lectures same as 180.

3 units, Aut (Chernoff) TTh 9

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

Note—Registration in courses numbered 300 and above generally requires completion of Statistics 236A,B,C (or concurrent registration, with the consent of the instructor).

314A,B. Matrix Analysis and Inequalities—
(Same as Operations Research 314A,B.) 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.

314A. 3 units, given 1974–75
314B. 3 units, given 1974–75

324A,B,C. Multivariate Analysis—The multivariate normal distribution and related distributions such as the Wishart distribution and Hotelling’s $T^2$. Statistical inference for the multivariate normal distribution. Multiple regression, canonical correlations, multivariate analysis of variance, classification problems. Application of group theory to multivariate analysis. Third quarter will be devoted to special topics.

324A. 3 units, Aut (Olkin) MWF 8:30–10:00
324B. 3 units, Win (Olkin) MWF 8:30–10:00
324C. 3 units, Spr (Stein) MWF 2:15

326A. Sequential Analysis — The Wald sequential probability ratio test, operating characteristics and applications; Bayes sequential decision problems; asymptotic shapes; sequential design of experiments; special topics. Prerequisites: 217 and 220.

3 units, given 1974–75

326B. Sequential Analysis—General theory of optimal stopping with applications to sequential statistical decision problems.

3 units, given 1974–75

328A,B. Non-Parametric Statistical Inference—Statistical inference when functional form of underlying distribution is unknown; rank order statistics; sign tests; non-parametric discriminant analysis; non-parametric tolerance limits; theory of runs.

328A. 3 units, Aut (Stein) MWF 3:15
328B. 3 units, Win (Stein) MWF 3:15

330. Stochastic Processes—Topics in stochastic processes to be announced. Prerequisites: 230A,B,C.

3 units, Spr (Resnick) MWF 4:15


3 units, given 1974–75

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 hypothesis testing will also be discussed. Prerequisites: 236A,B,C.

3 units, given 1974–75

336A,B. Decision Theory and Statistical Inference — Minimax theorem, admissibility and complete class theorem, formulation of statistical decision problems, sufficient statistics, testing hypotheses, estimation, compari-
son of experiments, and sequential problems.

336A. 3 units, given 1974–75
336B. 3 units, given 1974–75


343A. 3 units, Win (Efron) T 2:15–3:30; Th 3:15–4:30
343B. 3 units, Spr (Efron) T 2:15–3:30; Th 3:15–4:30

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 on breadth of the fields of application (for example, astronomy, atomic physics, biology, crystallography, physical chemistry, sampling theory); unsolved problems.

351A. 3 units, given 1974–75
351B. 3 units, given 1974–75


3 units, Win (Staff)

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, Spr (Cover)

378. Generation of Pseudo Random Numbers—The linear congruential generator is used to produce uniformly distributed pseudo random numbers. The joint distributions of pairs and of triples are studied. Multiple linear recursive generators. Efficient methods of producing non-uniform random numbers include the inversion method, rejection method, table methods and comparison methods. Special methods for the normal, gamma, beta, Poisson and binomial distributions are studied. Prerequisite: 217 or consent of instructor.

3 units, Spr (Dieter) by arrangement

399. Research — Research work as distinguished from independent study of non-research character listed in 199 and 299.

Any quarter (Staff) by arrangement
SCHOOL of LAW

Dean: Thomas Ehrlich
Professors: Mauro Cappelletti, Marc A. Franklin, Lawrence M. Friedman, John Kaplan, John Henry Merryman, Robert L. Rabin, David Rosenhan
Associate Professor: Victor H. Li
Assistant Professor: Visiting: Phoebe E. Diebold
Lecturer: George Torzsay-Biber

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 5, 1973, and classes for spring term will terminate on June 10, 1974.

COURSES

GRADUATE

The following courses are open to qualified graduate students of other departments of the University upon permission of the instructor:

235. Art and the Law — In this course we will consider selected problems at the intersection of law and the visual arts (painting, sculpture, and graphic art) including: the protection of national art treasures and the international traffic in them; art forgery and its control; the artist’s “droit de suite” and attempts to establish its equivalent in this country; legal relations between artists, dealers, museums, collectors, and auction houses; the work of “Volunteer Lawyers for the Arts” (a voluntary legal services organization); etc.

Associated Councils of the Arts, The Visual Artist and the Law (paperback ed.) and selected readings.

3 term units, Spr (Merryman)

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. Attention is centered on the operation of the criminal process, the powers and practices of the police, the role of the neighborhood apparatus, and the influence of the Communist Party in legal work. 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 (1968) and mimeographed materials.

3 term units, Spr (Li)

291. International Law, Chinese Perspectives on — (Same as Political Science 147-L.) This course examines the traditional international law subjects using materials from the People's Republic of China. The topics covered include the sources of international law, treaties, sovereignty, war, international organizations, settlement of international disputes, and international trade. Particular attention is paid to whether China's different cultural, ideological, and economic background has led to a different understanding of an attitude toward international law and practice.

3 term units, Aut (Li)

311. Law and Social Science — (Same as Sociology 125.) 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, Spr (Friedman)

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 (Merryman, Cappelletti)

336. Seminar in Psychology and Law—(Same as Psychology 252.) 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 (Diebold, Rosenhan)

341. Roman Law—Study of Roman law as it has developed from the time of Augustus to that of Justinian. Although the private law will be studied in its entirety, emphasis will be on those parts which are still operative in modern civil law systems and in international law. Legal institutions will be studied through actual problems drawn mainly from Justinian’s Digest and their solutions will be discussed in historical context. The main purpose of the course is to identify and study the fundamental principles of Roman law and, in addition, to provide a background for further study in jurisprudence, legal history, and comparative law. Roman text will be provided in English translation. Some knowledge of Latin is desirable but not required. A paper will be required.

3 term units, Spr (Torzsay-Biber)

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.

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, Spr (Franklin)

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.

5 units, Spr (Kaplan)

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)
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, and to conduct teaching and 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 whose approach to problems in clinical medicine is that of a scientist.
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 emphasize the development of individualized study plans for each student. Medical students no longer take a group of specified courses nor are they required to meet specific course requirements. Rather, each student develops a study plan from among the course offerings of the School of Medicine. Students are encouraged to develop study plans that will enable them to take full advantage of the resources of the Medical School and University and to pursue study of one of the medical disciplines in depth. 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.

Students are encouraged to prepare for medical school with a thorough exposure to the basic natural sciences. This includes basic courses in physics, chemistry, and biology. Because of its importance to an understanding of medicine, course work in mathematics is highly recommended. 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

School of Nursing

The School of Nursing has offered a five-academic-year curriculum since 1957. Stu-
DENTs presently enrolled will complete this program although no new students will be admitted. A recommendation has been made that only a Master of Science program be offered. If accepted, it is anticipated that the first class will be admitted in 1975.

DIVISION OF PHYSICAL THERAPY

Emerita: Sarah Semans (Associate Professor)
Director: Helen Blood
Associate Professors: Lucille Daniels. Clinical: Catharine Graham
Assistant Professors: Helen Blood, Barbara E. Kent
Lecturers: Carolyn R. Houser, Katharine B. Robertson, Katherine F. Shepard
Clinical Teaching Assistant: Elaine M. Hansen

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 two specialty areas, Administration and Community Health or Clinical Specialists, 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, and a full-time assignment during the summer quarter. 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 and, upon request, 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.

Further information about traineeships and scholarships may be obtained from the Division of Physical Therapy upon request.

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 other departments in the Medical School and other schools in the University. Electives related to the student's program may be selected.

Graduate students from other departments may attend courses in the Division with the consent of the instructor.
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. Neuroanatomy and Physiology of Human Motion—Emphasis on the neuroanatomical and physiological basis for normal and abnormal movement as it relates to physical therapeutic procedures.

3 units, Aut (Houser, Staff) TThF 10:00–11:50

226. Neurophysiological Basis of Human Motion I—Neurophysiology of the central control systems for movement; pre- and postnatal development of motor action; the assessment of neurological patients. Prerequisite: 225.

5 units, Win (Houser) TTh 8:00–11:50; F 10:00–11:50

227. Neurophysiological Basis of Human Motion II—Analysis of treatment approaches for the neurological patient; assessment and program planning for patients with neuromuscular disabilities. Prerequisite: 226.

4 units, Spr (Houser) 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

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. (Open to undergraduates with consent of instructor.)

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, Aut (Shepard) by arrangement

254. 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, any quarter (Kent, Staff) by arrangement

255. Directed Clinical Experience in Physical Therapy II—Continuation of 254.

1 to 5 units, any quarter (Kent, Staff) by arrangement

256. Internship in Physical Therapy—Students are assigned to treatment facilities for full-time clinical experience.

1 to 9 units, any quarter (Kent, Staff) 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.

4 units, Win (Shepard) by arrangement

258. Seminar: Evaluation of Physical Therapy—Comparative analysis of physical therapeutic procedures, evaluative and testing instruments, and treatment programs and regimens.

2 units, Aut (Staff) TTh 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 8:00–9:50

**SPECIALTY AREAS**

Courses listed between 260 and 285 are related to the specialty areas. Students must complete one of the following groups:

- Administration and Community Health—260 and 261
- Pediatrics—265 and 266

**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.
4 units, Aut (Daniels, Blood) by arrangement

**261. Administration and Community Health in Physical Therapy II**—Continuation of 260.
4 units, Win (Daniels, Blood) by arrangement

4 units, Aut (Houser) by arrangement

**266. Pediatric Physical Therapy II**—Continuation of 265.
4 units, Win (Houser) by arrangement

**282. Directed Teaching.**
1 to 5 units, any quarter (Staff) by arrangement

**285. Individual Work.**
1 to 8 units, any quarter (Staff) by arrangement

**RESEARCH COURSES**

Research requirements of the Division must be satisfied by completing either 292 or 295.

**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

**292. Master’s Thesis in Physical Therapy.**
1 to 10 units, any quarter (Staff) by arrangement

**ANATOMY**

_Emeriti:_ Donald J. Gray, William W. Greulich, Hadley Kirkman (Professors)

_Actoring Chairman:_ Robert A. Chase

_Professors:_ Robert A. Chase, Robert S. Turner. _Visiting:_ Benjamin Castleman, Otto Mortensen

_Associate Professor:_ Donald L. Stilwell, Jr.

_Assistant Professors:_ Gerald R. Cunha, Lawrence H. Mathers. _Acting:_ Otto M. Sokol

_Instructors:_ Acting: Leonard Gordon, Ian H. Leverton

_Lecturer:_ Visiting: Ardon Malan

_Clinical Lecturers:_ Dean T. Clark, Burt L. Davis, Jr., Robert W. Meyer, Reuben Stutch, Bernerd 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 summa-
rized 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 human body by dissection, study of anatomical preparations. Lectures, demonstrations. Enrollment limited to those for whom this course is required, e.g., students of nursing, physical therapy, and physical education.

5 units, Aut (Cunha) T W Th F 1:15-4:05

201. Human Gross Anatomy—Embryology, dissection, demonstrations, and clinical correlations. Enrollment ordinarily limited to medical students.

5 units, Win (Chase, Gray, Leverton, Mortensen, Stilwell) MWF 10-12; T Th 9-12


5 units, Spr (Chase, Gray, Leverton, Mortensen, Stilwell) MWF 10-12; T Th 9-12

204. Histology—Structural and functional organization of cells, tissues, and organs, as seen with the light and electron microscopes.

3 units, Aut (Kirkman, Mathers) T Th 2-5

205. Histology—Continuation of 204.

3 units, Win (Kirkman, Mathers) T 2-5; Th 2-4

206. Individual Work—When circumstances warrant, work not specifically provided for in scheduled courses may be carried on under supervision of one or more members of the staff.

Any quarter (Staff) by arrangement

209. Neuroanatomy—Study of the functional anatomy of the central nervous system of man, including the study of prepared slides and dissections of central nervous systems of man and other mammals. Enrollment of non-medical students by consent of instructor. Prerequisite: histology.

4 units, Aut (Mathers, Stilwell) MWF 2-4

299. Research—By individual arrangement, approved by Department faculty.

Any quarter (Staff) by arrangement

BIOCHEMISTRY

Chairman: Paul Berg


Assistant Professor: Ronald W. Davis

PROGRAMS OF STUDY

The Department offers a first-year course in modern biochemistry open to medical students, qualified graduate students, and senior undergraduates. Also a series of advanced courses is given by the Department; these are open to medical and graduate 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.

200. 5 units, Aut (Staff) MTWThF
201. 5 units, Win (Staff) MTWThF

**203. Mechanisms of Biochemical Reactions.**
2 units (Stark) given 1974-75

**204. Membrane Biochemistry.**
2 units (Kornberg) given 1974-75

**205. Mechanism and Control of Transcription in Bacterial and Higher Cells** — A discussion of recent advances in the understanding of in viva and in vitro transcription. Several model systems including both bacterial and animal viruses will be covered. Special attention will be given to the various methods used in transcription studies. Prerequisites: Biochemistry 200 and 201.

2 units, Win (Davis) given 1973-74


3 units, Spr (Kaiser) given 1973-74

**212. Enzymology of Nucleic Acids.**
3 units (Lehman) given 1975-76

**213. The Arrangement of Information in Chromosomes**—Recent advances in the arrangement, replication and regulation of genetic information in the chromosomes of higher organisms will be discussed. Prerequisites: Biochemistry 200 and 201, or comparative knowledge.

2 units, Aut (Hogness) given 1973-74

**214. Physical Chemistry of Proteins and Nucleic Acids.**
3 units (Baldwin) given 1974-75

**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, immunochemistry.

2 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 Professor:* A. T. Ganesan

*Senior Scientist:* Elliott C. Levinthal

*Director, Lt. Joseph P. Kennedy, Jr. Laboratories for Molecular Medicine.*

**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 Bio-behavioral 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 an overall training toward the Ph.D. program in Genetics.

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 Neurological 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.

The principal areas for which research training is available at the present time are the function of DNA in bacteria, genetics of hemoglobin and immunoglobulins, genetics of antibody formation, immunogenetics and somatic cell genetics, biochemical neurogenesis, biochemical genetics of mental disease, the interactions of cultural and biological evolution, the investigation of extraterrestrial life, application of new physical methods to biochemical analysis, and cell detection and sorting procedures, genetic demography, and population genetics.

The availability of financial support for trainees is dependent on federal policies which were unsettled at the time of this writing. Nevertheless, 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 (postdoctoral 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, Win (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, Spr (Cann, Staff) MWF 1

208. Human Cytogenetics and Its Clinical Applications—After a review of normal human chromosome structure and normal chromosome segregation in mitotic and meiotic 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 1973-74
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.

2 units, Win (Herzenberg, McDevitt)  
M 4:15–6:05, given 1973–74

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

249. Cytogenetics—(Same as Biological Sciences 249.) Principles and modern biochemical methods of chromosome analysis. Structure, function, and replication of chromosomes in prokaryotic and eukaryotic organisms. The influence of chromosomal changes in development and evolution. Analysis of human chromosomes and their behavior in cell hybrids. Prerequisites: Biology 21, 22, and 23, knowledge of genetics and biochemistry.

3 units, Aut (Ganesan) given 1974–75

260. Supervised Study — Prerequisite: consent of the instructor.

Any quarter (Staff) by arrangement

270. Genetics Seminar.

Any quarter (Staff) by arrangement

271. Immunology Literature Reviews — Discussions by course participants of selected recent articles in an area of immunology. Limited to 12 students. Prerequisites: a working knowledge of biochemistry, genetics, and immunology, and consent of instructor.

2 units, any quarter (Herzenberg, Weissman) W 8:30 p.m.

299. Individual Research.

Any quarter (Staff) by arrangement

HEALTH SERVICES ADMINISTRATION  
(MASTER OF SCIENCE PROGRAM IN )  
DEPARTMENT OF COMMUNITY AND PREVENTIVE MEDICINE

Acting Director: Count D. Gibson, Jr., M.D., Chairman, Department of Community and Preventive Medicine

Assistant Director: Floyd A. Grolle, Ph.D., Lecturer, Department of Community and Preventive Medicine

Assistant Professors: John C. Hershey, Ph.D., and Harold S. Luft, Ph.D.

Instructor: Joan M. Gianaris

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 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 and a one-quarter, full-time practicum. 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 Community and Preventive Medicine, School of Medicine, Stanford University, Stanford, California 94305.
Program in Hearing and Speech Sciences

Emeriti: Virgil A. Anderson, Jon Eisenson (Professors)
Director: James H. Dewson III
Professor: Earl D. Schubert
Associate Professors: James H. Dewson III, Dorothy A. Huntington
Assistant Professor: Theodore J. Glattke

Cooperating in the offerings of the Program is Clara N. Bush, Associate Professor of Linguistics

Offerings and Facilities
The aims of the Program are two-fold: (a) to make available to doctoral and postdoctoral students the material essential to a complete understanding of behavioral and physiological aspects of normal and defective processes of human communication; and (b) to provide, at the undergraduate level, a systematic understanding of these processes as a complement to formal study in such disciplines as Psychology, Biology, Linguistics, etc. Students may be preparing for careers in university teaching or research, or they may have primary interest in another discipline, e.g. Medicine, with a desire for specialized study in some area of human communication.

The available facilities include fully equipped new laboratories for basic and applied research into every major aspect of the hearing and speech sciences. A direct relation with the Division of Otolaryngology of the Stanford Medical School makes it possible to offer excellent opportunities for training and research in the clinical aspects of communication disorders. Strong working relationships with other departments of the University, both within the School of Medicine and elsewhere, provide further for a well-balanced undergraduate and postgraduate academic environment.

Programs of Study
Each student’s doctoral program is planned individually with the needs and interests of the candidate in mind. Candidates may include a formal minor as part of their program. The minor is chosen in consultation with the candidate’s major adviser, but the content and details of the 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) MWF10 plus 1 hour 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

265. Assessment of Auditory Function—An overview of measurement techniques and a comparison of normal and pathological findings for absolute and differential thresholds, pitch, loudness, adaptation, and speech perception.
2 units, Win (Glattke) by arrangement

268. Selected Topics in Audiology — Detailed consideration of current tests of auditory function with special reference to psy-
chological and physiological interpretation of results.

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 to 4 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 to 4 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 (Glattke) 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
Senior Lecturer: John P. Steward
Assistant Professors: Alfred A. Amkraut, Bernard W. Nelson
Instructor: Eric J. Stanbridge
Lecturer: Steven Bret Snyder
Senior Scientists: Monroe D. Eaton, Esther M. Lederberg

PROGRAMS OF STUDY

The Department of Medical Microbiology offers a program leading to the degree of Bachelor of Science to undergraduates. Requirements include: Biological Sciences, 15 quarter units; Chemistry, 19 quarter units; Physics, 12 quarter units. The following courses in the Department are required. Medical Microbiology 101, 200, 202, 204,
206, and 270. In addition, Biochemistry 200 and 201 are required.

**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, and Quantitative Analysis. 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 an oral examination covering the fundamentals of 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. During the first year or two of graduate work, the foreign language requirement (French or German or a language approved by the Department) should be met, and courses taken in biochemistry (Biochemistry 200, 201), 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 21, 22, 23, 250). 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 248, 249, 252; Genetics 201); biochemistry (e.g., Biochemistry 204, 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, bacterial viruses, animal viruses, and fungi. Coverage will include physiology, metabolism, immunology, genetics, and host-parasite relationships. Prerequisites: Biological Sciences 1 and Chemistry 4 and 5, or Chemistry 31, 33, and 35.

5 units, Aut (Roantree) MWF 1:15; lab. MWF 2:15-4:05

200. Immunology—A general course in the principles of immunology.

3 units, Win (Raffel, Rosenberg) M 2:15–4:05; F 2:15–3:05

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 1:15–3:05; TTh 1:15; F 1:15–3:05

204. Bacterial Genetics—(Same as Biological Sciences 204.) A course of lectures on inheritance in bacteria. Prerequisite: 101 (or equivalent).

3 units, Win (Stocker) MWF 11 alternate years, given 1973–74

206. Virology — Lectures and demonstrations on general nature of plant and animal viruses, and their relationships with their hosts. Prerequisites: 101 or 202, and Biochemistry 200.

3 units, Win (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, Aut (Roantree, Stocker) TTh 2:15

211. Immunologic Techniques — Antibody preparation and purification by physico-chemical and specific methods. Determination of antigen-antibody reactions by biological and physical means, e.g., hemagglutination, phage neutralization, hemolytic plaque formation, radioactive coprecipitation, agar diffusion, immunoelectrophoresis. Prerequisites: 200 and Biochemistry 200, consent of instructor during preceding winter quarter.

5 units, Sum (Amkraut) by arrangement

260. Literature Reviews — Review of literature on special topics to be assigned by instructor.

3 to 5 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.

2 units, any quarter (Amkraut, Rosenberg) by arrangement

270. Seminar — Reports, discussions on selected topics by outside speakers. Required of all graduate students.

1 unit, Aut, Win (Staff) by arrangement

299. Research — Students who have satisfactorily completed necessary foundation courses may elect research work in: general bacteriology, including genetics; microbial pathogenicity; immunology; virology, including viral oncology; aging; and cell biology. Grade average of B in microbiological subjects required for admission to research or thesis work.

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 260. 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. Endocrine Behavior
Psychology 208. Physiological Psychology: Brain and Behavior

PATHOLOGY

Chairman: David Korn
Course Advisers: Klaus G. Bensch, Mary M. Herman

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 understanding of disease, are prerequisites for all advanced and special courses.

**200. General Pathology** — Lectures and demonstration providing an introduction to general pathology.

*Spr (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.

*Aut, Win, Spr (Dorfman, Kempson, Staff)*

**205. Clinico-Pathological Correlations** — Correlation of clinical histories with autopsy material, including microscopy.

*Win, Spr (Kosek, Fajardo, Bignami)*

**206. Neuropathology** — Systematic course on the pathology of diseases of the nervous system, including (1) the broad principles of neural cell and tissue pathology; (2) a review of common pathological processes affecting the brain, spinal cord, and peripheral nerves: cerebral edema, cerebrovascular disease, infections, demyelinating disorders, tumors, degenerative diseases, myopathies, and congenital and infantile defects.

*Win (Rubinstein, Bignami, Herman, Forno)*

**207. Principles of Electron Microscopy.**

*Aut, Win, Spr (Haydon) by arrangement*

**208. Interpretation of Electron Micrographs.**

*Spr (Haydon) by arrangement*

**210. Transplantation Biology.**

*Spr (Weissman, Lucas) alternate years; given 1973–74*

**212. Systemic Pathology Laboratory.**

*Aut, Win (Rather, Clinical Staff)*

**213. Fundamentals of Laboratory Medicine.**

*Any quarter (Wolf)*

**281. Practical Introduction to Electron Microscopic Techniques.**

*Any quarter (Haydon) by arrangement*

**210. Transplantation Biology.**

*Spr (Weissman, Lucas) alternate years; given 1973–74*

**212. Systemic Pathology Laboratory.**

*Aut, Win (Rather, Clinical Staff)*

**213. Fundamentals of Laboratory Medicine.**

*Any quarter (Wolf)*

**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)

Chairman: Oleg Jardetzky

Professors: Lewis Aronow, Avram Goldstein,
PROGRAMS OF STUDY

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. Postdoctoral 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 two major fields of research interest in the Department are molecular pharmacology, and clinical pharmacology and toxicology.

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, 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. Research in clinical pharmacology 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. A corollary aim is to develop an understanding of chemical hazards in the environment in order to safeguard society against this danger. Topics of interest to members of the Department include drug metabolism, dosage scheduling, pharmacogenetics, and environmental pharmacology.

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 11:00

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 11:00

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, anesthetics, sedatives, analgesics, tranquilizers, and other psychoactive drugs. Problems of drug abuse are also considered.

3 units, Spr (Staff) MWF 11:00

**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.

Pharmacology 207, 208 and 209 are advanced courses to be taken concurrently with 201, 202 and 203. They are appropriate for graduate students or medical students wishing a more comprehensive coverage of the experimental basis of pharmacology.

207. Topics in Pharmacology — A lecture and discussion course, developing in greater detail topics considered in Pharmacology 201. May be taken only in conjunction with Pharmacology 201.

2 units, Aut (Staff) F 2:15–4:15

208. Topics in Pharmacology — Continuation of Pharmacology 207, to be taken in conjunction with Pharmacology 202.

2 units, Win (Staff) F 2:15–4:15

209. Topics in Central Nervous System Pharmacology — A discussion and seminar course, developing in greater detail the topics considered in Pharmacology 203. Concurrent registration in the latter course is required.

2 units, Spr (Staff) F 2:15–4:15

212. Fundamentals of Neurobiology—Same as Physiology 212 and Psychiatry 212. Systematic introduction to the normal structure and functions of the nervous system. Topics will include: ultrastructure and biochemistry of neurons, properties of and action of neurotransmitters, organization and function of neuronal networks, sensory and motor mechanisms, major reflexes and the function of regulatory and coordinating centers. The course is designed to integrate classical material and recent advances and to prepare the first-year student for the study of neuropathology, neurology, and general clinical medicine. Limited to approximately 100 students. Prerequisite: consent of instructor.

4 or 5 units, Spr (Jardetzky, Epstein, Pharmacology; Kral, Physiology; Barchas, Psychiatry) MTWTh 11:00, plus optional seminar by arrangement

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) T 4:15, given 1973–74

214. Hormonal Control of Cellular Metabolism and Development — Lectures, discussions, and readings concerned with mechanisms of hormone effects on regulation of metabolism and development at the cellular and subcellular levels dealing primarily with various vertebrate systems.

1 unit, Win (Schimke) T 4:15, given 1974–75

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, Aut (L. Aronow) T 4:15, given 1973–74

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) T 4:15, given 1974–75

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) T 4:15, given 1974–75
224. Seminar on Neurobiology — Seminar dealing with current literature and thought on fundamental properties of excitable membranes and the problem of information transfer and storage.
2 units, Win (Jardetzky) by arrangement, given 1974–75

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) T 4:15, given 1974–75

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

Emeriti: James P. Baumberger, Jefferson M. Crismon (Professors)
Chairman: Maurice E. Krahl
Associate Professor: Julian M. Davidson. Visiting: Ardis J. Krahl
Acting Assistant Professor: Noel 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 in Immunophysiology.

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 knowl-
edge 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.)

6 units, Aut (Krahli, Harrison) MWF 8-10

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, and laboratory projects are used.
8 units, Spr (Krahli, Robin, Maffly, Jamison) MWF 8-11; TTh 8-9

202. Clinical Physiology (Physiology and Medicine) — (Formerly 251.) Endocrinology, reproductive and gastrointestinal function. An interdepartmental course.
7 units, Win (Krahli, Davidson, Reaven, Luetscher, Gray) MWF 8-10; T 8-9

203. Neurophysiology — (Formerly 350.) Lectures on the basic physiology of the mammalian central nervous system. Prerequisites: neuroanatomy must be taken previously or concurrently.
3 to 5 units, Aut (Grant) MTWThF 1:15-2:05

205. Biological Systems Analysis — (Formerly 302.) A lecture course for biologists on the mathematical approach to comparative mechanical, electrical and biological systems. Includes treatment of first- and second-order linear systems, forcing functions, Laplace transform and stability analysis. Prerequisite: one year of calculus.
3 units, Win (Thompson) W 4:15-6:05 and F 4:15-5:05, alternate years, given 1974-75

207. Immunophysiology Laboratory—(Formerly 304.) A laboratory course in quantitative immunophysiology emphasizing basic immunological phenomena such as isolation and preparation of purified antigens and antibodies, quantitative analysis of specific precipitates, immunoelctrophoresis, immune hemolysis, isotopic labeling, identification of reactants by gel diffusion; quantitative tissue anaphylaxis. Limited to 15 students. Prerequisite: Biology 105 or 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 Physiology—(Formerly 306.) Discussion of selected biophysical, pharmacological, and immunological aspects of muscle contraction; evaluation of modern theories of contractility.
2 units, Spr (Feigen) T 7:30-9:30 p.m., alternate years, given 1974-75

209. Central Autonomic Neurophysiology—(Formerly 307.) A lecture and discussion course on recent advances in understanding of central nervous mechanisms involved in regulation of body temperature, food and water intake, the cardiovascular system, etc. Predominantly neuroendocrine mechanisms will not be taken up. See Course 210. Prerequisite: Neurophysiology 203.
2 units, Spr (Grant) T 7:30-9:30 p.m.

210. Neuroendocrinology—(Formerly 308.) A lecture and discussion course on selected topics of current interest in the general area of nervous and endocrine system interrelationships. Special emphasis will be placed on mechanisms for control of pituitary function and behavioral aspects of neuroendocrinology. Prerequisites: basic knowledge of neu-
Physiology, neuroanatomy and endocrinology; consent of instructor.

2 units, Spr (Davidson) T 7:30-9:30 p.m., alternate years, given 1973-74

212. Fundamentals of Neurobiology—Same as Pharmacology 212 and Psychiatry 212. Systemic introduction to the normal structure and functions of the nervous system. Topics will include: ultrastructure and biochemistry of neurons, properties of excitable membranes, mechanisms and patterns of nerve conduction, storage, release and action of neurotransmitters, organization and function of neuronal networks, sensory and motor mechanisms, major reflexes and the function of regulatory and coordinating centers. The course is designed to integrate classical material and recent advances and to prepare the first year student for the study of neuropathology, neurology, and general clinical medicine. Limited to approximately 100 students. Prerequisite: consent of instructor.

4 or 5 units, Aut (Krahl, Physiology; Jardetzky, Pharmacology; Barchas, Psychiatry) MTWTh 11:00, plus optional seminar by arrangement. Given 1974-75. Content combined with 203 in Autumn 1973-74

213. Special Topics in Physiology—A seminar course of guided reading and discussion in both introductory and advanced physiological topics. Topics are agreed upon by an individual instructor and interested students. Prerequisite: consent of instructor.

(Staff) by arrangement

214. Physical Chemical Principles in Physiology—(Formerly 310.) A quantitative, experimental approach to problems in thermodynamics, kinetics, transport, and bioelectric phenomena. Restricted to Ph.D. candidates in Physiology, or consent of instructor.

2 units, Win (Feigen) TTh 2:15-5:05

215. Tutorial in Clinical Physiology—Guided study, with readings and discussions in both introductory and advanced physiological topics, to supplement 200, 201, 202.

1 or 2 units, any quarter (Robin, Krahl, Staff) by arrangement

260. Advanced Readings in Neurophysiology—A tutorial course involving guided study in depth of aspects of neurophysiology selected by individual students in consultation with the instructor. Ordinarily, the student will be expected to present orally and defend a paper based on his reading to other registered students in an open seminar, but critical written review in which the student is involved may be incorporated in these papers. Prerequisite: Neurophysiology 203.

Units flexible, any quarter (Grant) by arrangement

282. Physiology and Pharmacology of Marine and Amphibian Toxins—(Same as Biological Sciences 282H.) 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, Sum (Fuhrman) See Hopkins Marine Station Bulletin for days and hours

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, adrenal cortical functions, regional blood flow in skin and nerve, 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), William O. Jones (Food Research Institute), Benton F. Massell (Food Research Institute), Robert B. Textor (Anthropology and Education)

Associate Professors: David B. Abernethy (Political Science), Elizabeth Traugott (Linguistics), Hans Weiler (Education and Political Science)

Assistant Professors: Don Dodson (Communication), Joseph Irvin (History), Kennell Jackson, Jr. (History) (on leave 1973-74), Tetteh Kofi (Food Research Institute), William Leben (Linguistics), Scott R. Pearson (Food Research Institute). Acting: Bridget O'Laughlin (Anthropology)

Teaching Fellow: Salisu Abubakar (Linguistics)

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 Committee 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:

1. Peoples of Africa—(Enroll in Anthropology 109.) A survey of social structure and process in rural sub-Saharan Africa: emphasis on the political, social, and economic organization of descent groups in both acaequal and state societies.
   5 units, Aut (O'Laughlin) MWF 9

2. 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.
   5 units, Spr (O'Laughlin) MWF 9

3. Language, Society and Culture—(Enroll in Anthropology 166 or Linguistics 45.) The relationship of language to culture and society and the role of linguistic data in the reconstruction of history.
   5 units, Win (Greenberg) MWF 11

4. Comparative Urbanism — (Enroll in Anthropology or Sociology 136.) 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 (Drake) MWF 2:15

5. Belief Systems 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 (Drake) MWF 2:15

5. Kingdoms of Africa: Society and History —(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 kingdoms, 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.
   4 to 5 units (Jackson) given 1974-75

6. 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 (Jackson) given 1974–75

8. 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.

5 units (Jackson) given 1974–75

9. The History of West Africa—(Enroll in History 148A.)

5 units, Win (Irvin)

10. Islam in West Africa—(Enroll in History 148B.)

5 units, Spr (Irvin)

11. Graduate Core Colloquium: The Interpretation of African History—(Enroll in History 345B.)

5 units, Aut (Irvin)

12. Government and Politics of Africa South of the Sahara—(Enroll in Political Science 117.) Focus is on the colonial situation, the growth of nationalism, the one-party state, the role of the military, and such current issues as tribalism and regionalism, administrative weakness, neo-colonialism and race relations in plural societies.

4 to 5 units, Aut (Abernethy)

13. Seminar in Comparative Politics: Africa—(Enroll in Political Science 227.) An exploration of the economic determinants of policy formation and implementation in selected independent African states, with special attention to hypotheses about neo-colonialist influence on these states. The course is designed to increase an understanding of the interaction between domestic and international politics; of the severe constraints operating on policy-makers in poor countries; and of the techniques involved in formulating and testing hypotheses in the social sciences.

5 units, Win (Abernethy)


5 units, Aut, Win, Spr (Kaufman) by arrangement

15. Intermediate Swahili—(Enroll in Linguistics 263A,B,C.)

5 units, Aut, Win, Spr (——) by arrangement

16. Beginning Hausa—(Enroll in Linguistics 260A,B,C.)

5 units, Aut, Win, Spr (Leben, Abubakar) by arrangement

17. Intermediate Hausa—(Enroll in Linguistics 261A,B,C.)

5 units, Aut, Win, Spr, by arrangement

18. Beginning Yoruba—(Enroll in Linguistics 264A,B,C.)

5 units, Aut, Win, Spr (——) by arrangement

(Other African languages such as Amharic and Twi may occasionally be taught on a tutorial basis if facilities are available.)

19. Economic Development Problems of Third World Economies with Colonial Heritage I and II—(Enroll in Food Research 133, 134.) The making of economic societies, and specifically the evolution of the Third World Economies from traditional economic societies through the colonial period to the present status of economic dependency. An introduction to the literature on economic development theory and theoretical tools for applied economic analysis of development problems.

5 units each quarter, Aut, Win (Kofi) TTh 4:15–6:05


3 to 5 units, Win (Pearson) MW 4:15–6:05

5 units, any quarter (Gann or Duignan)

22. Languages of Africa—(Enroll in Anthropology 269 and 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 (Greenberg)

23. 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.

24. Undergraduate Special: African Art—This course will introduce students to important works of art from Africa and to their cultural/historical context. It will contrast the processes involved in the production, function and appreciation of these forms with our Western experience. The first objective will rely on the extensive use of visual materials, information from the instructor and readings undertaken by students. The second will depend on student apprehension of similarities and differences in approaches to the visual arts in Africa and the West, stimulated by class discussion.

5 units, Aut (Neaher)

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 10, 15 or 50 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

Undergraduate students who wish to concentrate on a course program in astronomy should take the physics course sequence (see under Physics) up to and including the third year. In the third or fourth year they could take Astronomy 101 to 106. Specially well-prepared students who are following a four-year physics curriculum could in the fourth year follow a more specialized program suitably chosen from the following courses: 240, 249, 295, 353, 354, 360, 361, 362, 363, and 367.

The course program should be worked out in consultation with a member of the Astronomy Committee. Undergraduate students who are majoring in chemistry or geophysics could in their fourth year take Astronomy 101 to 105 and 240.

Graduate students in Applied Physics or Physics who wish to follow a course program in astrophysics should, in consultation with their adviser, choose courses from those numbered 200 and above, after having completed the physics courses 210, 211, 220, 221, 230, 231, 232, or their equivalents.
Graduate students in Aeronautics and Astronautics would profit from the courses Astronomy 101 to 105, 240 and 249. Graduate students in Applied Mechanics specializing in the solar system would find the courses Astronomy 101, 102, 240, 249, 295, 360, and 361 suitable to their interest. Graduate students in Electrical Engineering who specialize in radio or radar astronomy could take the courses Astronomy 101 to 106, to be followed by courses chosen from 240, 249, 295, 350, 353, 354, 360, 361, 364, 365, 366, and 450.

10. Special Topics in Physics: The Astronomical Universe—(Enroll in Physics 10.)
   3 units, Win (Wagoner) M 2:15-4:05; discussion W 2:15

15. 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 11

50. Modern Astronomy—(Enroll in Physical Sciences 50.) 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

101. Solar-Terrestrial Astronomy—The sun, solar activity, solar magnetic field, the solar wind and interplanetary magnetic field, geomagnetic and meteorological effects of solar activity. Spacecraft experiments and results. Observations with Stanford Solar Telescope. Prerequisites: two years of college physics, chemistry, or engineering.
   3 units, Aut (Wilcox) MWF 1:15

102A, B, C. Astronomy Laboratory—Theory and use of an optical telescope. Individual observations with a 16-inch Cassegrain telescope. Observations of solar magnetic and velocity fields with the Stanford Solar Telescope. One experiment on a radiotelescope will be available.
   102A. 1 unit, Aut (Wilcox) by arrangement
   102B. 1 unit, Win (Wilcox) by arrangement
   102C. 1 unit, Spr (Walker) by arrangement

103. Stellar and Galactic Astronomy—(Enroll in Aeronautics and Astronautics 226.) Introduction to stellar, galactic, and extragalactic astronomy: stars, galactic structure, the interstellar medium, galaxies. Stellar evolution: star formation, energy generation, the H-R Diagram. Modern developments, pulsars and X-ray stars. Techniques and technical problems. Prerequisites: two years of college physics, chemistry, or engineering, or 101.
   3 units, Win (Johnson) MWF 1:15

105. High-Energy Astronomy — (Enroll in Applied Physics 261.) 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: Physics 121 and 131, or consent of instructor.
   3 units, Spr (Petrosian) MWF 1:15

240. Space Physics—(Enroll in Applied Mechanics 240.)

249. Interplanetary Gasdynamics — (Enroll in Applied Mechanics 249.)

295. Physics of Planetary Interior—(Enroll in Geophysics 295.)

350. Radioscience Seminar — (Enroll in Electrical Engineering 350.)

353. Radiometry and Interferometry—(Enroll in Electrical Engineering 353.)

354F. Theory and Application of Radio Wave Scattering—(Enroll in Electrical Engineering 354F.)

360. Solar Terrestrial Relations—(Enroll in Applied Physics 360.)

361. The Sun and Solar Activity—(Enroll in Applied Physics 361.)

363. Seminar in Astrophysics — (Enroll in Applied Physics 363.)
364. Radiation from Plasmas — (Enroll in Applied Physics 364.)
365. Introduction to General Relativity and Cosmology — (Enroll in Applied Physics 365.)
366. Cosmology and High-Energy Astrophysics—(Enroll in Applied Physics 366.)
367. Physical Processes in the Galaxy—(Enroll in Applied Physics 367.)
368, 369. Gravitation — (Enroll in Physics 368, 369.)

450A,B,C. Radio Astronomy 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 II 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 (Staff) by arrangement
450B. 3 units, Win (Staff) by arrangement
450C. 3 units, Spr (Staff) by arrangement

CENTER FOR INFORMATION PROCESSING

Director: Charles R. Dickens
Deputy Director: Michael M. Roberts
Chairman, Executive Committee: Gene F. Franklin, Associate Provost for Computing
Assistant Director for Business Services: William H. Yundt
Assistant Director: Lyle B. Smith

ACADEMIC COMPUTING

The Academic Computing Service of the Stanford Center for Information Processing is responsible for providing computing services to the University faculty, staff members and students in connection with their research work and their course requirements. Academic Computing is located in Pine and Polya Halls on the Jordan Quadrangle. The equipment currently operated by SCIP includes a drum-based IBM 360/67 computing system with high-speed disks for on-line storage of users' programs and data. There is also a variety of peripheral equipment such as

MEDICAL COMPUTING

For Medical Computing, SCIP operates an IBM System/370 Model 158 that is used to serve the patient care, management, research and teaching activities of the Medical Center. Those interested in the following courses offered by the Medical Center may register by calling Ext. 6085.

1. PL/ACME — This course teaches programming using the subset of PL/I implemented for the Medical Center. The course covers numerical procedures, the handling of data in textual form, and the use of data files. Available statistical routines and other library programs are discussed. Access to terminals is provided. No previous computer experience is expected.

0 units, monthly

2. Advanced PL/ACME — This course includes instruction in the following subjects: PL/ACME ON conditions for error control, the acquisition and output of digital signals in laboratory environments, the use of CRT displays to present graphical output, and considerations for efficient use of the computer and its files.

0 units, Aut, Win, Spr, Sum
as tape units, graphical plotters, and typewriter terminals. Many of these terminals are located remotely throughout the campus, permitting the Stanford community to make use of the computer without frequent trips to Pine Hall.

The Academic Computing system includes 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, APL and SPIRES II, a generalized information retrieval system. In addition, the first stage of BALLOTS, the library automation and management information system, has been in production since 1972; new features will be developed in the course of the next two years.

A comprehensive library of analysis programs and statistical routines is maintained to assist users in solving their data processing problems. Programming languages available on the 360/67 include ALGOL, BASIC, COBOL, FORTRAN, APL, PL/360, GPSS, LISP, PL/1, SNOBOL, and 360 Assembler. Many other software packages that run under the IBM operating system OS/360 are also available.

The staff of Academic Computing stands ready to provide advice in program development and problem solving to present and potential users of the services. Nevertheless, it is expected that all 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 offers short courses in the use of the data processing and time-sharing 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 Bulletin. In addition, with at least one quarter advance notice, special sections or courses can be arranged through the User Services Office (ext. 4400).

1. Introduction to Academic Computing Services Center—This one-session course is designed for faculty, staff and students who will be using Academic Computing for the first time. Topics to be covered include language and program availability, computer charges, keyword protection, use of key-punches and use of the Pine Hall lobby terminal. A tour of Pine and Polya Halls will be given. This course meets several times during the first week of the quarter.

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 uniquely valuable in solving small day-to-day problems. In addition, the immediate and informative responses by BASIC 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. This course covers topics from the Stanford/BASIC User's Manual. 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 terminal users with the text editing capabilities of WYLBUR. Students who complete this course will have a good understanding of the available features, and will be able to create, modify, and use data sets which contain programs, data, or textual material. Anyone who plans to use the text editor for preparing reports needs no prior programming experience. While not required, some typing experience will prove helpful. Anyone who plans to use WYLBUR for preparing programs should know a programming language.

0 units, Aut, Win, Spr, Sum

15. FORTRAN IV (level H)—This course is designed to provide a thorough introduction to FORTRAN programming with emphasis on the effective use of the various FORTRAN compilers available on the SCIP IBM 360/67 system. A brief introduction to computer systems including a description of software services and a typical hardware configuration will be presented. The concept of an operating system and the need for Job Control Language will be discussed. The student will solve fairly complicated problems which require him to input and output data under format control. He will learn to
use the available program library facilities, and to create his own SUBROUTINE and FUNCTION subprograms. Some attention will be given to the numerical problems encountered when using a digital computer, and good programming practices will be emphasized. Throughout the course, the student will gain experience in designing, coding, and debugging FORTRAN programs. The student will learn enough Job Control Language to enable him to use the IBM 360/67 system, and he will be given an opportunity to run his programs on the computer.

0 units, Aut, Win, Spr, Sum

17. FORTRAN/OS Interface—This course introduces the FORTRAN programmer to the Job Control Language for Operating System/360, and explains the job, execute, and data definition statements in detail. The FORTRAN H catalogued procedure is used extensively as a source of examples of these statements, and the way in which it can be altered to meet specific program requirements is discussed. The student learns to use the FORTRAN sequential and direct access file manipulation statements, and to create the Job Control statements required for their use. Students are given an opportunity to utilize this information in writing and running class problems. Programmers who plan to use tape or disk devices should find this course valuable. Knowledge of FORTRAN programming and experience in using the FORTRAN G or H compiler are essential.

0 units, Aut, Win, Spr, Sum

19. LISP—This course is designed to teach the student the language LISP. The intent is not to emphasize techniques in the theory of list-processing but to develop skills in the features inherent in the language itself. There will be laboratory sessions during which the student will solve a series of programming problems using LISP. He will also have at his disposal a terminal for initial debugging using the time-shared LISP facility. The problems will be oriented around the list-processing areas (information retrieval, symbol manipulation, etc.). However, no previous knowledge of the area is required. Experience in the use of the text editor WYLBUR is desirable.

0 units, Aut

20. 360 Assembler Language Programming—This course introduces experienced FORTRAN programmers to the 360 assembler level language. In addition to receiving a complete introduction to the language, the individual 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. Throughout the course, the student will gain experience in actually coding problems for the computer. A thorough knowledge of FORTRAN and a high degree of programming sophistication are absolute necessities.

0 units, Win

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. The purpose of the SNOBOL course is to introduce the student to the elements of the SNOBOL language and to develop programming skills. In addition, the course will cover the use of an interactive SNOBOL system which is particularly suited to computer-assisted instruction.

0 units, Aut, Win

22. General Purpose Simulation System—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 queueing. The course is designed to acquaint the student with the necessary tools to design his own program. Some familiarity with simple statistics and some previous programming experience (BASIC, FORTRAN, etc.) are desirable.

0 units, Aut, Spr

23. Mathematical Programming System—MPS (Mathematical Programming System) is a language designed for solving linear and non-linear programming problems. It 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 pro-
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

25. Data Management and Utilities—This course provides a general introduction to the data management facilities of the IBM 360. Particular emphasis will be given to the physical data set layout, the formation of source and load module libraries and the services provided by the IBM utility programs. In addition, efficient use of data storage facilities will be discussed. Individuals who make extensive use of disk and tape storage, including remote terminal (WYLBUR) users, should find the course worthwhile. A knowledge of FORTRAN and Job Control Language is required.

0 units, Aut, Win, Spr, Sum

26. SPSS—This course is intended to introduce the social science student to SPSS (Statistical Package for the Social Sciences). SPSS is an integrated system of computer programs for the analysis of data. No previous computer experience is required.

0 units, Aut, Win, Spr

27. Plotting—This course is designed to introduce the student to the Overall Plotting System of the Campus Center. Emphasis will be on line graph plotting; bar graph, three-dimensional and free-form design plotting will be discussed briefly. Students will learn to plot using the plotting hardware available on the IBM 360/67. Since the Overall Plotting System is a package of FORTRAN callable subroutines, it is assumed that the student has a knowledge of FORTRAN.

0 units, Aut, Spr

28. PL360—This course introduces the PL360 programming language as an alternative to Assembler Language. The course is designed to provide a thorough introduction to PL360 programming with emphasis on the effective use of the PL360 language. Some knowledge of the System/360 architecture is advised.

0 units, Aut, Spr

29. SIMSCRIPT—SIMSCRIPT is a programming language designed for discrete event simulations. SIMSCRIPT has many additional capabilities. These include straightforward, concise methods for list processing, set definition, time advance, event processing, generation of statistical variates and accumulation and analysis of simulation generated data. Typical simulations implemented in SIMSCRIPT are queuing models and network problems. The course is designed to develop the student's skill in using SIMSCRIPT as a general programming language and more specifically as a simulation language. The course will not stress the theory of discrete event simulation.

0 units, Win

30. Introduction to SPIRES—This course is intended to introduce users to the Stanford Public Information RETrieval System. Primary emphasis will be placed on the search capabilities of SPIRES, using examples from typical bibliography, personnel directory and numerical data files. File updating using the on-line SPIRES processor will also be discussed. Anyone who uses SPIRES for searching or updating needs no prior programming experience. Students will be expected to be familiar with common WYLBUR commands.

0 units, Aut, Win, Spr, Sum

31. SPIRES File Definition—This course will cover the file definition capabilities of the Stanford Public Information RETrieval System. Students will learn how to describe file structures in SPIRES, to create SPIRES 'subfiles', to specify access or update restrictions for groups of file users, and to use SPIRES processing rules to describe input and output formats. 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 to SPIRES File Definition.

0 units, Aut, Win, Spr

SLAC CENTER

The SLAC Center of the Stanford Center for Information Processing provides computational support for the high energy physics research program and related activities at the Stanford Linear Accelerator Center. The computing resources at the SLAC Center are centered on an IBM System/360 Model 91 and two IBM System/370 Model 168 designed to handle scientific calculations.
FOOD RESEARCH INSTITUTE

Emeriti: Karl Brandt, Joseph S. Davis, Helen C. Farnsworth, S. Daniel Neumark, E. Louise Peffer, Vernon D. Wickizer, Holbrook Working (Professors)

Director: Walter P. Falcon

Professors: Walter P. Falcon, Roger W. Gray, Bruce F. Johnston, William O. Jones, Dudley Kirk, Benton F. Massell, Clark W. Reynolds, Pan A. Yotopoulos

Assistant Professors: Omar L. Davies (Geography), Tetteh A. Kofi, Scott R. Pearson, C. Peter Timmer. Acting: Barry J. Edmonston (Demography)

Associate Statistician: Rosamond H. Peirce

Librarian: Charles C. Milford

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").

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; 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 dis-
sertation, 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.

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 $2,000 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—This course seeks to acquaint the student with the geographic point of view and some of the materials of geography fundamental to an understanding of man-environment relations and patterns of resource use. Major themes are the relation between changing earth environments and human evolution, changing man-land relations in culture history, natural environments and contemporary livelihood systems, the determinants of the spatial structure of economic and social institutions, and the determinants of patterns of resource evaluation and utilization. Instruction is given in those branches of physical geography most relevant to the concerns of social sciences.

5 units, Aut (Davies) MTWTh 10

101. Economic Geography — This course provides an introduction to some of the more important concepts in economic geography. The main themes to be considered are theories of agricultural, industrial and residential location, inter-regional movement, the regional structure of cities, and regional policy and planning. Examination of these themes involves analysis of the structure of market areas, central place theory and the influence of transport costs on economic location.

5 units, Win (Davies) TTh 10-12

102. The Geography of Latin America—(May be taken as 202 by graduate students.) The course deals with the economic geography of Latin America, concentrating upon the development of agriculture and the adaptation of rural society to modern conditions. Against the background of an explanatory-descriptive model of Latin American ecological sub-regions it traces the development of the rural economy in its colonial, primary export, and industrialization phases. In examining such problems of modern agricultural development as the adequacy of the performance of agriculture, the current means by which production expands, the influence of land tenure on the efficacy and equity of growth, equal stress is placed on the current state of knowledge and the theory and methodology underlying this analysis.

5 units, Win (Davies) given 1974-75

103. The World's Food Economy—(Same as Economics 106.) (May be taken as 203 by graduate students.) 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, Aut (Johnston) MWF 9

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 4:15–6:05

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, Spr (Falcon, Timmer) given 1974–75

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 monocoeconomies, 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, Aut, Win (Kof) TTh 4:15–6:05

135. Population Problems—(Same as Economics 131 and Sociology 130.) (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) MTWTh 9

138. Marketing of Tropical Agricultural Products and Economic Development — (May be taken as 238 by graduate students.) This course examines the interrelationships between marketing of primary products of the tropical belt and economic development of low income countries. The role of marketing in stimulating and maintaining development is stressed. The market structure and organization of production and distribution in commodity trade will be analyzed. Topics include: marketing functions and performance, price determination mechanisms in commodity trade, economics of price and income fluctuations and the mechanics of commodity control (national stabilization policies and international commodity agreements).

3 units, Spr (Kof) given 1974–75

144. Economics of Agriculture: Policy, Poverty, and Politics—(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; special attention will be given to issues involving California agriculture.

3 to 5 units, Win (Falcon, Jones) MWF 10

150, 151. World Food Problems—(Same as Economics 108A,B.) A two-quarter workshop to examine the current adequacy of world food supplies on a country and regional basis. Members of the workshop will examine concepts and measurement of the quality of nutrition, problems of measurement of food supplies, the incidence and causes of inadequate nutrition, and projections of nutritional problems over time. Each member of the workshop will investigate the sufficiency of food supplies in a particular less developed country or region and present a report on his findings. Enrollment limited to 12. Prerequisite: consent of instructors.

5 units each quarter, Win, Spr (Jones, Taylor) MTWTh 153.

153. Location Theory and Spatial Analysis—(Same as Economics 149.) (May be taken as 253 by graduate students.) This course will be organized as a seminar and students are expected to prepare research papers. It will present the principal theories and techniques that have been found useful for the analysis of the spatial expression of social and economic systems. They include central place theory, models of spatial interaction, the economic theory of location, space in development planning, and certain aspects of spatial statistics. Theoretical and methodological developments will be related to their application to hypothesis testing and planning.

5 units, Spr (Davies) TTh 2:15-4:05

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

202. The Geography of Latin America—See 102.

203. The World's Food Economy—See 103.

205. Commodity Futures Markets and Prices—See 105.

206. Workshop in Commodity Price Analysis—See 106.

218. Development Problems of Latin America—(Given 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, Win (Reynolds) TTh 3:15-5:05

220. Economics of Consumption—Applications of the theory of consumer behavior and price determination. Analytic techniques and empirical investigations will be stressed. A research paper is required.

5 units, Aut (Timmer) TTh 1:15-3:05

221. Economics of Production—The theory of production with special emphasis on agri-
culture. 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, Aut (Yotopoulos) MW 1:15–3:05

224. Empirical Investigations in the Economics of Development—The course concentrates on empirical propositions in the theory of economic development. It deals with the formulation of operational hypotheses and the construction of tests and it surveys recent empirical research. It examines selectively some of the important variables of development, e.g., capital, labor; and also some of the significant features of the structure of growth, e.g., efficiency, sectoral change and interrelationships, choice of techniques and investment criteria, financial and monetary structure, international trade. The agricultural sector receives special emphasis. Prerequisites: one course each in microeconomic theory, economic development, and econometrics.

5 units, Win (Yotopoulos) MW 1:15–3:05

225. Agricultural Development and Economic Growth—A theoretical-historical approach with emphasis on agriculture’s role in the development process. Attention will be given to Japan, Taiwan, Mexico, and the Soviet Union as case studies. Selected issues to be examined include intersectorial 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: Policy, Poverty, and Politics—See 144.

253. Location Theory and Spatial Analysis—See 153.

260, Trade and Development Problems of Tropical Africa—See 160.

261. Seminar: Policies Governing International Trade and Investment—Discussion of selected policies, especially American, governing international trade, foreign investment, and international payments. Each student will be required to lead a seminar discussion and write a term paper. Open to advanced undergraduate students with consent of the instructor.

3 units, Win (Pearson) Th 1:15–3:05

285. Seminar: Demography of the Developing Countries—(Same as Sociology 231.) 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 will be required to lead a seminar and prepare a paper based on a term project. Prerequisite: 235 or consent of instructor.

5 units, Spr (Kirk) MW 1:15–3:05

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) by arrangement

320. Seminar: Empirical Analysis of Consumption—The seminar will discuss in depth several research papers prepared for 220, as well as a number of readings essential for preparation for the field examination in the economics of consumption. Food and agricultural topics are highlighted. Prerequisite: 220.

3 units, Win (Timmer) 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) T 1:15–3:05

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, Spr (Jones) 7:30–9:30 p.m.
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: Lincoln E. Moses
Associate Deans: J. Merrill Carlsmith, Frederick W. Crawford
Assistant Deans: Karlene N. Dickey, Lynette N. Hall, Thomas A. Rhue, 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 (Hutchinson) by arrangement
337B. 5 units, Win (Hutchinson) by arrangement
337C. 5 units, Spr (Hutchinson) by arrangement

420A, 420B. Short Haul Transportation —This lecture/workshop course is intended to provide a background in transportation problems from economic, sociological, environmental, psychological, and technologi-
cal points of view. Students of diverse educational backgrounds (e.g., various departments of engineering, the social sciences, business, economics, etc.) will join in a specific study of Bay Area Short Haul (50 to 500 miles) passenger requirements, forecasting future travel requirements, and evaluating the relative merits of various transportation modes (air, rail, highway, advanced guided ground concepts), or mixes of modes, with respect to their ability to fulfill social, environmental, and economic requirements. The lecturing staff will include faculty from various schools and departments as well as a few highly qualified guests. Seniors may enroll upon consent of instructor.

420A. 3 units, Win (Shevell, Staff) MWF 10
420B. 3 units, Spr (Shevell, Staff) 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**

200. History of Education.
220. Introduction to Public School Administration.
315. Cultural Transmission.
326A. Educational Finance.
326B. Financial Decision Making in Education.

**FOOD RESEARCH INSTITUTE**

260. Trade and Development Problems of Tropical Africa.

**GEOLOGY**

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.
209. Analytical Methods for Industrial Engineers.
229. Engineering Economy.

**GRADUATE AT LARGE**

Graduate at Large status is granted to applicants whose previous academic preparation has not included the necessary prerequisite course work for application to future graduate education. The applicant must (1) hold a Stanford degree, (2) lack some or all prerequisite courses for desired graduate work, and (3) must have maintained a 2.5 grade point average.

If the applicant holds the Bachelor's degree only, he or she must submit both a Graduate at Large and Graduate Division application at least one month before the quarter of desired study begins. If the applicant holds a Stanford advanced degree, he or she must petition the Registrar to change his or her major from the original graduate field to Graduate at Large and submit the Graduate at Large application to the Graduate Division.

No letters of recommendation nor Graduate Record Examination scores are required. No financial aid is available. Further questions should be directed to the Assistant Dean of Graduate Studies, Graduate Division office, Inner Quad, Building I.
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 a national and international center for documentation and research on problems of political, economic, and social change in the twentieth century. Its library includes the largest private archive in the United States.

The world-wide coverage of the Institution’s collections makes them especially valuable in this period when so many problems are international in scope. While each of the principal area collections (Africa, East Asia, Eastern Europe, Latin America, the Middle East, and Western Europe) is in itself outstanding, the distinguishing feature of this Institution lies in the fact that it houses under one roof for convenient study the records of major upheavals that have occurred during the twentieth century.

The Institution’s 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. These materials are open to all Stanford students, faculty, and staff, and to scholars from outside the University.

The Institution has its own resident research staff of historians, economists, and political scientists as well as persons broadly trained and experienced in international law and the social sciences generally. The program is concerned primarily with promoting basic research and documentary studies, which provide the foundation upon which new knowledge is built. The Institution is, however, concerned with dynamic rather than static developments; that is, with studying problems where the findings can make important contributions to national policy. Notable long-term research topics include African colonialism, post-Mao China, the Communist International, and the "new Left" both as a national and global phenomenon.

Since it is as important to understand the background and the causes of the social, political, and economic changes taking place in the United States as it is to be informed about those taking place in other countries, the Institution is implementing a sizable expansion in its domestic research and fellowship programs. This program will become comparable in size and quality to the international studies program, but not at the expense of the latter. Scholars participating in the program will conduct advanced research on current political, economic, and social issues of domestic policy, and there will be conferences, seminars, and lectures that deal with these issues.

Three senior scholars in the domestic studies program have already begun examining such problems. Senior Fellow Martin Anderson has been studying alternative ways of raising an armed force and at the same time studying the economics of private enterprise; Senior Fellow Rita Campbell published in 1971 *Economics of Health and Public Policy* and is continuing work in that field; Senior Fellow Roger Freeman has been studying the fiscal growth of the American government, while contributing to national legislative debate on school finance and welfare reform.

In addition to its own research staff, the Institution has been used 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 predoctoral and 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 gifted young scholars a period of creative and unrestricted research in modern history, political science and international relations, economics, and sociology.

The Institution also has a publications program, and since 1919 some 250 volumes have been published.

In these ways, by acquisitions, research, publications, and fellowships, the Institution carries out its functions of collecting the important documents on international affairs, organizing and making them available for use, fostering their utilization, and encouraging and facilitating the spread of knowledge.

Among the Institution staff members scheduled to teach during 1973–74, together with their areas of specialization and the course designations, are the following: Rita R. Campbell, Economics of Health, Undergraduate Special; Alexander Dallin, Soviet Politics, History Department; Lewis Cann and Peter Duignan, Graduate Division Special Program on Methodology of African History; and George S. Rentz, Islamic and Ottoman History, History Department. See also Graduate Division Special Programs, in addition to the departments noted above. Curators and other senior staff are particularly willing to work out directed reading arrangements.

### COMMITTEE ON HYDROLOGY

**Committee in Charge:** Irwin Remson (Chairman), Joseph B. Franzini, Paul Kruger, Ray K. Linsley, Perry McCarty

### PROGRAMS OF STUDY

The Committee on Hydrology, which includes faculty from the Departments of Civil Engineering and Geology, administers a program of graduate studies leading to degrees of M.S. in Hydrology and Ph.D. in Hydrology.

The program is interdisciplinary and cov-
ers 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</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>AES 284</td>
<td>Engineering Geology</td>
<td>4</td>
</tr>
<tr>
<td>AES 304, 305</td>
<td>Applied Geomathematics</td>
<td>10</td>
</tr>
<tr>
<td>Civil Engr. 201</td>
<td>Environmental Fluid Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 203</td>
<td>Ocean and Coastal Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 206</td>
<td>Fluid Mechanics of Closed Conduits</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 207</td>
<td>Open Channel Hydraulics and Sedimentation Problems</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 222</td>
<td>Water Resources Planning</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 233</td>
<td>Statistical Models in Civil Engineering</td>
<td>3 or 4</td>
</tr>
<tr>
<td>Civil Engr. 236</td>
<td>Stochastic Processes and Decision Statistics for Civil Engineers</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 266</td>
<td>Engineering Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 267</td>
<td>Advanced Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 268</td>
<td>Water Resources Development</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 269</td>
<td>Water Resources Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Civil Engr. 270</td>
<td>Water Quality in Water Resources Development</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 273</td>
<td>Water Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 273A</td>
<td>Water Chemistry Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Civil Engr. 274</td>
<td>Water Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 276A</td>
<td>Nuclear Methods in Environmental Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 267B</td>
<td>Environmental Impact of Power Generation</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 276C</td>
<td>Environmental Radioactivity</td>
<td>3</td>
</tr>
<tr>
<td>Civil Engr. 277</td>
<td>Explosion Excavation Construction</td>
<td>3</td>
</tr>
<tr>
<td>Elec. Engr. 292A</td>
<td>Environmental Systems Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 174</td>
<td>Nuclear Science</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 176</td>
<td>Nuclear Energy</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 171</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 190</td>
<td>Introduction to Probability and Statistics in Geology</td>
<td>3</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 (Commission on)**

The Commission on International Studies (CIS), appointed by the President of the University, and an affiliated administrative entity, the Center for Research in International Studies (CRIS), provide mechanisms for coordination and cooperation among international, regional, and comparative programs. These programs are University-wide and include research and training activities in the Schools of Humanities and Sciences, Law, Business, Education, Engineering, Earth Sciences, and Medicine. Within the School of Humanities and Sciences, the Departments of Anthropology, Communication, Economics, History, Political Science, Sociology, and the language departments are those primarily concerned. The Food Research Institute and the Hoover Institution on War, Revolution and Peace are heavily involved in international affairs as well. Neither the CIS nor CRIS offers courses or confers degrees.

The CIS is composed of faculty members and administrators representing organizations—schools, departments, institutes, centers—which have significant international components in their research and training programs. The Commission, which meets several times each year, is concerned with major policy questions and decisions and with the ordering of priorities within the overall program.

**CRIS**

The University established the Center for Research in International Studies in 1967 and assigned to its director and staff the role of coordinating various aspects of the international studies program. These include administering some foundation and government financial support for faculty research, student fellowships, library development, and new faculty appointments. CRIS also provides assistance in seeking funds to advance all aspects of the international studies program.

**Area Studies**

The work of CIS and CRIS is closely affiliated with all of the research and training programs having regional or area orientations. Interdisciplinary subcommittees of the CIS concerned with Africa, East Asia, Latin America, and Russia and East Europe coordinate University resources in the study of each region. All area-related courses are offered by individual schools, departments, and institutes and are listed thereunder in this bulletin. Undergraduate degree programs are coordinated by the Latin American Studies Committee and the African and Afro-American Studies Committee. At the graduate level, special programs leading to the A.M. in Latin American Studies, East Asian Studies, Russian and East European Studies are available. These degree programs are described under the headings of the various area programs in other sections of this bulletin. No Ph.D. is offered in any area studies program, but a qualified doctoral candidate may design a cross-disciplinary specialization which emphasizes the area interest within the student’s disciplinary preparation for the degree.

**Research Programs**

CIS and CRIS also work closely with discipline-oriented research and training programs located in centers, institutes, and schools. These include the Food Research Institute, the Center for Research in Economic Growth, the Comparative Politics program, the International Development Education Center, the Institute for Communication Research, and the International Legal Studies program. The emphasis in these discipline-oriented research and training programs is on graduate level education, but faculty have responsibilities for training and counseling undergraduates as well.

**Undergraduate Series**

A special interdisciplinary series for undergraduates has been developed by a subcommittee of the CIS in response to initiatives taken in 1968 to review this aspect of the international studies curriculum. Course offerings in this series are described under
the rubric “International Relations: Special Offerings for Undergraduates” in the School of Humanities and Sciences section of this bulletin.

Inquiries relating to any of the above should be directed to Chairman, Commission on International Studies, Building 460, Room 465, Stanford, California 94305.

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 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:
Graduate Overseas and Special Programs
Room 465, Building 460
Stanford University
Stanford, California 94305

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, sponsored 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:
Graduate Overseas and Special Programs
Room 465, Building 460
Stanford University
Stanford, California 94305

Emeriti: Minna Stillman (Associate Librarian); Alice Charlton (Chief Catalog Li-
OTHER DEPARTMENTS, INSTITUTES, AND PROGRAMS

brarian); Jeannette M. Hitchcock (Chief of Division of Special Collections); Margaret Wells (Education Librarian); Grace E. Stillson (Assistant Chief Catalog Librarian); Ruth Scibird (Curator of the Stanford Collection); Margaret Windsor (Assistant Chief Librarian); Jennette E. Hitchcock (Chief Catalogue Librarian).

University Libraries
Director: David C. Weber
Associate Director: Earl C. Borgeson
Associate Director for Resources: Elmer M. Grieder
Assistant Director for Undergraduate and Branch Services and Librarian, J. Henry Meyer Memorial Library: Robert A. Golley
Assistant Director for Bibliographic Operations: Allen B. Veaner
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 (Catalogue); Jack Plotkin (Central Circulation and General Reference); Sandra K. Korn (Government Documents); Bernard J. Denham (Personnel); B. Jack Pooler (Science); Acting: Wyllis E. Wright (Special Collections)
University Archivist: Ralph W. Hansen
Curators — Resources Development Program: James Breedlove (Latin American Materials); Peter Frank (Germanic Languages); Paul J. Kann (Romance Languages); Wojciech Zalewski (Russian and East European Materials)
Curators — Honorary: George T. Keating (Music Bibliography); Irving Whittemore Robbins, 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
Head, Reader Service: David Zaehringer;
Head, Technical Service and Acquisitions Librarian: Charles T. Pfingsten

Law Library
Law Librarian: J. Myron Jacobstein
Acquisition Librarian: Howard W. Sugarman; Head Catalog Librarian: Rosalee Long; Reference: Adrienne Adan, George Torzsay-Biber

Linear Accelerator Center Library
Technical Information Officer: George E. Owens
Head Librarian: Robert Gex
Associate Head Librarian: Louise Addis

FACILITIES

All faculty, staff, and registered students of the University are entitled to use the University Libraries. Information is available in the guide "Stanford University Libraries" or in special leaflets about general borrowing regulations, reserve books, book stack access, interlibrary loans, photocopies, microtext reading machines, etc. Students wishing an explanation of library services are urged to see the reference librarians, in the Main Library or the J. Henry Meyer Memorial Library.

Information regarding special borrowing privileges for individuals not connected with the University may be obtained at the Service Desk in the Central Circulation Department of the Main Library. With some exceptions, individual cards may be obtained upon payment of an annual fee of $12.50 for Stanford alumni and $25 for others. Special permission must be secured to use the collections of the following libraries which have their own regulations and in some cases require payment of fees: Hoover Institution on War, Revolution and Peace; Law Library; Lane Medical Library; J. Hugh Jackson Library of Business; Food Research Institute; and Linear Accelerator Center. Special regulations are in force for high school, college, or university students from other institutions, who may consult the Central Circulation Service Desk attendant or their own school librarians for information. Industrial
firms wishing to use the Libraries should consult the Head of the Technical Information Service for information regarding subscriptions.

The Libraries of the University altogether contain over 3,700,000 volumes, 1,800,000 manuscripts, 118,000 sheet maps, 608,000 microtext sheets, and considerable other material. Part of the Libraries' collections is concentrated in the stack of the Main Library, which houses over 800,000 volumes on its seven levels, and in the Meyer Library basement with over 325,000 volumes. The various library units are described in the following paragraphs; the Library of the Hoover Institution on War, Revolution and Peace is described elsewhere in this bulletin.

J. HENRY MEYER MEMORIAL LIBRARY

The Meyer Memorial Library, with a collection of over 100,000 volumes and housing language laboratories, an Audio Library, a Forum Room, and seminar rooms, was opened in November, 1966.

The library is open from 8 a.m. to midnight Monday through Friday, and from 10 a.m. to midnight on Saturday and Sunday during school sessions; extended study will be possible until 2:30 a.m. in one or two seminar rooms. A more detailed listing of hours and other services can be found in the guide "Stanford University Libraries."

Gathered primarily for undergraduate needs, the collection contains books on "reserve" for courses and available for short circulation periods, some on "closed reserve" at the second floor Loan Desk, but most shelved with the open collection and marked as being on reserve. The library also provides a wide range of major works supplementing course assignments in most academic disciplines, basic reference works, a wide selection of current periodicals, and a broad collection of books in all fields of general undergraduate interest.

Audio service facilities on the first floor are available for classroom or individual use and include a general listening room as well as two rooms for listening by groups of up to nine persons. A selected collection on disc and tape comprises music, literature, drama, and other significant and historical recordings. Audio programs may also be produced in the six seminar rooms and the larger Forum Room on the first floor. Also on that floor are four language laboratories which provide instructional facilities for students enrolled in undergraduate language courses.

MAIN LIBRARY

When school is in session, the Main Library is open Monday through Friday from 8 a.m. to 10 p.m. On Saturday the hours are 9 a.m. to 5 p.m., and on Sunday from 1 p.m. to 10 p.m. Hours of opening for other rooms and other libraries on the campus are listed in the guide "Stanford University Libraries."

The Main Library provides 741 seats and quarters for the following:

The Reference Room in the Main Library contains reference and subject collections totaling about 30,000 volumes and current issues of approximately 2,000 periodicals. The Library's Central Map Collection is located in the Shainwald Room for the social sciences. The Microtext and Newspaper Reading Room is in the basement.

The Government Documents Library brings together most of the Library's collection of municipal, state, federal, foreign, and international documents. It is especially strong in the publications of the United States, California, Great Britain, Canada, Australia, and the United Nations.

The Department of Special Collections houses the Library's rare and valuable books and manuscripts and administers a number of specialized research collections. The main reading room for books is the Albert M. Bender Room and for manuscripts is Room 310.

Among the most important of these collections are: the Frederick E. Brasch Collection on Sir Isaac Newton and the History of Scientific Thought covering the history of several branches of the physical sciences centering around the life and thoughts of Newton; the Charlotte Ashley Felton Memorial Library, devoted to British and American literature of the nineteenth and twentieth centuries (published works, first editions, variant editions, bibliographies, criticisms, and biographical material of selected authors, supplemented where possible with manuscripts, proofs, letters, and association items); the Memorial Library of Music, devoted to musical manuscripts and first issues of important and rare musical scores; the Elmer E. Robinson Collection on American History and Constitutional Law; the Morgan
A. and Aline D. Gunst Memorial Library, composed of examples of fine printing, binding, etc., and books on the history and the art of the printed book; and the general Rare Book Collections where emphasis is placed on sixteenth century continental books, particularly Italian literature, the Reformation, the classics, and history and biography. There is also a collection of books pertaining to the French Revolution and the Napoleonic Era.

Of the manuscript collections (Room 310), those with prominence are the Antoine Borel Collection, manuscript material on California political history; the Bernard DeVoto Papers covering his career in literature, history, and politics; and the papers of authors represented in the Felton Library, particularly D. H. Lawrence, James Joyce, Ambrose Bierce, Jack London, and Mary Halleck Foote.

SPECIAL LIBRARIES IN THE HUMANITIES AND SOCIAL SCIENCES

The Art and Architecture Library, located in the Nathan Cummings Art Building, is a reference, research, and rare book library of over 75,000 volumes devoted to the comprehensive coverage of the history of art, architecture, classical archeology, drawing, painting, and sculpture. There are extensive periodical runs and over 10,000 exhibition catalogues. Special collections include the J. D. Chen Collection of Chinese art and archeology, the Thomas Rowlandson Collection, and the Theodore Duret Collection, including manuscripts and letters. There is also a complete set of the French Salon Catalogues from 1673 to 1952.

The Cubberley Library of Education, with three reading rooms on the second floor of the School of Education building, houses over 80,000 books, periodicals, text books, curriculum guides, and pamphlets in the field of education. Other special collections include college catalogs and state and city school reports.

The Music Library, located on the second floor of The Knoll, comprises the general collection of musical scores, books, and recordings for the use of music students, faculty, and the University at large. Adjoining the Music Library are the Archive of Recorded Sound and the Harry R. Lange Historical Collection of Musical Instruments and Books.

Other special libraries in the humanities and social sciences are: Briggs Memorial (English), Classics, Communication, Graduate Program in Humanities, Jones Collection (in creative writing), Modern European Languages—German Collection, Physical Education for Women, Psychology, Tanner Memorial Library of Philosophy, and Victor J. West Memorial (political science).

SPECIAL LIBRARIES IN THE SCIENCES

The Library's collections in science and engineering are assembled in eight major groups of departmental libraries—Biology, Chemistry, Computer Science, Earth Sciences, Engineering, Marine Biology, Mathematical Sciences, and Physics.

The Frederic M. Falconer Biology Library, located on the third floor of the Teaching Wing of the Biological Sciences Center, houses general publications in botany and zoology as well as specialized materials in the experimental fields of biology. Branches are the Systematic Biology Library and the Dudley Herbarium Library which specializes in distributional studies of flora.

The Hopkins Marine Station Library at Pacific Grove provides a collection in marine biology and oceanography.

The Swain Library of Chemistry, located in Room One in the Chemistry Building, contains the major works in the field of Chemistry. Its branch, the Chemical Engineering Library, contains materials related to the chemical and petroleum industries.

The Engineering Library, located on the first floor of the Main Library, contains all of the library materials in the field of engineering. Its specialized branches include the Guggenheim Space Sciences Library, the Ryan Nuclear Technology Library, the Electrical Engineering–Solid State Library, and the Timoshenko Collection.

The Branner Earth Sciences Library, located on the 2nd floor of the Mitchell Earth Sciences Building, houses collections on geology, geophysics, mineral engineering, and petroleum engineering, as well as geological maps and the U.S. Geological Survey topographical sheets.

The Mathematical Sciences Library is located in Room 414 of the Sloan Mathematics Center.

The Computer Science Library, Room 170, Polya Hall, houses a specialized collec-
tion covering the full range of computer theory and application. The Physics Library is located in Room 301 of the Varian Building. Its branches are the Hansen Microwave Laboratory Library, specializing in microwave physics and engineering, and the Plasma Physics Library, serving the Plasma Physics Institute.

BUSINESS

The J. Hugh Jackson Library, located in the Graduate School of Business Building, is primarily a working laboratory available to students in the Graduate School of Business in the daily preparation of their work. Members of the Stanford community may use the library upon identification. The library contains over 170,000 catalogued items and additional miscellaneous pamphlets and reports. It maintains extensive holdings of corporate annual reports from the leading stock exchanges. It receives in excess of 4,500 trade, financial, labor, and general business periodicals and continuations. In addition, it subscribes to many of the leading labor, financial, marketing, and business research services.

FOOD RESEARCH INSTITUTE

The Food Research Institute Library, located in the Food Research Institute Building, supports research and instruction in the economic aspects of the production, trade, disposition, and prices of food, feed, and fibre commodities throughout the world. Its collection of over 60,000 items is especially strong in federal, foreign, and international documents containing commodity and trade statistics. The Library is open to other faculty, staff, and students.

LAW

The Law School Library contains over 195,000 volumes. In addition to extensive holdings in Anglo-American law, there are important special collections of French, German, Italian, Indian, British Commonwealth, and early State laws. The International Legal Studies Collection of international law and organization and of foreign and comparative law is of increasing importance.

The Law Library is primarily intended for use by students, faculty, and research staff of the Law School. Other faculty, staff, and students are welcome to use the Law Library when in need of legal materials.

MEDICINE

The Lane Medical Library, located in the Lane Building of the Medical Center, contains over 230,000 volumes and currently receives about 2,500 journals. The Barkan Library of Ophthalmology and Otolaryngology and the Medical History Collection are notable special collections. Specialized branches include the Anatomy Library and the Medical Microbiology Library.

COURSE

1. Use of the Library—Introduction to the Library; emphasis on major types of material and use of catalogs, bibliographies, indexes, abstracts, other aids to study.

3 units, Aut, Win, Spr (Staff) T or Th 10

STANFORD LINEAR ACCELERATOR CENTER

The Stanford Linear Accelerator Center Library (SLAC) is located in the Central Laboratory Building on Sand Hill Road. The collection is primarily for use by the staff of the Center.

STANFORD OVERSEAS CAMPUSES

The overseas campuses offer to undergraduates the opportunity to spend six months studying in a foreign country. In addition to using the human and cultural resources of Europe, the academic programs at the overseas campuses are closely integrated with the regular curriculum at Stanford. Practically all of the courses offered overseas fulfill University distribution requirements in the field of Humanities (H) and the Social Sciences (SS), and all courses completed overseas count fully toward graduation.

Students should complete two quarters of the language (or three courses relevant to the country, for Britain) before going to an overseas campus. Applications are open autumn, winter, and spring quarters, at least six months in advance of the sessions. Students are invited to come to the Overseas Campuses Office, 112 Old Union, for admission and help in planning their program.
In addition to the overseas campuses, there are Specialized Programs operated jointly by the Overseas Campuses Office and Departments of French and Italian, German Studies, Spanish and Portuguese, Classics, and the Center for Latin American Studies. These programs are located in Tours, France; Bonn, Germany; Salamanca, Spain; Rome, Italy; and Mexico City. All except the program in Rome are conducted in collaboration with foreign universities, and students who are interested should talk to the appropriate departments.

**STANFORD IN BRITAIN**

*Academic Director:* Paul K. Ledger  
*Director of Administration:* George A. B. Docker  
*Assistant to the Directors:* Dave Denton  
*Professors:* Gerald M. Meier (Business), Thomas C. Moser (English), Gordon Wright (History), Morris Zelditch (Sociology)  
*Assistant Professor:* David Riggs (English)  
*Lecturers:* Felix Aprahamian, Charles McCorquodale, Desmond Vowles  
*Tutors:* Barrie Axford, Rodney Shewan, Geoffrey C. Tyack

**COURSES WITH NO LIMIT ON ENROLLMENT**

History 32. Twentieth Century Europe (SS)  
3 to 5 units, Aut, Win (Wright)  
Economics 112. International Economic Development (SS)  
3 to 5 units, Sum (Meier)  

Overseas Campuses—Britain 120A. British Society and Politics 1800–1950, Part I (SS)  
3 to 5 units, Win, Sum (Tyack, Axford)  

Overseas Campuses—Britain 120B. British Society and Politics 1800–1950, Part II (SS)  
3 to 5 units, Aut, Spr (Axford, Tyack)  

Overseas Campuses—Britain 126. Twentieth Century English Composers (H)  
3 to 5 units, Win, Sum (Aprahamian)  

Overseas Campuses—Britain 128. British Government and Politics (SS)  
3 to 5 units, Win, Sum (Axford)

Overseas Campuses—Britain 135. The Grand Tour (H)  
3 to 5 units, Aut, Win (McCorquodale)  

Overseas Campuses—Britain 136. The 19th Century Avant-Garde (H)  
3 to 5 units, Spr, Sum (Shewan)  

Sociology 143. Social Structure of Modern England (SS)  
3 to 5 units, Spr (Zelditch)  

English 173A. Shakespeare (H)  
3 to 5 units, Win (Riggs)  

English 182E. Forms of the English Novel (H)  
3 to 5 units, Sum (Moser)

**COURSES WITH LIMITED ENROLLMENT**

Overseas Campuses—Britain 122. English Architecture 1500 to the Present (H) — Enrollment limited to 20.  
5 units, Win, Sum (Tyack)  

Overseas Campuses—Britain 124. The English Town, Past and Present (SS) — Enrollment limited to 8.  
4 units, Aut, Spr (Tyack)  

Economics 124E. Britain and the European Community (SS) — Enrollment limited to 20.  
5 units, Sum (Meier)  

Overseas Campuses—Britain 130. Modern British Drama (H) — Enrollment limited to 20.  
5 units, Aut, Win (Shewan)  

Overseas Campuses—Britain 130D. Practical Literary Criticism (H) — Enrollment limited to 20.  
5 units, Win, Sum (Shewan)  

Overseas Campuses — Britain 133. Britain and European Unity (SS) — Enrollment limited to 8.  
4 units, Win, Sum (Axford)  

Overseas Campuses — Britain 137. Education in England and Wales (H) — Enrollment limited to 20.  
5 units, Spr (Vowles)  

Overseas Campuses—Britain 138. Chaucer (H) — Enrollment limited to 20.  
5 units, Spr (Ledger)  

Overseas Campuses — Britain 139. Urban
OVERSEAS CAMPUSES

Politics: Poverty, Planning, and Participation (SS)—Enrollment limited to 20.
5 units, Aut, Spr (Axford)

Overseas Campuses — Britain 140. Images of the English Landscape (H)—Enrollment limited to 20.
5 units, Spr (Tyack)

Sociology 147. English Society in Literature (SS)—Enrollment limited to 20.
5 units, Spr (Zelditch)

English 180C. Politics and Drama in Elizabethan England (H)—Enrollment limited to 20.
5 units, Aut, Win (Riggs)

English 181E. Hardy and Conrad (H) — Enrollment limited to 20.
5 units, Sum (Moser)

History 244B. Modern British Statesmen (SS)—Enrollment limited to 20.
5 units, Aut, Win (Wright)

STANFORD IN FRANCE

Director: Paul LeMoal (Professeur à l'Université de Tours)
Associate Directors: Henriette Bordenave, René Borius (Professeur à l'Université de Tours)
Assistant to the Directors: Steve Hatfield
Professor: Albert J. Guerard (English)
Associate Professor: Harumi Befu (Anthropology)
Assistant Professors: Emerson Brown (English), Stephen Olsen (Sociology)
Lecturers: Bernard Chevalier (Professeur à l'Université de Tours), Jean Lafond (Professeur à l'Université de Tours), Jacques Roger (Professeur à l'Université de Paris), J. M. Vaccaro (Professeur à l'Université de Tours), Pierre Waldner (Professeur à l'Université de Poitiers)

COURSES WITH NO LIMIT ON ENROLLMENT

Anthropology 1. General Anthropology (SS).
4 units, Sum (Befu)

Sociology 75A. Comparative Social Structure (SS).
4 units, Aut (Olsen)

Sociology 75B. Comparative Social Structure (SS).
4 units, Win (Olsen)

English 80H. France and England in the 12th Century (H).
4 units, Aut (Brown)

English 81H. France and England at the Close of the Middle Ages (H).
4 units, Win (Brown)

Anthropology 128. Folk Society (SS).
4 units, Spr (Befu)

3 units, Aut, Spr (Borius)

3 units, Win, Sum (Borius)

Overseas Campuses—France 135. La Peinture en France au Moyen Age (IXe–XVeme Siecles) (H).
3 units, Aut (Chevalier)

3 units, Aut, Spr (Borius)

3 units, Win, Sum (Borius)

Overseas Campuses—France 139. Les Impressionistes Francais (H).
3 units, Win (de Croizant)

French (H)—Courses in French language, literature, conversation, and civilization. Students who need work in conversation, as determined by the Director of Studies, will be required to take a language course or have equivalent training in conversation for the first quarter and possibly the second quarter of the session. 80-90 level courses continue the sequence begun in California.
3 units or more, Aut, Win, Spr, Sum (Staff) by arrangement
Overseas Campuses 140A. Debussy et la Renovation de la Musique Francaise au Debut de XXe Siècle (H).

3 units, Aut (Vaccaro)

Overseas Campuses—France 140B. Debussy—Pelleas et Melisande ou la Musique et la Symbolism (H).

3 units, Win (Vaccaro)

Overseas Campuses—France 143. Translation (H).

3 units, Aut, Win, Spr (LeMoal)

Overseas Campuses—France 144. Anthropologie (SS).

3 units, Aut (Menget)

Overseas Campuses—France 145. La Peinture en France de 1860-1960 (H).

3 units, Spr (de Croizant)

Overseas Campuses—France 146. La Chanson Polyphonique de la Renaissance (H).

3 units, Spr (Vaccaro)

Overseas Campuses—France 147. Histoire Economique de la France Contemporaine (SS).

3 units, Spr (Pech)


3 units, Spr (Roger)

Overseas Campuses—France 149. La Peinture Francaise au XVII (H).

3 units, Sum (Girard)

Overseas Campuses—France 150. La Revolution Francaise et ses Idées Politiques (SS).

3 units, Sum (Borius)

Modern Thought and Literature 172. Forms of the Modern French Novel (H).

4 units, Spr (Guerard)

Anthropology 123. Culture and Behavior (SS)—Enrollment limited to 15.

4 units, Spr (Befu)

English 180B. Medieval Epic and Romance (H)—Enrollment limited to 15.

4 units, Aut (Brown)

English 181B. The Medieval Lyric (H) — Enrollment limited to 15.

4 units, Win (Brown)

English 189G, I. Critical Analysis (H) — Enrollment at University of Tours limited to English majors and others specifically qualified.

5 units, Aut or Win (LeMoal)

Modern Thought and Literature 202. Writing Seminar (H)—Enrollment limited to 12.

5 units, Spr (Guerard)

STANFORD IN GERMANY

Director of Studies: H. Rüdiger Hipp
Director of Administration: Alfred Schmid
Assistant to the Directors: Bob Sader

Professors: Elliot W. Eisner (Education and Art), Kurt Forster (Art History), A. Peter Foulkes (German), Leonard Ratner (Music), W. Richard Scott (Sociology), Kurt Steiner (Political Science)

Associate Professors: Joachim Bark (German Studies), John H. Thomas (Biology)

Lecturers: Carl Davis, Michael von Poser, Gabriele von Radecki, Peter Schermuly, Hartmut Wasser

LANGUAGE COURSES

German (H) — Courses in German language, literature, conversation, and civilization. Students who need work in conversation, as determined by the Director of Studies, will be required to take a language course or have equivalent training in conversation for the first and possibly the second quarter of the session. 80-90 level courses continue the sequence begun in California.

3 units or more, Aut, Win, Spr, Sum (Staff)

COURSES WITH LIMITED ENROLLMENT

Sociology 86. French Regionalism (SS) — Enrollment limited to 15.

4 units, Aut (Olsen)

Sociology 87. Social Change in Modern France (SS)—Enrollment limited to 15.

4 units, Win (Olsen)

Anthropology 113. Analysis of Folk Society in France (SS)—Enrollment limited to 15.

4 units, Sum (Befu)

COURSES WITH NO LIMIT ON ENROLLMENT

Music 1. Introduction to Music (H).

5 units, Spr (Ratner)
Art 111 A. Northern Renaissance Art I (H)  
5 units, Sum (Forster)

Political Science 128G. Politics in Germany (SS).  
5 units, Spr (Steiner)

German 131A. Faust in Legend and Literature (H).  
5 units, Aut (Foulkes)

German Studies 149A. Critical Approaches to Modern German Culture (H).  
5 units, Win (Bark)

Overseas Campuses — Germany 179. Educational Alternatives and Social Criticism (SS).  
5 units, Win (Eisner)

Biology 182. General Ecology (NSMT).  
5 units, Aut (Thomas)

COURSES WITH LIMITED ENROLLMENT

Music 4G. Investigation of Important German Composers (H)—Enrollment limited to 15.  
3 units, Spr (Ratner)

German 90. Sprachlich-Literarische Ubung (H)—Enrollment limited to 15.  
3 units, Aut, Win (von Poser)

Political Science 111G. German Political Parties (SS)—Enrollment limited to 15.  
3 units, Spr (Steiner)

German 140A. University Reform in West Germany (H)—Enrollment limited to 12.  
3 units, Win, Sum (Wasser)

Overseas Campuses — Germany 143A. Modern Germany (SS)—Enrollment limited to 30.  
3 units, Win, Sum (Wasser)

Overseas Campuses — Germany 143B. Modern Germany (SS)—Enrollment limited to 30.  
3 units, Aut, Spr (Wasser)

Overseas Campuses — Germany 145. Drama Workshop (H)—Enrollment limited to 15.  
3 units, Aut, Spr (von Radecki)

Overseas Campuses — Germany 146. The Writer and His Environment (H)—Enrollment limited to 15.  
3 units, Sum (von Poser)

Overseas Campuses — Germany 148. Thomas Mann (H)—Enrollment limited to 15.  
3 units, Spr (Schmid)

Overseas Campuses — Germany 155. Hitler, Goebbels, and the Language of the “Third Reich” (H)—Enrollment limited to 20.  
3 units, Sum (Hipp)

Overseas Campuses — Germany 160A. Goethe (H)—Enrollment limited to 15.  
3 units, Spr (von Radecki)

Overseas Campuses — Germany 161. Political Poetry (H)—Enrollment limited to 15.  
3 units, Spr (von Poser)

Overseas Campuses — Germany 164. Bertold Brecht (H)—Enrollment limited to 15.  
3 units, Win (Schmid)

Overseas Campuses — Germany 166. Max Frisch and Friedrich Durrenmatt (H)—Enrollment limited to 15.  
3 units, Aut (Schmid)

Overseas Campuses — Germany 167. Märchen, Balladen, und Volkslieder (H)—Enrollment limited to 15.  
3 units, Win, Sum (von Radecki)

Overseas Campuses — Germany 170. The Modern German Novel (H)—Enrollment limited to 15.  
3 units, Sum (Schmid)

Overseas Campuses — Germany 174. German Movie Classics (H)—Enrollment limited to 15.  
3 units, Aut, Win (Hipp)

Overseas Campuses — Germany 176. Major German Composers (H)—Enrollment limited to 20.  
3 units, Aut, Win (Davis)

Overseas Campuses — Germany 177. German Art History (H)—Enrollment limited to 20.  
3 units, Spr, Sum (Staff)

German Studies 179A. National Socialism: Its Roots, Development, and Political System (H)—Enrollment limited to 15.  
3 units, Win (Bark)

Overseas Campuses — Germany 180. The Development of Artistic Intelligence (SS)—Enrollment limited to 15.  
3 units, Win (Eisner)

Biology 181. Darwin and His Influence on
Germanic Intellectual Thought (NSMT)—Enrollment limited to 15.
3 units, Aut (Thomas)

Art 213. Dürer and Grunewald (H)—Enrollment limited to 15.
3 units, Sum (Forster)

Stanford in Italy

Director of Studies: Guelio A. Frulla
Director of Administration: Giuseppe Mammarella
Assistant to the Directors: Don Rooks

Professors: Frank Cancian (Anthropology), Herbert Lindenberger (Comparative Literature, English and Humanities), Richard F. Muth (Economics), Leonard Ratner (Music), Kurt Steiner (Political Science)
Assistant Professors: Francesca Cancian (Sociology), N. Gregson Davis (Classics)
Instructors: Lucia Benini, Franca Celli, Guido Fink, Anna Kaiser
Lecturers: Sidney Alexander, Giovanni Scichilone, Maria Todorow

Language Courses

Italian (H) — Conversation courses and seminars on aspects of contemporary Italy. Students who need work in conversation, as determined by the Director of Studies, will be required to take a language course or have equivalent training in conversation for the first, and possibly the second quarter of the session. 80-90 level courses continue the sequence begun in California.
4 units, Aut, Win or Spr, Sum (Staff) by arrangement

Courses with No Limit on Enrollment

Music 1. Introduction to Music (H).
4 units, Sum (Ratner)

Political Science 20 I. Government and Politics in Italy: A Comparative Perspective.
4 units, Win (Steiner)

Art 110D. Tuscan Art from Giotto to Leonardo (H).
4 units, Aut, Spr (Todorow)

Political Science 128A. Italian Contemporary History (SS).
4 units, Aut, Spr (Mammarella)

Sociology 129. Family and Kinship (SS).
4 units, Spr (Mrs. Cancian)

Economics 150. Spatial Structure of European Cities (SS).
4 units, Aut (Muth)

Anthropology 151. Economic Anthropology (SS).
4 units, Sum (Mr. Cancian)

4 units, Win, Sum (Alexander)

Classics 163. Comparative Mythology (H).
4 units, Win, Spr (Davis)

Comparative Literature 188. Major Modern Dramatists: Pirandello, Brecht, and Beckett (H).
4 units, Aut (Lindenberger)

Courses with Limited Enrollment

Music 3D. Italian Music in the Eighteenth Century (H)—Enrollment limited to 15.
4 units, Sum (Ratner)

Overseas Campuses—Italy 111. The Etruscans and Roman Culture and Art (H) — Enrollment limited to 20.
4 units, Aut, Sum (Scichilone)

Overseas Campuses — Italy 112. The Art and Culture of Greece and Magna Grecia (H)—Enrollment limited to 20.
4 units, Win, Spr (Scichilone)

Political Science 127 I. The Civil Law Tradition and the Italian Legal System.
4 units, Win (Steiner)

Political Science 128C. Post-War Italian Foreign Policy in the European Framework (SS)—Enrollment limited to 15.
4 units, Win, Sum (Mammarella)

Sociology 152. European Social Theory (SS)—Enrollment limited to 15.
4 units, Sum (Mrs. Cancian)

Economics 155. Economics of European Housing Policy (SS)—Enrollment limited to 12.
4 units, Aut (Muth)

Overseas Campuses—Italy 155A. Medieval and Renaissance Florence (H) — Enrollment limited to 15.
4 units, Win, Sum (Frulla)
English 180G. Confrontations with Italy in English and American Literature (H) — Enrollment limited to 15.

4 units, Aut (Lindenberger)

Classics 185. Ovid's Metamorphoses and its Influence on European Arts and Letters, particularly on the Renaissance in Italy (H) — Enrollment limited to 10.

4 units, Win, Spr (Davis)

Anthropology 300. Anthropological Field Work (SS) — Enrollment limited to 15.

4 units, Spr (Mr. Cancian)

PHYSICAL EDUCATION FOR MEN

Emeriti: Allen Elward, Edward M. Twiggs, (Directors); C. Myron Sprague (Associate Director); Ernest P. Hunt (Associate Professor)

Director of Physical Education and Athletics: Joseph H. Ruetz

Associate Director: Robert G. Young

Professor: John E. Nixon (Director of Professional Education)

Associate Professor: Wesley K. Ruff (Director of Physical Education for Men)

Directors: Jack Christensen (Football), Howard Dallmar (Basketball), Joe DeMeo (Wrestling), William P. Fehring (Intramurals and Club Sports), Charles E. Finger (Golf), James Gaughran (Aquatics), Richard Gould (Tennis), Payton Jordan (Track), Peter Knetovic (Rugby), Sadao Hamada (Gymnastics), Fred J. Priddle (Soccer), J. Ray Young (Baseball)

Assistant Directors: Clayton Bowling (Basketball), Marshall Clark (Track), Gunther Cunningham (Football), Dave Currey (Football), Clyde F. Devine (Diving), Thomas Dunton (Baseball), Jeff Hammett (Aquatics), Ray Handley (Football), Mark Marquess (Baseball), Norb Hecker (Football), Hudson Houck (Football), Bill Jones (Basketball), Pete Kettela (Football), Bill Moultrie (Football), George Seifert (Football)

OFFERINGS AND FACILITIES

ATHLETICS

In keeping with our cultural heritage and American university tradition, Stanford offers students a wide variety of competitive opportunities in intercollegiate sports. Stanford has always managed to be vigorously competitive in all sports, both within the Conference and on the national level. Our sports effort has, through the years, continually improved both in quantity and quality and we look ahead in anticipation of continued achievement. Through its membership in the National Collegiate Athletic Association, the Pacific Eight Conference, and other such organizations, Stanford meets teams of outstanding universities throughout America in a number of sports every year. Stanford usually schedules such teams on a home-and-home basis which means that Stanford athletes travel extensively to major cities throughout the United States. Sports for which the University grants the Stanford Sport Award are football, basketball, track and field, baseball, swimming, golf, tennis, wrestling, gymnastics, rugby, soccer, water polo, and cross country.

PHYSICAL EDUCATION, INTRAMURALS, AND CLUB SPORTS

The Physical Education Program is designed to accommodate the interests and needs expressed by our students. Students may elect the available activity of their choice and quality instruction with appropriate facilities can be expected. The Intramural Sports Program is designed to provide competitive sports opportunities for those who desire competition but do not care to participate in the intercollegiate sports program. All students are encouraged to participate in their favorite sports activities. Proceeding on the premise that experience and its reconstruction constitutes education and that man is an integrated, indivisible organism in need of emotional outlets and physical stimulation, Stanford provides a vigorous and well-rounded program of physical education and intramural athletics. Our students have traditionally enjoyed participation in recreational sports. The sports instruction program is designed to nurture the participation habit and hopefully thus enhance the fulfillment life brings to Stanford graduates. All sports included in the competi-
the intramural program. The intramural program varies, to accommodate student interest but basically includes seven-man touch football, two- and six-man volleyball, bowling, table tennis, horseshoes, handball, weight lifting, wrestling, basketball, softball, tennis, swimming, golf, gymnastics, water polo, soccer, and track and field. Those who are not interested in or do not have the physical qualifications for intercollegiate competition find our intramural program an avenue for expanding social contacts, an opportunity for exercise, and a source of sheer enjoyment.

Student organized club teams are encouraged by the department. The club teams represent Stanford and the club organization. The department assists in matters of administration, facilities, organization, scheduling, some financial assistance, and encourages awards for outstanding achievement. Club teams currently scheduling competition include such sports as: crew, lacrosse, ice hockey, sailing, skiing, and volleyball.

ACADEMIC DEGREES AND TEACHING CREDENTIALS

The Department of Physical Education and Athletics for Men cooperates with the School of Education and the Department of Physical Education for Women by providing faculty, facilities, and equipment necessary to the conduct of the Professional Physical Education Program which leads to the Master's and Doctor's degrees and teaching credentials in the State of California. See the "School of Education" section of this bulletin for details of requirements leading to credentials and degrees.

Undergraduate students interested in the graduate degrees at Stanford should declare their intent early in their undergraduate career and enroll in selected courses offered by the Department of Physical Education for Women, Department of Physical Education for Men, and School of Education. These courses will satisfy most requirements for eligibility admission to the graduate program.

Teaching Credentials—Students desiring to teach physical education at the secondary and community college levels or dance at the community college level should enter the physical education credential program no later than the junior year to be able to complete the program at the end of the first graduate year under normal circumstances.

See Professors Miriam Lidster, John Nixon, Wesley Ruff or Pamela Strathairn or Miss Weiss for further information.

FACILITIES

Abundant space has been a factor in the development of an extensive athletic plant. Included in the facilities for men are:

The Stadium, seating 87,206, enclosing a standard American football field encircled by a quarter-mile track with a new all-weather surface, is used for intercollegiate competition in football and track.

Angell Field, named for Dr. Frank Angell, pioneer member of the University faculty who devoted much time and interest to the development of athletics. It is a standard quarter-mile track developed as a special facility for recreational jogging and physical conditioning.

Sunken Diamond, a turfed baseball field used exclusively for varsity baseball. Provides seating for 3,000 spectators.

Harry Maloney Field, a turfed field for soccer, rugby, football practice, and other field sports. It is named for the former director of minor sports at Stanford, an active member of the faculty for 36 years.

Three other turfed fields for football and rugby, intramural sports fields, and a freshman baseball diamond are available.

Three varsity tennis courts, hard-surfaced, with stands for spectators, and fourteen physical education practice tennis courts.

Roscoe Maples Pavilion, the new basketball pavilion seating 8,000 spectators, and used for intercollegiate basketball, intramurals, recreation, and volleyball.

Encina Gymnasium, including a basketball floor, three bleacher-flanked swimming pools, offices, rooms for weight training, faculty lockers, student lockers, showers, training quarters, and team rooms.

A new aquatics complex including a 50 meter pool, a diving pool, and a 25 yard competition pool is currently under construction.

Other facilities include the riding stables and an 18-hole championship golf course on the campus.

The Department of Physical Education and Athletics is near the Gymnasium and the Pavilion and contains offices of the director, his staff, and all coaches.
OFFERINGS

FEES

Fees are charged for enrollment in bowling, equitation, golf, and scuba diving. Club sports organizations may also assess themselves membership fees and dues.

CREDIT

Students may enroll in as many physical education courses as they wish. However, only 12 units of credit of the 1-unit activity courses will be accepted toward graduation. No such limit is placed on 2- to 5-unit courses. Courses are for 1 unit unless otherwise noted.

KEY TO COURSE NUMBERS

Numbered courses under 200 are instructional at the beginning level. Letters added to the numbers are: A—advanced instruction; F—frosh; I—intercollegiate. Courses in the 171 series and those numbered 200 are intended primarily for credential students in the pre-intern program.

SPORTS INSTRUCTION

2. Individual Programs — Individually prescribed exercise programs adapted to meet special needs.
   - Aut, Win, Spr (Ruff) three periods weekly by arrangement

   - Aut, Win, Spr (Staff) by arrangement

10. Sports Instructor Practicum.
   - 2 units, Aut, Win, Spr (Ruff) by arrangement

   - Aut, Win, Spr (Staff) TTh 11 or 1:15

14. Touch Football and Rugby.
   - Aut (Staff) MW 3:15

15. Golf, Beginning.
   - Aut, Win, Spr (Finger) TTh 11, 1:15, 2:15

15A. Golf, Advanced.
   - Aut, Win, Spr (Finger) MTWThF by arrangement

   - Aut, Win, Spr (Hamada) MW or TTh 1:15

16B. Trampoline and Gymnastics.
   - Aut, Win, Spr (Hamada) MW or TTh 2:15

17. Volleyball.
   - Aut, Win, Spr (Staff) TTh 2:15 or 3:15

17A. Advanced Volleyball.
   - Aut, Win, Spr (Staff) by arrangement

19A. Bowling, Tournament.
   - Aut, Win, Spr (Staff) by arrangement

19C. Bowling, Co-educational.
   - Aut, Win, Spr (Staff) MW 11 or 1:15; TTh 9, 10, or 11

20. Swimming and Diving, Beginning.
   - Aut, Win, Spr (Hammett) MWF 10

20A. Swimming, Advanced.
   - Aut, Win, Spr (Hammett) TTh 10

21. Tennis, Beginning.
   - Aut, Win, Spr (Staff) MW 11, 1:15, 2:15, 3:15, or 4:15

21A. Tennis, Advanced.
   - Aut, Win, Spr (Staff) TTh 11, 1:15, 2:15, 3:15, or 4:15

22. Track, Individual Programs.
   - Aut, Win, Spr (Clark) TTh 10

   - Aut, Win (DeMeo) MWF 2:15

25. Tournament Tennis.
   - Aut, Win, Spr (Goold) TTh or MW 2:15

29. Water Polo.
   - Aut, Win, Spr (Hammett) TTh 11 or 2:15

39. Soccer.
   - Aut, Win, Spr (Priddle) MWF 4:15

41. Physical Conditioning.
   - Aut, Win, Spr (Staff) MWF 4:15

42. Skin and Scuba Diving — Prerequisite: ability to swim 400 yards in 7 1/2 minutes. Enrollment limited.
   - 3 units, Aut, Win, Spr (Gaughran, Hammett) MWF 2:15

45. Life Saving — Prerequisite: swim 400 yards continuously.
   - 2 units, Aut, Win, Spr (Hammett) MWF 11

46. Water Safety Instructor Practicum — Prerequisite: WPE 135.
   - 2 units, Spr (Gaughran, Hammett) TTh 3:15 and by arrangement

53. Weight Training.
   - Aut, Win, Spr (Staff) MWF 11, 1:15, 2:15, 3:15, or 4:15
92. Techniques of Athletic Management.
   *Aut, Win, Spr (Tobin) by arrangement*

**INTERCOLLEGIATE SPORTS**

**FROSH, VARSITY, AND JUNIOR**

**VARSITY SPORTS**

111F. Frosh Basketball.
   *Aut, Win (Jones) MTWThF 2-4 p.m.*

111J. Basketball.
   *Aut, Win (Dallmar, Bowling) MTWThF 4-6 p.m.*

114F. Frosh Football.
   *Aut (Cunningham) MTWThF 2-4 p.m.*

114L. Football.
   *Aut, Spr (Christensen, Staff) MTWThF 4-6 p.m.*

115J. Golf.
   *Aut, Win, Spr (Finger) by arrangement*

116L. Gymnastics.
   *Aut, Win, Spr (Hamada) MTWThF 3:15 p.m.*

120J. Swimming and Diving.
   *Aut, Win, Spr (Gaughran) MTWThF 3:15*

121J. Tennis.
   *Aut, Win, Spr (Gould) MTWThF 3:15*

122J. Track.
   *Aut, Win, Spr (Jordan, Clark) MTWThF 3:15*

123J. Wrestling.
   *Aut, Win (De Meo) MTWThF 3:15*

129J. Water Polo.
   *Aut (Gaughran) MTWThF 3:15
   Spr (Gaughran) MWF 4:15*

130J. Baseball.
   *Aut, Win, Spr (Young) MTWThF 3:15*

139J. Soccer.
   *Aut, Win, Spr (Priddle) MTWThF 4:15*

140J. Rugby.
   *Win (Kmetovic) MWTh 4:15*

**THEORY AND TECHNIQUE COURSES**

*Note—Prerequisite: Education 156. Co-ed except for H and J. These courses generally involve lecture and discussion with occasional outside practice assignments.*

*Consent of instructor required.

171A. Theory and Technique: Baseball.
   *2 units, Aut (Young) by arrangement*

171B. Theory and Technique: Basketball.
   *2 units, Aut (Dallmar) Th 10 and by arrangement*

171C. Theory and Technique: Football.
   *2 units, Spr (Christensen) alternate years, given 1973-74*

171E. Theory and Technique: Adapted Physical Education.
   *2 units, Spr (Ruff) M 1:15, alternate years, given 1973-74*

   *2 units, Spr (Blanchard) by arrangement*

171I. Theory and Technique: Waterpolo and Swimming—Prerequisite: Water Safety Instructor's Certificate, ARC.
   *2 units, Spr (Gaughran) TTh 11*

171J. Theory and Technique: Gymnastics—Prerequisite: 16.
   *2 units, Win (Hamada) MWF 1:15*

171K. Theory and Technique: Golf.
   *2 units, Win (Finger) TTh 11*

171L. Theory and Technique: Tennis.
   *2 units, Aut, Spr (Gould) by arrangement*

171M. Theory and Technique: Volleyball and Soccer.
   *2 units, Spr (Ruff) by arrangement, alternate years, given 1973-74*

201. Seminar on Sports Sociology.
   *4 units, Sum (Ruff, Nixon) MTWThF 9-10*

   *3 units, Spr (Nixon, Ruff) MWF 10*

See Women's Physical Education for additional offerings.

**INTRAMURAL SPORTS**

Competing organizations are urged to contact the IM office during registration to obtain meeting dates and times to assure representation. Sign-up lists are often posted at the beginning of each quarter so early organization of competing groups is essential.

**CLUB SPORTS**

The Club Sports program has achieved remarkable stability in recent years due to enduring student interest. Those clubs cur-
rently affiliated with this Department are listed below. The scheduled meeting, practice times, and availability of credit are normally published in the quarterly time schedule.

Crew—127C  Karate (Shotokan)—136C
Ice Hockey—110C  Judo—aikido—146C
Backpacking—126C  La Crosse—145C
Karate (Kenpo)—135C  Volleyball—117C
Tae Kwon Do—147C

PHYSICAL EDUCATION FOR WOMEN

Emeriti: Maud L. Knapp (Professor), Margaret C. Barr (Associate Professor), Luell W. Guthrie (Associate Professor), Marian S. Ruch (Associate Professor), Sylvia P. Cain (Instructor)

Chairman: Pamela L. Strathairn
Associate Professors: Miriam B. Lidster, Pamela L. Strathairn
Senior Teaching Associate: Carroll G. Diaz, Inga Weiss
Instructor: Mary Margaret Neal
Teaching Associates: Susan Cashion, Mary Anne Newell, Elizabeth P. Weeks
Teaching Specialists: Jean P. Helliwell, Shirley H. Schoof

OFFERINGS AND FACILITIES

Since the founding of Stanford University in 1891, physical education and dance courses have been a part of the University academic curriculum. The scope of the program is broad, encompassing knowledges, understandings, and skills with educational value in the realm of self-perception and understanding and of reacting to and interacting with others. The courses are concerned primarily with education through, not of, the physical and provide a unique medium for learning—one in which non-verbal intelligence and communication can be expressed.

The Women's Physical Education building houses a gymnasium floor, dance studio, and other teaching areas. The dance and physical education library is also located here. The outdoor facilities include eight tennis courts, a heated 75-foot swimming pool, a golf green, and field space.

These facilities as well as those listed in the Men's Physical Education section of this Bulletin are utilized by all students for class instruction (basic through advanced and intercollegiate), intramurals, club sports and general recreation.

COURSES OF STUDY

The variety of course offerings for men and women students is designed to: (1) increase understanding of the value and role of physical activities in developing and maintaining total fitness throughout life; (2) provide opportunity for discovering or increasing educational experiences related to a major interest in some other subject field; (3) develop leadership ability which has particular application to community service; and (4) encourage, through satisfying learning experiences, continued participation in physical activities appropriate to health status as well as interest.

Aquatics, dance, individual activities, and sports courses are scheduled for homogeneous skill groupings and limited in class size to enable each student, the beginner through the advanced performer, to achieve success within the limits of individual interest and capability. The highly skilled in dance and in sports have opportunity to pursue their interests through special programs, including an intercollegiate athletic program for women which is part of this department's curriculum.

With few exceptions, as indicated by course descriptions, all aquatics, dance, non-contact sports and theory courses as well as Club Sports instructional program are open for enrollment by men or women students. This policy also applies to the program offered by the Men's Physical Education Department.

Equipment—All equipment, except badminton and tennis rackets and golf clubs, is provided for students enrolled in courses. Golf clubs may be rented.

Fees—Fees are charged for enrollment in bowling, equestrian, men's golf, and scuba diving courses. Club Sports organizations may also assess themselves membership fees and dues.

Credit—Students may enroll in as many physical education courses as they wish.
However, only 12 units of credit of the 1-unit activity courses will be accepted toward graduation. No such limit is placed on the 2- to 5-unit courses.

**Academic Degrees and Teaching Credentials**

The Department of Physical Education for Women cooperates with the School of Education and Department of Physical Education for Men by providing faculty, facilities, and equipment necessary to the conduct of the Professional Physical Education Program which leads to the Master's and Doctor's degrees and teaching credentials in the State of California. See the “School of Education” section of this bulletin for details of requirements leading to:

**Degrees**—Students with a major in physical education may become candidates for the A.M., Ed.D., and Ph. D. degrees in Education, with a concentration in physical education, or for the A.M. degree in Education, dance specialization. At the present time Stanford does not offer a Bachelor of Arts in Physical Education degree. Undergraduate students interested in the graduate degrees at Stanford should declare their intent early in their undergraduate career and enroll in selected courses offered by the Department of Physical Education for Women, Department of Physical Education for Men, and School of Education. These courses will satisfy most requirements for eligibility admission to the graduate program.

**Teaching Credentials**—Students desiring to teach physical education at the secondary and community college levels or dance at the community college level should enter the education credential program no later than the junior year to be able to complete the program at the end of the first graduate year under normal circumstances.

See Professors Miriam Lidster, John Nixon, Wesley Ruff or Pamela Strathairn or Miss Weiss for further information.

**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, Spr (Diaz, Weeks) MWF 9 or 10
   Win 10 or 1:15

2. **Conditioning** — Introduction to techniques of training and conditioning for physical and motor fitness, including knowledge of basic physiological and kinesiological principles underlying various conditioning techniques.
   
   1 unit, Aut (Newell) TTh 3:15 or 4:15 each with an additional hour
   Win (Newell) MWF 1:15; or TTh 2:15 with an additional hour
   Spr (Newell) MWF 11 or 12

4. **Apparatus Gymnastics: Elementary** — Instruction in and conditioning for activities in tumbling and the four official events in gymnastics: floor exercise, uneven parallel bars, balance beam and sidehorse vaulting. Development of grace, flexibility, strength, and coordination.
   
   1 unit, Aut, Win (Staff) MW or TTh 12
   Spr TTh 11–12

5. **Apparatus Gymnastics: Intermediate** — Review of basic gymnastics skills with an emphasis on more advanced and difficult maneuvers in all official gymnastics events. Prerequisite: promoted from 4 or equivalent.
   
   1 unit, Aut (Staff) TTh 1–2
   Win, Spr (Staff) TTh 11–12

7. **Sports Skills**—The development of coordination and basic skills for use in all sports and games.
   
   1 unit, Aut, Spr (Diaz) TTh 10

8. **Self Defense for Women**—This course is 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 (Staff) MW or TTh 4–6 p.m.

10. **Badminton: Elementary** — This course covers basic strokes (serves, clears, drops, smashes, and drives), rules and scoring and practice in game playing.
    
   1 unit, Aut (Diaz) MW 1–2
   Spr (Schoof) TTh 2:15 and an additional hour

    
   1 unit, Aut (Schoof) MW 2:15 and an additional hour
   Spr (Schoof) MW 1–2
12. Fencing: Elementary—The study of basic movements and practice in coordination and timing.

1 unit, Aut (Helliwell) MWF 10
   Win (Helliwell) MWF 10 or 11
   Spr (Helliwell) MWF 10 or 2:15


1 unit, Aut (Helliwell) MWF 9 or 11
   Win, Spr (Helliwell) MWF 9

14. Fencing: Epee—For men. Prerequisite: consent of instructor.

1 unit (Helliwell) by arrangement

15. Tennis: Elementary—This course covers fundamental strokes (forehand, backhand, service, and volley), rules and scoring.

1 unit, Aut (Neal) TTh 9 and by arrangement; (Neal) MW or TTh 1-2
   Win (Schoof) TTh 10 and by arrangement; (Neal) MW 1-2
   Spr (Schoof) TTh 9 and by arrangement; (Newell) MW or TTh 1-2

16. 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 the fundamental strokes.

1 unit, Aut (Schoof) MW 9 or 10 each with an additional hour; (Neal) TTh 10 and by arrangement
   Win (Schoof) MW 10 or TTh 11 each with an additional hour; (Neal) TTh 1-2 or MW 2:15 and by arrangement
   Spr (Schoof) MW 9 or 10 or TTh 10 each with an additional hour; (Neal) MW 2:15 and by arrangement

21. Basketball: Intermediate — Review of conditioning, ball handling, goal shooting skills, individual tactics, team play, strategy and rules. Prerequisites: knowledge of rules and average ability in the game. Women only.

1 unit, Win (Schoof) TTh 3:15-4:30

23. Field Hockey—This course focuses up-on conditioning, stick work, individual tactics, team play, strategy, and rules.

1 unit, Aut (Schoof) TTh 2:15-3:30
   Spr (Schoof) TTh 3:15-4:30

44. Golf: Elementary — 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 to 2 units, Aut, Win, Spr (Diaz)
   MTWTh 2:15

45. Golf: Intermediate—Improvement and perfection of previously learned fundamentals. Utilization of these skills in the game. Prerequisite: promoted from 44 or the equivalent or ability to score in the 60's for nine holes on a regulation length course.

1 to 2 units, Aut, Win, Spr (Diaz)
   MTWTh 11


1 unit, Aut, Win, Spr (Melville)
   MTTh 1:15 or 2:15

49. Equitation: Intermediate — Continued development of skill in English (forward seat) riding. 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

102. Conditioning: Individual Programs—Conditioning through aerobic techniques. Prerequisite: experience in conditioning programs.

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

104. Apparatus Gymnastics: Advanced — Prerequisite: promoted from 5 or equivalent.

1 unit, Aut (Staff) TTh 1-2
   Win (Staff) TTh 11-12
   Spr (Staff) TTh 12-1

110. Badminton: Advanced—Refinement of strokes and utilization of strategy in game playing. Prerequisite: promoted from 11 or extensive experience which has resulted in above average ability.

1 unit, Aut (Diaz) MW 3:15 and by arrangement
   Spr (Schoof) MW 1-2

112. Fencing: Advanced — Concentration on practice of attacks. Regular lessons and
some competition. Prerequisite: promoted from 13 or equivalent.

1 unit, Aut, Win, Spr (Helliwell) TTh 10 and T 7 p.m.

115. Tennis: Advanced — Refinement of strokes and utilization of strategy in game playing. Prerequisite: promoted from 16 or extensive experience which has resulted in above average ability in all strokes.

1 unit, Aut (Neal) MW or TTh 11-12
Win (Neal) MW 11-12 or 3:15-4:15
Spr (Neal) MW or TTh 11-12 or TTh 2:15-3:15

120. Basketball: Advanced — Prerequisite: promoted from 21 or equivalent.

1 unit, Win (Schoof) MW 3:15-4:15

144. Golf: Advanced—This course focuses upon understanding and refining the golf swing as well as increasing power and distance. Prerequisites: ability to hit the ball with relative accuracy and to play on a full 18-hole course with an average score of 115 or better.

1 unit, Aut (Diaz) TTh 1:15 and by arrangement
Win, Spr (Diaz) MW 1:15 and by arrangement

148. Equitation: Jumping—Introduction to and development of jumping skill using low single fences, higher fences, combinations, and courses. Prerequisite: promoted from 49 or equivalent.

1 unit, Aut, Win, Spr (Melville) MTTh 10:00

AQUATIC ACTIVITY AND THEORY

30. Swimming I—For those unable to swim at all or who feel unsafe in deep water. Concern with physical and mental adjustment to the water, buoyancy and body position, propulsion, personal safety skills, elementary rescue skills and the fundamentals of swimming on front and back.

1 unit, Aut, Spr (Newell, Weeks) MWF 1:15

31. Swimming II—Continued work on personal safety skills, elementary rescues and fundamentals of crawl and elementary back stroke. Introduction to side stroke, breaststroke and back crawl; to defense techniques and to conditioning. Prerequisite: promotion from 30 or equivalent.

1 unit, Aut, Win, Spr (Weeks, Staff) MWF 2:15

32. Swimming III—Particular attention to refinements in crawl, elementary back stroke, side stroke, breaststroke and back crawl. Continued development of personal safety, elementary rescues and conditioning. Prerequisite: promotion from 31 or equivalent.

1 unit, Aut, Win, Spr (Newell, Staff) MWF 11

130. Swimming IV—Review and refinement of the five basic strokes and all safety skills. Introduction to five new strokes (including the butterfly) and racing starts and turns. Extensive conditioning. Prerequisite: promotion from 32 or equivalent.

1 unit, Aut, Win, Spr (Weeks, Newell) MWF 3:15

134. Lifesaving—The American Red Cross Lifesaving course which focuses upon increasing awareness of water hazards, the avoidance of accidents, prevention of accidents to self and others, and utilization of appropriate rescue techniques. Prerequisites: promotion from MPE 20A or WPE 130 and ability to swim 440 yards continuously.

2 units, Aut, Spr (Strathairn, Weeks) MWF 11 or 3:15
Win (Weeks) MWF 11

135. WSI—The American Red Cross Water Safety Instructor course which focuses on the analysis and evaluation of swimming fundamentals and strokes and lifesaving techniques for the primary purpose of teaching water safety. Certification requires enrollment in the Spring Quarter Men’s Physical Education WSI practicum. Prerequisite: MPE 45 or WPE 134.

3 units, Aut, Win (Strathairn) MWF 2:15

230. Aquatics Seminar—In depth analysis of aquatic skills and exploration of various teaching methods, class organization patterns, evaluative techniques and pool management. Prerequisites: current WSI certification and consent of instructor.

3 units, Win, Spr (Strathairn) by arrangement

DANCE ACTIVITY AND THEORY

Although Stanford does not offer a Bachelor of Arts degree in Dance, a wise selection from among the following courses will fulfill most of the prerequisites for admission to
and completion of the A.M. degree in Education with a Dance Specialization.

Men and women students should declare their intent early in their undergraduate career and confer with the dance advisers. All courses except as indicated are coeducational.

   1 unit, Aut (Staff) MW 7:30-9:00 p.m.
   1 unit, Win (Staff) MW 7:30-9:00 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 (Cashion) MWF 9
   Win (Cashion) TTh 9 plus an additional hour
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, Aut (Lidster) TTh 9 plus an additional hour
   Spr (Cashion) MWF 10
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 (Staff) TTh 10
   Win (Staff) MWF 10
62. Modern Dance I—Development of flexibility, coordination, motor skills and modern dance techniques.
   1 unit, Aut (Staff) MWF 10 or 3:15
   Win (Cashion, Staff) MWF 9 or 3:15
   Spr (Staff) MWF 9 or TTh 9 plus an additional hour
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 (Cashion, Weiss) TTh 11-12:15 or 2:15-3:30
   Win, Spr (Weiss) TTh 2:15-3:30
   1 unit, Aut, Win (Weiss) W 11-1
65. Modern Dance III—Course material based on a progressive upper intermediate level. Prerequisite: 63 or equivalent.
   1 unit, Win (Cashion) TTh 10 and an additional hour
   Spr (Cashion) MWF 3:15
72. Folk Dance I—Selection of 25 or more dances from many countries with emphasis on traditional and foundation folk dance steps.
   1 unit, Aut (Lidster, Staff) MWF or TTh 1:15
   Win, 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; elementary folk dance or equivalent.
   1 unit, Aut, Win, Spr (Lidster, Staff) MWF 2:15
74. Folk Dance III—Continued presentation of dances from selected countries with concentration on foot and body skills necessary for the styling related to specific countries. Prerequisite: 73 or equivalent.
   1 unit, Win, Spr (Lidster, Staff) TTh 1-2
75. Ethnic Dance: Styles and Techniques—Mexican—Selected regional dances of Mexico to be taught for technical and cultural understanding.
   1 unit, Aut (Cashion) TTh 1-2
   Spr (Cashion) MWF 1:15
76. Ethnic Dance: Styles and Techniques—Israeli—A concentration on the dance, music, and dancelore of Israel.
   1 unit, Win (Lidster) TTh 11-12:15
77. Ethnic Dance: Styles and Techniques
—Balkan—Selected dances of the Balkans with a concentration on styles, music and costume.

1 unit, Spr (Lidster, Staff) TTh 11–12:15


1 unit, Spr (Staff) MW 7:30–9:00 p.m.

160. Modern Dance Technique: Advanced
—Development of versatile dance techniques and disciplines for strong control and expressive use of movement.

1 to 3 units, Aut (Weiss) MF 4:15–6

161. Contemporary Dance Forms I — Sequences for manipulation of movement and advanced techniques. Prerequisite: consent of instructor.

1 to 3 units, Win (Weiss) M 4:15–6

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

163. Choreography I — 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: 61, 62, or intermediate skill.

3 units, Aut (Cashion) TTh 7–9:45 p.m.

164. Choreography Workshop — A continuation of the compositional elements of modern dance. Prerequisite: 163.

3 units, Win (Cashion) Th 7–9:45 p.m.

and by arrangement

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) W 4:15–6 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.

F 4:15–6

169. Dance Appreciation — This course is designed to develop an understanding and appreciation of dance (ballet, modern, and ethnic) through films which serve as the basis for discussion of the artists and dances.

2 units, Spr (Lidster) T 4:15–5:45


4 units, Aut (Lidster) TTh 11

171. Notation — The Laban method of notating, with symbols, dance and other forms of movement such as aquatic art.

2 units, Aut (Cashion) MW 1–2

172. Folk Dance: Advanced — Presentation of dances with complex patterns and intricate steps. Emphasis on styling and footwork. Prerequisite: 74 or equivalent.

2 to 3 units, Aut (Lidster) Th 4:30–5:45 and M 7–9 p.m.

173. Folk Dance: Advanced — Continuation of dances with complex patterns and steps with an opportunity to work with guest teachers. Prerequisite: promotion from 172 or equivalent.

2 to 3 units, Win (Lidster) Th 4:30–5:45 and M 7–9 p.m.

174. Folk Dance: Advanced — Continuation of dances with complex patterns and steps with an opportunity to work with guest teachers. Prerequisite: promotion from 173 or equivalent.

2 to 3 units, Spr (Lidster) Th 4:30–5:45 and M 7–9 p.m.

175. Folk Dance Exhibition: International — Advanced and exhibition dances mastered in order to participate in dance demonstrations, exhibitions, and festivals. Prerequisite: consent of instructor.

2 to 3 units, Win (Lidster, Staff)

W 7–9:45 p.m.

176. Folk Dance Exhibition: International — Continuation of advanced and exhibition dances in order to present exhibitions and an international folk dance concert. Prerequisite: 175 and/or consent of instructor.

2 to 3 units, Spr (Lidster, Staff) W 7 p.m.

177. 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.

2 to 3 units, Win (Cashion) T 7–9:45 p.m.
178. Folk Dance Exhibition: Mexican — Continuation of Mexican dance for exhibition and concert presentations. Prerequisite: 177 or equivalent and consent of instructor.

2 to 3 units, Spr (Cashion) T 7-9:45 p.m.

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, Spr (Cashion) offered 1974-75

260. Contemporary Dance Practicum — Teaching Assignments. Prerequisite: consent of instructor.

2 units, Aut (Weiss) F 11-1

261. Contemporary Dance Practicum and Research — Exploration and study of potential resources for creative design in the teaching of Dance. Ideas and assignments for improvisation, composition, music for dance and concepts for performance and dance for children. Prerequisite: consent of instructor.

4 units, Spr (Weiss) W 11-1 and by arrangement

262. Seminar in Dance Styles — Focus on the changing aims and expressions of a time and its artists as reflected by various techniques and styles of dance. Evaluation of different emphasis and points of view and study of traditional and experimental procedures in dance. Master lessons and lectures by visiting guest artists included.

2 to 4 units, Win (Weiss) 4:15-6:00 and by arrangement

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

265. Fundamentals of Modern Dance — This course involves analytical study of movement vocabulary and techniques as well as methods of presentation, rhythmic accompaniment with percussion instruments and basic concepts for structural development of movement as a creative experience and dance as a performing art. Prerequisites: advanced level students and consent of instructor.

1 to 3 units, Win (Weiss) F 11-1

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, Spr (Weiss) F 11-1

270. Folk Dance Practicum — Analysis and development of instructional materials for an elementary folk dance class. Opportunity to teach. Prerequisite: 172, 173 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. Opportunity to teach. Prerequisite: 172, 173 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.

5 units, Win (Lidster, Cashion)
MW 11-12:15 and M 7 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 (Lidster, Weiss) by arrangement

INTERCOLLEGIATE SPORTS

As a member of the Northern California Intercollegiate Athletic Conference (NCIAC), Association for Intercollegiate Athletics for Women (AIAW), and Northern California Intercollegiate Fencing Association (NCIFA), Stanford offers an intercollegiate program for the highly skilled woman student in six sports. The men's fencing teams are sponsored by this department. Eli-
gible team members compete in invitational, regional, and national collegiate championships as well.

113. Fencing: Varsity—Men’s and women’s teams.
   2 units, Aut, Win, Spr (Helliwell) TTh 9 and T 7-9:45 p.m.

116. Tennis: Varsity—Women only.
   1 to 2 units, Aut (Neal) MTWTh 2:15-4:00
   Win (Neal) TTh 2:15-4:00
   Spr (Neal) MTWTh 3:15-5:00

121. Basketball Varsity—Women only.
   2 units, Win (Schoof) MTWTh 4:15-6:00

124. Field Hockey: Varsity—Women only.
   2 units, Aut (Schoof) MTWTh 3:15-5:00

132. Swimming Varsity — Conference competition during Autumn Quarter. Winter enrollment for national competition requires team membership during the immediately preceding Autumn quarter. Women only.
   1 to 2 units, Aut, Win (Weeks)
   MTWTh 4:15-6

145. Golf: Varsity—Women only. Prerequisite: average scores under 100 for a regulation length 18-hole course.
   1 unit, Aut (Diaz) TTh 1:15 and
   by arrangement
   Win, Spr (Diaz) MW 1:15 and
   by arrangement

213. Fencing: Varsity—Graduate students only. Men’s and Women’s teams.
   2 units, Aut (Helliwell) TTh 11 and
   T 7-9:45 p.m.
   Win, Spr (Helliwell) TTh 9 and
   T 7-9:45 p.m.

**PHYSICAL EDUCATION AND SPORTS**

**Theory Courses**

To supplement the following courses, students should enroll in physical education courses offered through the School of Education as well as Theory and Technique courses in the Department of Physical Education for Men. All courses are coeducational.

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.
   2 to 5 units, Aut, Win, Spr (Staff) by arrangement

106. Elementary Analysis of Human Movement—A brief study of skeletal anatomy and of mechanical principles of stability, motion and leverage as they relate to efficient performance in sports, aquatics and dance.
   3 units, Aut, Spr (Weeks) TTh 10-12

180. Basketball Officiating—Emphasis upon the principles and techniques of officiating which requires a thorough knowledge of and ability to apply the rules of basketball for girls and women. Prerequisite: above average playing ability or two seasons of playing experience.
   2 units, Win (Schoof) by arrangement

181. Golf Officiating and Tournament Organization—This course focuses upon planning various types of golf tournaments according to USGA rules, with main emphasis on collegiate events.
   2 units, Aut, Win, Spr (Diaz) by arrangement

182. Tennis Officiating and Tournament Organization—This course focuses upon understanding the principles and mechanics of organizing and conducting a variety of tennis tournaments and upon developing the knowledge and ability to become USLTA rated tennis officials.
   2 units, Spr (Neal) by arrangement

183. Fencing Officiating and Tournament Organization—Students learn how to conduct fencing meets and develop competency in directing, judging, and time keeping for fencing competitions.
   2 units, Aut, Win, Spr (Helliwell) by arrangement

184. Swimming Meet Officiating and Organization—Principles and mechanics of organizing swimming meets and developing skills in duties of all officials. Practical experience provided. Written and practical exam may be taken to become a rated official.
   2 units, Win (Weeks) by arrangement

187. Field Hockey Officiating—The principles and techniques of officiating field hockey games.
   2 units, Spr (Schoof) by arrangement

210. Badminton Theory and Technique — Prerequisite: consent of instructor.
   2 units, Aut, Spr (Staff) by arrangement

211. Badminton Practicum—Prerequisites:
advanced level ability and consent of instructor.

2 units, Aut, Spr (Staff) by arrangement

212. Fencing Theory and Technique—Analysis of the various moves used in fencing and of learning sequences. Prerequisite: consent of instructor.

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

214. Fencing Practicum—Prerequisites: advanced level ability and consent of instructor.

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

215. Tennis Theory and Technique—Analysis of the strokes and strategies of tennis with emphasis on understanding learning progressions. Prerequisite: consent of instructor.

2 units, Aut, Win (Neal) by arrangement

216. Tennis Practicum—Prerequisites: advanced level ability and consent of instructor.

2 units, Win, Spr (Neal) by arrangement

244. Golf Theory and Technique—Analysis of golf skills with emphasis on learning progressions for groups and individuals. Prerequisite: consent of instructor.

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

245. Golf Practicum—Prerequisite: advanced level ability and consent of instructor.

2 units, Win, Spr (Diaz) by arrangement
SPECIAL OPPORTUNITIES
IN GRADUATE STUDY

INSTITUTE FOR PLASMA
RESEARCH

Executive Committee: Peter A. Sturrock (Chairman), Daniel Bershader, Oscar Buneman, I-Dee Chang, Marvin Chodorow, Frederick W. Crawford, Robert H. Eustis, Krishnamurty Karamcheti, Charles H. Kruger, Morton Mitchner, Vahe Petrosian, Sidney A. Self, Arthur B. C. Walker, John M. Wilcox

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, Devoto) 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 Astrophysics Group (Petrosian, Sturrock) is engaged in astrophysical studies related to the sun, pulsars, radio galaxies, quasars, cosmic rays, and cosmology.

The Gas Kinetics Group (Karamcheti, 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, 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) 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 Astronomy Group (Walker) conducts experimental studies with emphasis on spectroscopic observations and analysis, on various topics of X-ray astronomy including the solar corona, supernova remnants, pulsars, X-ray stars, and the interstellar medium.

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

Committee in Charge: Von R. Eshleman (Chairman), Daniel Bershader, Ronald N. Bracewell, Frederick W. Crawford, Robert A. Helliwell, Robert L. Kovach, Vahe Petrosian, John R. Spreiter, Peter A. Sturrock, John M. Wilcox

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: radio emission in the magnetosphere; radio measurements of the interplanetary medium and of planetary atmospheres; plasma waves
in space; infrared and radar sensing of planetary surfaces; X-ray astronomy; and gravitation.

Related observations by means of ground-based equipment are made at the Radioscience Laboratory (ionospheric and magnetospheric structure and radio properties); the Radio Astronomy Institute (the sun and other radio sources); and the Center for Radar Astronomy (magnetospheric and cislunar media, sun and moon), operated jointly with Stanford Research Institute.

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.

Courses related to many of the above topics will be found listed under Aeronautics and Astronautics, Applied Mechanics, Electrical Engineering, Geophysics, and Applied Physics, 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 Mechanics, Electrical Engineering, Geophysics, and Applied Physics 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.

**Traineeships in Educational Research**

The doctoral student in any department who is preparing himself to investigate matters related to education may be supported under the Research Traineeship Program administered by the School of Education.

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**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)


Assistant Professors: Elliot Bloom, Michel Davier


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 chamber 82 inches long and 20 inches wide which was transferred to SLAC from the Lawrence Radiation Laboratory in Berkeley; 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 beginning a research program with colliding beams each of 2.5 BeV energy.

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 1973, physicists from 48 other institutions have had research programs accepted for execution at the Center. The faculty of the Center leads a group of some 70 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, and studies of decay properties of weakly interacting particles. 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.

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. 2. Peopledynamics Laboratory
Engr. 3,4,5. Applied Mechanics I, II, III
Human Biology (Program in)

Committee in Charge: Donald Kennedy (Biological Sciences), Chairman; Sanford M. Dornbusch (Sociology); Paul R. Ehrlich (Biological Sciences); David A. Hamburg (Reed-Hodgson Professorship of Human Biology and Psychiatry); Albert Hatorf (Psychology); Norman Kretchmer (Pediatrics); Joshua Lederberg (Genetics); Colin S. Pittendrigh (Bing Professor of Human Biology and Biology); James L. Gibbs, ex officio (Dean of Undergraduate Studies)

Faculty: John E. Adams (Psychiatry); Albert J. Ammerman (Genetics); Keith Brodie (Psychiatry); Luigi L. Cavalli-Sforza (Genetics); Garth Collier (Civil Engineering); Peter Corning (Political Science); Carl Djerassi (Chemistry); Shirley Feldman (Psychology); Jane van Lawick-Goodall (Psychiatry); John G. Gurley (Economics); Nicholas J. Hoogenaard (Pediatrics); Herant Katchadourian (Psychiatry); Sidney Liebes, Jr. (Genetics); William V. Robertson (Pediatrics); Alberta A. Siegel (Psychiatry)

Student Members: Donna Anderson, Cynthia Clinkingsbeard, Laurie S. Gill, Robert Kaplan, Daniel J. McFarland, Anne M. Murphy, Iris M. Payne, Randall A. Yim

Program Coordinator: Sophia C. 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 is funded by a grant from the Ford Foundation and 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 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. It is expected that, in addition, at least six advanced courses will be taken in fields related to the biological, social, or physical aspects of Human Biology. 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.

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

I. 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.

Metabolism in general, with principal emphasis on the energetics of the organism and traffic with the environment in material constituents, is given only brief treatment. The cell is studied as the simplest unit of living organization. The structure of its organelles is considered in terms of the functions 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 (Pittendrigh) MTWThF 10

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 central nervous organization underlying behavior and finally to social organization in animal societies, provides the major theme for the course. Prerequisite: 1 or Biological Sciences 1; must be taken concurrently with 2B.

4 units, Aut (Kennedy, Staff) 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 in different eras of human evolution: in nonhuman primates; in hunting-and-gathering societies; in agricultural societies. Attention will be
given to: subsistence patterns; interpersonal and intergroup relations; stressful experiences and their physiological concomitants; sources of conflict and modes of conflict resolution.

4 units, Aut (Hamburg, Goodall) MWF 10

3A. Man as an Organism—The intra-uterine and extra-uterine development of man will be discussed structurally and physiologically. Extended treatment will be given to the study of the adaptation of man and his homeostatic capacity. The physiological discussions will focus on the endocrine organs as a system utilized by man for adaptation to environmental change. Prerequisites: Human Biology 2A and 2B; must be taken concurrently with 3B.

4 units, Win (Kretcher) MWF 9

3B. Development of Behavior—This course builds on the study of the evolution of behavior in its prerequisite course, 2B. The bases of behavior development are examined in the contemporary human species. Emphasis is on those capacities and behaviors in infancy and childhood which are adaptive for the individual and the social group. The emotional, social, and cognitive development of the human child is considered, beginning with the neonatal period. The utilization of this information is discussed for medical, educational and other social institutions. (This course has overlap with Psychology 111 and credit cannot be obtained for both.)

4 units, Win (Siegel, Staff) MWF 10

4A. Biology of Populations — The course will present a systematic approach to populations as biological units; the dynamics of population growth and the control of population size in the non-human and human populations. Demographic principles and community ecology will be emphasized. This course will include treatment of the structure of food webs, the flux of energy through communities, the flux of materials, renewable and nonrenewable resources and how these factors relate to the population dynamics of man. Prerequisites: Human Biology 3A and 3B; must be taken concurrently with 4B.

4 units, Spr (Cavalli-Sforza, Ehrlich) MWF 9

4B. Social Organization of Man — This course will present selected economic, cultural, and sociologic 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 (Dornbusch, 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. 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 examined. The emphasis in the course is on information, not advice.

4 unit, Spr (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 two-thirds of the units are in either the natural or the social sciences, while one-third are in the other—i.e., two-thirds social and one-third natural; or two-thirds natural and one-third social. The upper division courses should reflect a unity directed toward the ultimate goal of the student. The student's individual design of advanced courses must have approval from an adviser in the Program. At the stu-
dent'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—The interplay of environmental, genetic, and social factors that influence health outcomes. Historical epidemiology, contemporary environmental changes, the evolution of parasites and human hosts, the challenges of health research and of preventive medicine, and the dilemmas of value choices involving life and health will be reviewed. (Students interested in the sociology and economics of medical services should see CPM 200.) Prerequisites: Human Biology core or 20 units of Biological Sciences.

4 units, Win (Lederberg) MWF 11

104. Political Processes and Human Biology—Political practitioners and administrative officials drawn from local, state and national government will discuss issues in effecting changes in public policy. Prerequisite: Human Biology core or consent of instructor.

3 units, Aut (Dornbusch, Staff)
given 1974-75

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 2:05-4:15

110. Introduction to Biological Chemistry—This elective course is designed for students of Human Biology who cannot take courses offered by the Departments of Chemistry and Biochemistry. Major topics include biologically important principles of physical chemistry, characteristics of enzymes and other molecules of biological interest, biochemical pathways and genetic errors of metabolism. This course will be accepted as an advanced course for those Human Biology majors who do not intend to emphasize the natural sciences. Limited to 30 students with preference to students in the Human Biology Program.

3 units, Aut (Hoogenraad) TTh 4:15

120. Human Nutrition—An introduction to human nutrition including the metabolic basis of nutritional requirements, dietary requirements, biogeographic aspects, food production and distribution, specific deficiency diseases, and global aspects of malnutrition. Prerequisite: Human Biology core or consent of instructor.

4 units, Spr (Kretchmer, Robertson) MWF 4:15

128. Seminar in Comparative Survival Strategies—(Same as Political Science 128C.) A systematic comparison of how different human societies go about meeting their basic survival and reproductive needs. The overall configuration of survival strategies and behaviors will be considered, and students will be required to take a holistic approach, drawing upon data and research from a variety of disciplines.

5 units, Win (Corning) T 2:15-4:05

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, Win (Cavalli-Sforza) MWF 2:15

135. Subsistence Transformations in Prehistory—The course will examine the economic and cultural changes that occurred over most of the Old World during the last 10,000 years. Archaeological and biological lines of evidence will be used to consider the life ways of late hunter-gatherers and the emergence of early forms of agriculture. Discussion will also focus on the major impact that this economic transition has had upon cultural development, human demography, human genetics, and man's relation
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 (Goodall, Hamburg) by arrangement

150. Biosocial Aspects of Birth Control — (Same as Chemistry 130.) 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 course will deal with a critical evaluation of the logistic aspects of practical human fertility control. Groups of 5 to 8 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 selection of students admitted to this class will be based in part on the desire to create a multi-disciplinary student group 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, etc.) who will focus on specific logistic aspects of a common topic in the birth control field. Limited to 40 students. Pre-registration during fall quarter essential. Prerequisite: at least junior standing and completion of pre-registration questionnaire available from Human Biology Office.

5 units, Win (Djerassi) M 2:15-4:05; W 2:15-4:05

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 (Goodall, Hamburg) by arrangement

161. Primate Behavior Workshop—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

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 (Brodie) 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 (Hamburg, Adams) W 1:15-4:05

199. Directed Reading/Special Projects — Course graded pass / no credit exclusively.

Any quarter (Staff) by arrangement
Interschool and Interdepartmental 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 consult with at least three faculty members from at least two separate departments and/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 committee.

The “Committee in Charge”

The Interdepartmental Majors Program 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 Subcommittee 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 Subcommittee 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 committee.

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 committee 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 Interdepartmental Majors as being 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 interdepartmental major must have at least two quarters’ un-
dergraduate 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.

Further information on the program may be obtained at the Academic Information Center, extension 2426.

LEARNING ASSISTANCE CENTER

Director: Michael McHargue

The Learning Assistance Center (LAC) is designed to improve the learning environment 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 three 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 graduate student tutors from our files. The tutoring usually costs about $3.50/hour. Students who need financial assistance to obtain this service will be advised on how to get it.

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 and courses are also offered in this area.

LAC courses are pass / no credit and they are described below. All LAC services (except for individual course tutoring) are free. You are invited to visit the Center at Meyer Library 123, or call us at ext. 2207. We are open Monday through Friday, 9-5.

COURSES

1. Effective Learning Skills — Teaches self-management and study skills. Lectures; workshops, small sections, and individual counseling are designed to encourage students to practice new techniques on other course work.

   1 to 3 units, Aut, Win, Spr (McHargue, Staff)

10. Effective Reading Skills — Small sections designed to improve reading skills including vocabulary building, critical and analytical reading of college-level materials, speed reading and study reading.

   1 to 3 units, Aut, Win, Spr (McHargue, Staff)

Mathematical Sciences (Program in)

Committee in Charge: Arthur F. Veinott, Jr. (Operations Research), Chairman; Paul W. Berg (Mathematics), Herman Chernoff (Statistics), John G. Herriot (Computer Science)

STATEMENT OF PURPOSE

This interdepartmental, interschool undergraduate program is designed as a major 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).

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 (152, 153) or Linear Programming (240) and Models in Operations Research (250, 251).

4. Statistics (11-12 units): Theory of Probability (116 or Mathematics 123); Statistical Inference (119, 120).

5. Electives (12 units): Twelve units of courses in the Mathematical Sciences of which six (6) must be chosen from Mathematics 114, Mathematics 116, 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 graduate study in Operations Research are advised to take Mathematics 114 and 116.

**Seminars for Entering Students**

*Committee in Charge:* Marvin Chodorow (*Director of the Program*), Douglas D. Davis (*ex officio*), James L. Gibbs, Jr. (*ex officio*), George Collier, Karel de Leeuw, Stanley Fischman, Deborah Hinze, Jonathan Horton, Michael Lloyd, Lucio Ruotolo, Ann Snow

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 some 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 should be addressed to the Office of the Dean of Undergraduate Studies, Building 1, Room 1-R, 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, student-led program organized in an effort to provide within Stanford's curriculum more 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 3,000 students in over 150 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 faculty 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 as seminars, 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. 4305.

The Student Center for Innovation in Research and Education (SCIRE)

The Student Center for Innovation in Research and Education (SCIRE) is a student-implemented, extra-departmental program dependent on students—students with educational interests and needs unfulfilled by the traditional departmental structure and curriculum. SCIRE was founded specifically to support and assist students with the initiative to design an individual or small group project particularly suited to their own educational goals.

SCIRE facilitates student-initiated projects in several ways. The staff works with the 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 six students and five faculty members.

SCIRE projects allow undergraduates to directly affect their educations 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 2-15 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 responsibility for a student's individual academic program, SCIRE also supports students who wish to examine broader educational issues in the University. This institutional introspection has led to constructive changes in the University curriculum. Several SCIRE projects reflecting substantial trends in students' academic interests have
resulted in new course offerings through departments. Proposals for more extensive programs, such as the Urban Campus, the Ecology House, and the beginning of a Contemporary Asian Studies Program, have originated from SCIRE projects designed to explore the rationale and develop curriculum for such programs.

Students with project ideas, however vague, should come by the SCIRE office, 590A Old Union, below the Nitery, or call ext. 4504. 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. 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 Office of the Dean of Undergraduate Studies, indicating:

a) Course title and description, number of units. (The maximum number of credits offered is usually three.)

b) A description of the manner in which the course will be conducted, and a meeting schedule.

c) A reading list and course outline.

d) The name of the instructor and any others who will assist in teaching the course, and a statement of the qualifications of these individuals.

e) A statement assuming full academic responsibility for the course.

If the proposed instructor of the course is not a member of the Academic Council, he must be formally sponsored by a member of the Academic Council, who will be responsible to the Committee on Undergraduate Studies through the Office of the Dean of Undergraduate Special
Courses 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

The Undergraduate Writing Program is funded through the office of the Dean of Undergraduate Studies. It has three main functions: To offer experimental courses fulfilling the writing requirement, to offer courses for upperclassmen who wish to continue improving their writing skills and to offer tutorial help in writing on a drop-in basis. The program is staffed by people especially skilled in teaching composition and is located in Meyer Library 123.

COURSES

1. Small Group/Tutorial Sessions in Writing—Each quarter of this course fulfills half of the writing requirement. Every student meets with a small group of ten to twelve students once a week for two hours and again individually with his or her instructor. The approach to the course varies with instructor, but in each section eighty to one hundred percent of student/teacher energy is spent on reading, writing and talking about compositions. Goals are individualized as far as is possible under writing requirement guidelines.
   
   3 units, Aut, Win, Spr (Staff)

2. Small Group/Tutorial Sessions in Writing for Second Language Speakers—Each quarter fulfills half of the writing requirement. The format is the same as for WP1, but the instructor is skilled in handling problems encountered by non-native speakers of English.
   
   3 units, Aut, Win, Spr (Staff)

10. Writing about Political Science — Fulfills half of the writing requirement. Each student in this course must also take concurrently Professor Herbert Marshall’s popular course, Major Issues in American Public Policy (Political Science 1). Writing will be based on the issues, forms and reactions suggested by Political Science 1. The student may fulfill the second half of the writing requirement by taking another course in the Undergraduate Writing Program or by one quarter of a writing requirement course in the Freshman English or Freshman seminar program.
   
   3 units, Aut (Staff)

11A. Writing about History — Fulfills half of the writing requirement. Each student in this course must also take concurrently Professor Lewis Spitz’s Modern Europe I. Writing will be based on the issues, forms and reactions suggested by History I.
   
   3 units, Aut (Staff)

11B. Writing about History — Fulfills half of the writing requirement. Each student in this course must also take concurrently Professor Gordon Craig’s Modern Europe II. Writing will be based on the issues, forms and reactions suggested by History II.
   
   3 units, Win (Staff)

11C. Writing about History — Fulfills half of the writing requirement. Each student in this course must also take concurrently Modern Europe III. Writing will be based on the issues, forms and reactions suggested by History III.
   
   3 units, Spr (Staff)

14. Writing about Psychology—Fulfills half of the writing requirement. Each student in this course must also take concurrently Psychology 1. Writing will be based on the issues, forms and reactions suggested by Psychology 1.
   
   3 units, Aut (Staff)

15. Writing about Anthropology — Fulfills half of the writing requirement. Each stu-
dent in this course must also take concurrently Professor George Spindler's Anthropology 1. Writing will be based on the issues, forms and reactions suggested by Anthropology 1.

3 units, Spr (Staff)

101. Small Group/Tutorial Sessions in Writing for Upperclassmen—Designed for those students who have fulfilled the writing requirement but wish to improve further their writing skills. The course is in the same format as WP1. Assignments and goals are individualized.

3 units, Aut, Win, Spr (Staff)

102. Small Group/Tutorial Sessions in Writing for Second Language Upperclassmen—Designed for non-native speakers of English who wish to improve further their writing skills. The course is in the same format as WP1, but it is taught by an instructor skilled in handling problems of those students for whom English is a second language.

3 units, Aut, Win, Spr (Staff)

103. Directed Writing—Each student will meet with his or her instructor once a week. The student and his instructor will work out the student's goals and the means of reaching them.

1 to 5 units, Aut, Win, Spr (——)

TUTORING

Spot tutorial help in writing is available from specially trained tutors at the Undergraduate Writing Program. Appointments can be made on a same-day basis. This service is free to undergraduates, and to most graduate students. Drop by or call the Undergraduate Writing Program secretary in Meyer Library 123 for further details.

URBAN STUDIES

(Program on)

The Urban Studies Program is an undergraduate social science curriculum fostering the study of metropolitan and regional phenomena. As this statement went to press, a proposal for a Bachelor's Degree program was being prepared for University approval. Undergraduates who would be interested in majoring in Urban Studies should visit the Urban Studies office in the Old Union in order to obtain the latest information.

VALUES, TECHNOLOGY, AND SOCIETY

(Program in)

Chairman: Walter G. Vincenti
Coordinator: Robert E. McGinn
Professors: Clifford R. Barnett (Anthropology), Eric Hutchinson (Chemistry), Stephen J. Kline (Mechanical Engineering), William C. Reynolds (Mechanical Engineering), Alberta E. Siegel (Psychiatry), David F. Tuttle (Electrical Engineering), Walter G. Vincenti (Aeronautics and Astronautics)
Associate Professor: Robert W. Bartlett (Applied Earth Sciences)
Assistant Professors: Robert E. McGinn (Humanities Special Programs), Lee H. Yearley (Religious Studies)
Lecturers: Eric D. Fenster, William R. Kincheloe (Electrical Engineering), Robert A. Kreiss, Edwin A. Winckler (Political Science)

STATEMENT OF PURPOSE

Values, Technology, and Society (VTS) is a multi-disciplinary program focusing on technology and its interactions with various other dimensions of life in contemporary industrial society. The purpose of the Program is two-fold: (1) to provide students with materials and opportunities for synthesis, enabling them to realize more adequately the central goal of general education: broad understanding of man, society, and nature, including their interactions in the contemporary world; (2) to develop a program of courses providing the basis for an innovative form of broad undergraduate education particularly appropriate for students planning study in graduate professional schools (e.g., law, business, or education) or in fields leading to careers in sociotechnical assessment, urban policy science, engineering-economic systems, public policy analysis, environmental planning, etc.

VTS gives due recognition to the importance of technology as a force affecting
every individual and every aspect of modern life. However, VTS believes that for the study of technology and its ramifications to be fruitful it must be informed with historical and cross-cultural perspectives coupled with an emphasis on the importance of human values, and supplemented by study of the professions as the arenas in which constructive interdisciplinary syntheses find their practical applications to human needs. VTS thus hopes to generate in prospective professionals and citizens a keen, operational awareness of the need for viewing complex problems in technological society from a more comprehensive and integrated perspective.

**Offerings and Facilities**

The Program is funded in part by a grant from the Alfred E. Sloan Foundation. At present VTS is not a degree-granting program, although students may petition to design a special major in VTS in consultation with Program faculty, the Office of the Dean of Undergraduate Studies, and the Academic Information Center. The Program draws its faculty from the School of Humanities and Sciences, and the Schools of Earth Sciences, Engineering, Law, and Medicine.

The office of the Program in Values, Technology, and Society is located in Building 60 on the Inner Quad.

**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 for details on individual courses.

**Courses**

VTS courses will be particularly valuable for students desiring to relate the more specialized knowledge gained from their major fields—whether in the humanities, the social, behavioral, biological, or natural sciences, or engineering—to the broad problems of the contemporary world.

Many VTS courses may be applied toward the fulfillment of any one of the two or three University Distribution Requirement areas which a given course satisfies. For information on which distribution area(s) a particular VTS course satisfies, consult the Academic Information Center.

**Fundamental Courses**

1. Man in Contemporary Technological Society — Introduction to the interactions of values, technology, and society as they confront individuals living in America today. What are the important human, social, environmental, and technological factors bearing on the possibility of living a good life in technological society, today and in the future? Topics include: basic human needs and values; various conceptions of a good life; psychiatric perspectives on human values in contemporary technological society; past, present, and likely future impact of technology on human values; forms of social organization mediating achievement of a good life (e.g., family, religion, etc.); environmental quality and resource constraints on life in contemporary technological society; limits to growth and the quality of life; multi-disciplinary perspectives on population and environment; VTS-interactions in the urban-technological milieu; future values and new ethics for survival.

   5 units, Spr (McGinn, Staff)
   MWF 1:15 Section Th

5. Human Values and Technological Society—Analysis and assessment of the status of perennial human values in contemporary Western society; the complex network of factors affecting this status; its bearing on the quality and fabric of human life today. A broad spectrum of such values will be considered in this connection: moral and aesthetic, individual and social, material and spiritual. Topics covered include: alternate value systems and their relations to contemporary technological society; cultural trends and contemporary social structure; human costs and benefits of economic growth; character and quality of interpersonal relations in technological society; analysis of selected institutions and developments characteristic of technological society with a view toward illuminating their underlying philosophical principles and values. Readings drawn from: Nietzsche, Kafka, Rilke, Nin, Thoreau, Zolla, Marx, Mishan, Bell, Boulding, Reiff, and Grant.

   4 units, Aut (McGinn) MW 10;
   Section Th 3:15–5:05 or 7:15–9:05
6. Technology: Its Nature and Socio-Cultural Impact — The nature of technology; the concerns, perspectives, and methods of approach of technology contrasted with those of the humanities and social sciences; technology as a “constraint” on culture; technology and symbolic forms; costs and benefits of some socio-technological systems; ethnological and historical perspectives on technology; technology, aesthetics and the creative process; the functions and development of technologies in the modern industrial state; old, growing, and new technologies; technological scale-effects and support systems; technology and ecology; the nature of decision-making processes; emerging technological planning mechanisms; introduction to the analysis and assessment of socio-technological systems (e.g., automobile, land use, etc.).

4 units, Win (Kline) MW10; Section Th 9:00–10:50 or 2:15–4:05

7. The Political Management of Technological Society — Analysis and assessment of the role of politics in determining socio-technical outcomes; paradigms for analyzing the politics of socio-technical change; the politics of military and political applications of technology as well as those of economic production and social services; the nature and improvement of the process of forming public policy on these technological issues; the comparative politics of technology in primitive hunting bands, traditional agrarian empires, and modern industrial states; examination of the political history of several technologies central to “developed” society, e.g., elaborately armed men and vehicles, “high-technology” industry and agriculture, and capital-intensive urban infrastructure and social services; analysis of public policy in each of these areas illustrating both the political dimensions of alternative solutions and alternative interpretations of how political management occurs; likely case studies include the Cuban missile crisis and the Vietnam war, the politics of oil and the “green revolution,” mass transit and medicare and the political technology of coups d’état and mass revolutions.

4 units, Spr (Winckler) MWF 9, 1-hour section Th

ADDITIONAL COURSES

100. Models and Modeling: Representations of Reality — Human thought and action are often guided not so much by reality as by simple representations thereof, known as models. Appropriate models vary in nature, validity, and utility from one discipline to another. The course examines this thesis by scrutinizing as wide a variety of models as possible: from humanities, from social sciences, from physical sciences and technology. [The use of mathematics will be kept consonant with the class background.]

3 units, Spr (Tuttle) MW 2:15–4:05

121. Technology and Society: How Did We Get Here? — To understand where we are and decide intelligently which way we want to go, we need to know how we got here. This lecture-discussion course in the social history of technology examines the origins of contemporary industrialized civilization by surveying the interplay of technological change and societal development from ancient times until the beginning of the twentieth century. The course, especially the discussion, is built on carefully chosen readings from the history of technology and from associated social and economic history. The lectures, illustrated by slides, serve to supplement and extend the readings. 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 9, Th 9:00–10:50 or 2:15–4:05

122. Contemporary Technological Society — The nature, uniqueness, and significance of contemporary technological society. Topics covered include: technology and human behavior; technology, ecology, and new ethics for survival; technology and the fabric of the social life-world; technique and “being human”; the structure of technological society; technology and the transformation of culture; the future of technological society. Readings include works of Ellul, Habermas, Thompson, Hardin, Mailer, DuBos, Bell, Heilbroner, etc. Seminar: enrollment limited to 25.

4 units, Win (McGinn) TTh 3:15–5:05, given 1974–75

125. Case Study in Socio-Technological History — This seminar (enrollment limited to 12) is devoted to an in-depth study of some historical case in the interaction of technology and society. For 1973–74 the class will examine English industrial cities of the early 19th century, where sudden
growth gave rise to interrelated social, technological, and political problems not unlike those today. Members will do research papers on different aspects of the topic (technological, social, political, economic, biographical, etc.); these will be discussed as they develop and finally be coordinated and assembled as chapters in a monograph. Prerequisite: 121 or consent of instructor.

4 units, Win(Vincenti) MTh 2:15–4:05

131. The Professions—Study of the professions in contemporary technological society. Topics covered include: moral conflict and professional activity; social responsibility; conflicts with private life; impact of technological innovation on professional practice; personal satisfaction; role-behavior; professional activism. Through classroom interviews with practicing professional persons and by reading pertinent biographies, autobiographies, and modern novels, students examine the profession they think might befit their talents and fulfill their aspirations.

4 units, Spr(Siegel) MW 2:15–4:05

141. Energy: From Nature to Man—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, its use in solving engineering problems, and to the technical and social 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.)

3 units, Win(Reynolds) MWF 11,
1 to 2 additional units (term project)
by arrangement

142. Information: The Communications Revolution in Contemporary Society—The nature of the communications revolution and its impact on technological society, present and future. Topics covered include: fundamental concepts of communications and information theory; impact of communications technology on education (the future of books, libraries, teaching, etc.), participatory democracy, urban problems, human values (privacy, etc.); cable TV; society as an interactive organism; communications and ecology; communications and the nature of consciousness.

3 units, Aut(Kincheloe) MW 2:15–4:05

144. Materials: Non-Renewable Earth Resources and Man—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 resources; recycle technology and ultimate recycle limits; international mineral trade; perspectives of developed resource-consuming countries and under-developed resource-supplying countries; the economics of conservation; non-renewable resource policy and population policy of the United States: actual and optimum.

3 units, Spr(Bartlett) MWF 11
ginnings of life (extra-uterine conception, cloning, etc.), retardation of aging, and chemical, surgical, and electrical modification of behavior; social dimensions of these issues: legal questions, responsibilities of scientists and physicians, legislation and international regulation, assessment of public resistance to and demand for such techniques; the ethics of experimentation and application, etc.

4 units, Spr (Fenster) MWF 2:15-4:05

153. Ownership, Property, and Environment — Critical examination of possessory rights in land, water, air, and other resources, exploring the interactions of these rights with human values, social relationships, technological change, resource development, and pollution; the efficacy of various socio-political systems in relation to equitable distribution of benefits, efficient management of resources, and ecological viability. “Primitive,” historical, and contemporary examples will be analyzed with particular attention given to future problems and alternatives.

4 units, Aut (Kreiss) TTh 1:15-3:05

160. Scriptorium: Calligraphy and Illumination — A course designed to illustrate 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 course has a considerable craft content, through which the above points are brought out by teaching the foundational and italic hands: the technical and craft aspects of calligraphy and illumination will be supplemented by analysis of some great manuscripts, old and new. All students will be required to produce samples of finished calligraphy for evaluation. Limited to 20 students per quarter.

3 units, Aut, Win (Hutchinson, Minto) W 7:30-9:30 p.m.


3 to 5 units, Aut, Win, Spr (Staff) by arrangement

199. Individual Work.

1 to 5 units, Aut, Win, Spr (Staff) by arrangement
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