## UNIVERSITY CALENDAR

### AUTUMN QUARTER, 1972

| Sept. | 25–26 | Monday–Tuesday | Registration |
| Sept. | 27    | Wednesday      | Instruction begins |
| Sept. | 28    | Thursday       | Conferring of degrees |
| Oct.  | 1     | Sunday         | Matriculation Sunday |
| Oct.  | 17    | Tuesday        | Last day for registration |
| Oct.  | 24    | Tuesday        | Last day for filing advanced degree applications: A.M., M.S., Engineer for April conferral; Ph.D. for June |
| Nov.  | 23–26 | Thursday–Sunday| Thanksgiving Recess |
| Dec.  | 1     | Friday         | Last day for filing A.B. and B.S. applications for January conferral |
| Dec.  | 11    | Monday         | Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations |
| Dec.  | 11–15 | Monday–Friday  | End-quarter examinations |

### WINTER QUARTER, 1973

| Jan.  | 3     | Wednesday     | Registration |
| Jan.  | 4     | Thursday      | Instruction begins |
| Jan.  | 4     | Thursday      | Conferring of degrees |
| Jan.  | 13    | Saturday      | Last day for filing Fellowship and Graduate Scholarship applications |
| Jan.  | 24    | Wednesday     | Last day for registration |
| Jan.  | 31    | Wednesday     | Last day for filing A.B. and B.S. applications for April and June conferral |
| Jan.  | 31    | Wednesday     | Last day for filing advanced degree applications: A.M., M.S., Engineer for June conferral; Ph.D. for September |
| Feb.  | 19    | Monday        | Observance of Washington's Birthday (Holiday) |
| March | 11    | Sunday        | Observance of Founders' Day |
| March | 19    | Monday        | Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations |
| March | 19–23 | Monday–Friday | End-quarter examinations |

### SPRING QUARTER, 1973

| April | 2     | Monday      | Registration |
| April | 3     | Tuesday     | Instruction begins |
| April | 5     | Thursday    | Conferring of degrees |
| April | 20    | Friday      | Last day for filing Undergraduate Scholarship applications, matriculated undergraduates |
| April | 23    | Monday      | Last day for registration |
| April | 30    | Monday      | Last day for filing advanced degree applications: A.M., M.S., Engineer for September conferral; Ph.D. for January |
| May   | 21    | Monday      | Last day for filing Ph.D. Dissertations |
| May   | 28    | Monday      | Observance of Memorial Day (Holiday) |
| June  | 7     | Thursday    | Last day for filing A.M., M.S., Engineer theses |
| June  | 8–13  | Friday–Wednesday | End-quarter examinations |
| June  | 16    | Saturday    | Senior Class Day |
| June  | 17    | Sunday      | Commencement |

### SUMMER QUARTER, 1973

| June  | 25    | Monday     | Registration |
| June  | 26    | Tuesday    | Instruction begins |
| July  | 4     | Wednesday  | Independence Day (Holiday) |
| Aug.  | 17–18 | Friday–Saturday | Eight-week term examinations |
| Aug.  | 18    | Saturday   | Eight-week term closes |
| Sept. | 4     | Tuesday    | Quarter closes |
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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**

Undergraduate students at Stanford have opportunities to gain a liberal education and also to engage in specialized study. A liberal education is designed to prepare a citizen worthy of a free society and a free university, and to set the foundations for a lifetime of learning. Specialized study enables the person to take his or her place in a profession or other vocation.

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.

A number of overseas campuses add an especially valuable dimension to undergraduate experience at Stanford. Students gain the maximum benefit from a period of overseas study after preparing to speak the language of the country they will visit.

Although the student is not formally required to participate in extracurricular activities, the University recognizes and endorses the educational value of cultural, recreational, and community service activities. The goal is to encourage the person to cultivate or enhance interests which will continue beyond the university years and which will enrich his or her leisure. The student's attention is called to the value of sports and physical exercise, and to the courses offered by the Men's and Women's Physical Education departments. These courses are offered by specialists in their field and are designed to meet the needs and interests of students. His or her attention is called, also, to the various opportunities offered by the Department of Music: band, orchestra, chorus, choir, and others. The student will find worthwhile opportunities for activities in dance, speech, drama, student government, the Stanford Daily, the yearbook, the campus radio station KZSU, the student-initiated programs of instruction (SCIRE and SWOPSI), the Stanford Quarterly Review, programs of tutoring, etc. The student is advised to seek a balance between purely academic pursuits and other kinds of valuable activity, and is urged to take advantage of the variety of extracurricular activities available on the campus.

**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
DEGREES

met by courses in written composition offered by the English Department or other appropriate courses designated by the Advisory Committee on the Writing Requirement.

Students scoring 4 or 5 on the CEEB advanced placement test in English literature are automatically exempted from the writing requirement. In addition, students whose score on the CEEB achievement test in English composition is 700 or above 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.

**Distribution Requirements** — The 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. This distribution requirement encompasses at least 27 credits in all. With careful planning, a student 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.

**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:

1. Have applied in advance for graduation and who have fulfilled the following requirements. (See deadlines in Time Schedule calendar.)
2. Completed 180 (quarter) units of University work, including 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 last work-in-residence requirement.)
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 of a Bachelor of Science degree, and the holder of a Bachelor of Science degree may apply for candidacy for a Bachelor of Arts degree. Application must be filed prior to entry into the Graduate Division, and the recommendation of the major school or department to be entered is required. A student 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.

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 at Stanford is on a part-time registration, its equivalence to full-time study is determined by tuition payments.

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

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.

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 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 shall be the following Monday. These copies shall 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 is conferred on candidates who have satisfactorily completed not less than two years of study in the major department, presented an acceptable thesis, and fulfilled such other requirements as may be prescribed by the University Committee on Graduate Studies. 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.
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 re-admission 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 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 direction of the Graduate Study Office. A negative microfilm copy of the dissertation will be kept on file by University Microfilms (in Ann Arbor, Michigan), from whom positive microfilm copies may be ordered. When bound, one copy (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.
COURSES of INSTRUCTION
1972–73

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 1973 will be eight weeks in length, except in certain schools which will offer ten-week courses.

This announcement includes, for the Summer Session of 1973, 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 1973.
GRADUATE SCHOOL of BUSINESS

Dean: Arjay Miller
Associate Deans: Robert K. Jaedicke, Samuel A. Pond
Assistant Deans: Paul R. Johnson, William L. Lowe, Gerard M. Peterson, Robert W. Simon, Gary G. Williams

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

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

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

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

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

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

UNDERGRADUATE PROGRAM

Faculty Adviser—A student may enter the School of Earth Sciences when he selects one of the Earth Sciences fields for his major program. Upon entering the School, a student should report to the chairman of his department, who will designate a member of the faculty to act as his adviser. The adviser will aid the student in the selection of courses and will serve as consultant during his 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. As a general requirement for the School, a student’s mean grade in required courses in the fields of mathematics, chemistry, physics, and earth sciences must be C or better.

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 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. Fac-
ulty 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 most outstanding in the country. Many faculty and students of the School of Earth Sciences at Stanford are applying principles of mechanics to the understanding of geologic processes. For example, several people are studying deformation of earth materials by modifying and amplifying concepts already developed to explain plasticity and fracturing of metals. Some are measuring seismic, gravity, magnetic, electrical and thermal properties of rocks as a means of exploring structures and earthquake mechanisms. Others are studying the mechanics of the formation of laccoliths and sills, growth of folds, inception and growth of faults, twinning of plagioclase feldspar, deep crustal faulting, formation of slaty cleavage, flow of slurries in channels, creep of soil, slope stability in fractured rock, and fracturing of granite. The combination of field, theoretical, and experimental work is emphasized in the solution of these problems.

Students in Earth Sciences are strongly urged to take courses in many other departments of the University.

Courses recommended for students interested in mechanics are:

- Geol. 200. Physical Processes of Geology
- Geol. 204. Computer Applications in Earth Sciences
- Geol. 320. Advanced Structural Geology
- Geophys. 326. Mechanisms of Rock Deformation
- Geophys. 327. Experimental Rock Deformation
- Geophys. 328. Theoretical Structural Geology
- Mat. Sci. and Engr. 50. Introductory Science of Materials
- Mat. Sci. and Engr. 238. Fracture of Solids

Opportunities exist to develop laboratories to meet the requirements of new research projects. For example, a high-pressure triaxial chamber and a 120-ton testing machine recently have been designed for experimental rock deformation, and a laboratory for the study of slurry flow has been developed in conjunction with the U.S. Geological Survey, Menlo Park.

**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>4</td>
</tr>
<tr>
<td>Chem. 1, 2.</td>
<td>General Chemistry</td>
<td>8</td>
</tr>
<tr>
<td>Civ. Engr. 170.</td>
<td>Man &amp; 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. 1,2.</td>
<td>Geoscience I, II</td>
<td>10</td>
</tr>
<tr>
<td>Geol. 18A,B.</td>
<td>Framework of Geology</td>
<td>8</td>
</tr>
<tr>
<td>Geol. 100, 101, 102.</td>
<td>Environmental Earth Sciences</td>
<td></td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23 or 41, 42, 43.</td>
<td>Analytical Geometry and Calculus</td>
<td>15</td>
</tr>
<tr>
<td>Physics 21, 23 (or part of 51, 53, 54, 55, 56).</td>
<td>Elementary Physics</td>
<td>8</td>
</tr>
</tbody>
</table>

The following courses will be of interest to students having suitable prerequisites:

- Biol. Sci. 22, 23. Principles of Biology
- Chem. 3. General Chemistry
- Elec. Engr. 292A. Environmental Systems Analysis
- Engr. 161. Engineering Economy
- Food Res. Inst. 135. Population Problems
- Geol. 105. Structural Geology
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 particular interests and objectives, as well as to satisfy fundamental requirements of the program. He may choose one of several subdisciplines within Economic Geology or he may develop, with the advice of his faculty adviser, 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 must select an area of application in geology as for example in rock mechanics, hydrogeology, sedimentation, tectonophysics, or paleontology. The remainder of his 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. 280. Quantitative Exploration Decision Making
- Geol. 107. Introduction to Probability and Statistics in Geology
- Geol. 200. Physical Processes in Geology
- Geol. 204A,B. Computer Applications in Earth Sciences
- Geol. 205. Applications of Probability and Statistics in Geology
- Geol. 487. Seminar in Hydrogeology—Numerical and Other Mathematical Methods in Hydrogeology
- Geophysics 283. Computer Solution to Partial Differential Equations of Geophysics

Applied Earth Sciences

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

Chairman: Fredrick C. Kruger


Associate Professors: Robert W. Bartlett, Ar-
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 Engineering
- Mineral Processing
- Metallurgy
- Mineral Economics
- Resource Management
- 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>
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<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>
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<tr>
<td>Total</td>
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#### DEPARTMENTAL REQUIREMENTS

<table>
<thead>
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<th>Subject</th>
<th>Units</th>
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<tr>
<td>Fundamental</td>
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<tr>
<td>Chem. 4, 5. General Chemistry</td>
<td>8</td>
</tr>
<tr>
<td>Physics 51–56. Engineering Physics</td>
<td>14</td>
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<tr>
<td>Math. 41–43, or 10, 11, 21, 22 and 23.</td>
<td>15</td>
</tr>
<tr>
<td>Orientation</td>
<td></td>
</tr>
<tr>
<td>Geol. 1. Geoscience I or Geol. 18A.</td>
<td></td>
</tr>
<tr>
<td>Framework of Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 121A. Mineralogy and Crystal</td>
<td></td>
</tr>
<tr>
<td>Chemistry or Geol. 284. Engineering Geology</td>
<td>4</td>
</tr>
<tr>
<td>Any 10 units of the following:</td>
<td></td>
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<tr>
<td>A.E.S. 101. Elements of Mining Engineering</td>
<td>3–5</td>
</tr>
<tr>
<td>A.E.S. 105. Extractive Process Metallurgy</td>
<td></td>
</tr>
<tr>
<td>or A.E.S. 150. Introduction to Mineral</td>
<td></td>
</tr>
<tr>
<td>Extraction Processes</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 281A. Introduction to Ore Deposits</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 200. Physical Processes in Geology</td>
<td>5</td>
</tr>
<tr>
<td>Sub Total</td>
<td>80</td>
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</tbody>
</table>

#### ECONOMIC GEOLOGY OPTION

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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<tbody>
<tr>
<td>Geol. 107</td>
<td>Introduction to Probability and Statistics in Geology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 121B</td>
<td>Petrology</td>
<td>4</td>
</tr>
<tr>
<td>Geol. 171</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat. Sci. and Engr. 181. Thermodynamics and Phase Equilibria</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Geol. 220</td>
<td>Optical Mineralogy</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 282</td>
<td>Ore Genesis</td>
<td>3</td>
</tr>
<tr>
<td>Geophys. 190</td>
<td>General Geophysics</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 172</td>
<td>Geological Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 281A</td>
<td>Introduction to Ore Deposits</td>
<td>2</td>
</tr>
<tr>
<td>A.E.S. 281B</td>
<td>Ore Deposits</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 283</td>
<td>Laboratory Study of Opaque Minerals</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 296</td>
<td>Airborne Exploration</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 304</td>
<td>Applied Geomathematics I</td>
<td>5</td>
</tr>
<tr>
<td>Sub Total</td>
<td></td>
<td>40</td>
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<tr>
<td>Electives</td>
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<tr>
<td>Total</td>
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<td>180</td>
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#### MINING ENGINEERING OPTION

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
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</thead>
<tbody>
<tr>
<td>Civil Engr. 180</td>
<td>Elementary Structural Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 245</td>
<td>Advanced Construction Equipment and Methods</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 121B</td>
<td>Petrology</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Indus. Engr. 133. Industrial Accounting</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 118</td>
<td>Mining Methods</td>
<td>2</td>
</tr>
<tr>
<td>A.E.S. 150</td>
<td>Introduction to Mineral Extraction Processes</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 200</td>
<td>Introduction to Rock Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>A.E.S. 219</td>
<td>Mine Exploration</td>
<td>5</td>
</tr>
<tr>
<td>A.E.S. 281A</td>
<td>Introduction to Ore Deposits</td>
<td>4</td>
</tr>
<tr>
<td>A.E.S. 281B</td>
<td>Ore Deposits</td>
<td>3</td>
</tr>
<tr>
<td>Sub Total</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
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<td>180</td>
</tr>
</tbody>
</table>
**Metallurgy Option**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 171, 173, 175, 176. Physical Chemistry</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Engr. 50. Introductory Science of Materials</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 44. Advanced Calculus</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 130. Ordinary Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 203A. Mineral Processing</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 207. Metal Refining Processes, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.E.S. 225. Surfaces and Interfaces, or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.E.S. 227. Applied Aqueous Thermodynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 233. Rate Processes in Chemical Metallurgy</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Sub Total .............................................. 40
Electives ............................................ 60
Total .................................................. 180

**Graduate Programs of Study**

The Department of Applied Earth Sciences offers graduate programs to prepare students for responsible supervisory, research, and executive positions in the mining and metallurgical industries, or for governmental work or education. Meaningful interdisciplinary programs aimed at meeting career objectives are encouraged. These programs lead to the advanced degrees of Master of Science, Engineer, and Doctor of Philosophy. As the requirements for adequate training in mineral engineering are unusually broad, the Department of Applied Earth Sciences recommends at least one year of graduate study.

Because the majority of our graduates seek industrial employment, these programs are designed to carry forward training in basic sciences, engineering, or business. Emphasis is often placed on business courses in order to overcome the deficiencies which handicap most engineers in qualifying for executive status. Candidates for the Master of Science and Engineer degrees are encouraged to take a portion of their credits in the Graduate School of Business.

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.

**Master of Science**

Candidates for the degree of Master of Science in Applied Earth Sciences may emphasize either research or management. The degree is normally awarded on completion of the specific requirements listed below. The curricula are recommended; modifications are possible upon approval of a written proposal from the student.

**Specific Requirements**

1. Candidates must be registered in the Graduate School for at least three quarters. They must complete at least 45 units of course work; at least six but no more than 24 units must represent independent work on a comprehensive project or research program culminating in a written report or thesis.

2. Overcome important deficiencies in previous training. Not more than 10 units of such work may be counted as part of the minimum total of 45 units.

3. Candidates must successfully complete one core curriculum from Group A below and one of the options, either research or management, from Group B.

**Curricula Recommended for the Master's Degree**

**GROUP A**

**Economic Geology Option**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 300. Advanced Work</td>
<td>6</td>
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<tr>
<td>Electives from following list</td>
<td>24</td>
<td></td>
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<tr>
<td>Total .............................................. 30</td>
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</tr>
<tr>
<td>Geol. 205. Applications of Probability and Statistics in Geology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geol. 235. Geomorphology and Photogeology</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geol. 262. Ore Genesis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geophys. 190. General Geophysics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geophys. 191. Geophysical Field Techniques</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 215. Mine Economics</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 219. Mine Exploration</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 230. Case Histories</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 231. Valuation of Mineral Properties</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 281A. Introduction to Ore Deposits</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 281B. Ore Deposits</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 295. Structural Setting of Major Mining Districts</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 296. Airborne Exploration-Radar</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 297. Airborne Exploration-Infrared</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 304. Applied Geomathematics I</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 383. Studies of Metallic Ores</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 387. Resource Management</td>
<td>2</td>
<td></td>
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</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. Advanced Work</td>
<td>6</td>
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<tr>
<td>Electives from following list</td>
<td>24</td>
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<tr>
<td>Total .............................................. 30</td>
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</table>
Geol. 205. Applications of Probability and Statistics in Geology 3
Geophys. 190. General Geophysics 3
Geophys. 191. Geophysical Field Techniques 4
Pet. Engr. 150A,B,C. Formation Evaluation 8
A.E.S. 296. Airborne Exploration-Radar 3-4
A.E.S. 297. Airborne Exploration-Infrared 3-4
A.E.S. 304. Applied Geomathematics I 5
A.E.S. 388. Offshore Exploration Seminar 2
A.E.S. 390. Geology of Energy Sources 3-4

**Mining Engineering 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. 200. Introduction to Rock Mechanics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 230. Case Histories</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 231. Valuation of Mineral Properties</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 300. Advanced Work</td>
<td>6</td>
<td></td>
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**Mineral Economics Option**

<table>
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<th>Subject</th>
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</thead>
<tbody>
<tr>
<td>A.E.S. 230. Case Histories</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 231. Valuation of Mineral Properties</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 300. Advanced Work</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 287. Minerals, Politics, and Economics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 387. Resource Management</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Electives from following list</td>
<td>8-10</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
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</tr>
</tbody>
</table>

**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. Mineral Processing</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 207. Metal Refining Processes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 228. Extractive Metallurgy Seminar</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>A.E.S. 233, 234. Rate Processes in Chemical Metallurgy I and II</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Approved technical electives: A.E.S. 201, 203B, 206, 207, 215, 222, 225, 226, 227, 229, 236, 383</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
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</tbody>
</table>

**Environmental Earth Sciences Option**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.E.S. 300. Advanced Work</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Electives (See * below)</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Individual environmental programs may be developed to meet the needs and career objectives of students. Special programs might 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 are available in the School of Earth Sciences and other Schools of the University.

**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 of courses including original research. These courses should amplify the academic base from which research is done and provide experience with the practice and techniques of research.

**Management Option**

Select a minimum of 15 units from the following courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus. 200-01. Business Economics</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Bus. 210-11. Management Accounting or Bus. 410 or Indus. Engr. 133. Industrial Accounting</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Bus. 270. Organizational Behavior or Indus. Engr. 100. Industrial Organizations</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>Indus. Engr. 229. Engineering Economy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Engr.-Econ. Sys. 231A. Decision Analysis</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td></td>
</tr>
</tbody>
</table>

**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 coursework, 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 the University Committee on the Graduate Division.

**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>Graduate School of Business Courses</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* In addition to requirements for the Master's degree.
Comp. Sci. 136. Use of Automatic Digital Computers 3
Indus. Engr. 229. Engineering Economy 2
Indus. Engr. 230. Advanced Engineering Economy 3
Indus. Engr. 252. Operations Research 4
A.E.S. 300. Advanced Work (Thesis) 10
Stat. 110. Statistical Methods in Engineering 4
Electives 16

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is awarded upon completion of the general University requirements.

The Department requires a foreign language useful in research. The candidate for the Ph.D. may satisfy the foreign language requirement by one of the following: (1) passing a 10 level language course with a grade of B, (2) passing an examination administered by the language department, or (3) presenting evidence of having passed an equivalent language requirement at another university. A foreign student whose native language may be useful in research may satisfy the requirement with English as his “foreign language.” The language requirement must be satisfied before the written and oral examinations.

Prior to applying for admission to candidacy the student must demonstrate mastery of his option and related subjects by passing a qualifying examination usually taken during the first year of residence, and developing and demonstrating his ability to plan and execute research problems by successful treatment of assigned projects while enrolled for a minimum of two units in course Applied Earth Sciences 300. Candidates who take a Master of Science degree at Stanford may use their six-unit research requirements for the latter purpose.

UNDERGRADUATE COURSES

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

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


3 to 5 units, Aut (Kruger) MWF 8

105. Extractive Process Metallurgy—Introduction to the thermodynamics, and fundamentals of the processes used in the production and refining of metals. May be taken as an introduction to metallurgical thermodynamics by enrolling for 2 units. Prerequisite: Chemistry 5.

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.

2 to 3 units, Aut (Parlee) by arrangement

107. Introduction to Probability and Statistics in Geology—(Enroll in Geology 107.) Prerequisite: concurrent registration in Mathematics 22 or 42.

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 1972–73

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.) Prerequisites: 1, 121A, Chemistry 3 or 5. Geology 121A may be taken concurrently.

3 units, Aut (Krauskopf, Parks) MWF 9

172. Geological Thermodynamics—Empirical thermodynamics applied to geological problems. The derivation and use of thermodynamic equations and concepts. The relationships between measured quantities and the thermodynamic generalizations. Topics in equilibrium, phase rule, chemical potential, homogeneous equilibria, heterogeneous equilibria. Prerequisite: 171 or Chemistry 171 or consent of instructor.

3 units, Win (Dickson) MWF 9
180. Field or Laboratory Study and Report in Mining or Metallurgical Engineering.
1 to 2 units, Aut, Win, Spr (Staff) by arrangement

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

200. Introduction to Rock Mechanics—Application of rock mechanics and soil mechanics to the design of underground openings and of excavations. Prerequisites: calculus, and Geology 200 or Applied Mechanics 202A.
3 units, Win (Johnson) by arrangement, given 1972–73

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 principle in preliminary process feasibility appraisal. Topics include sizing, solid-liquid separations, and gravity, magnetic, electrical, and flotation methods of solid-solid separation. Prerequisite: graduate standing in the Department or consent of instructor.
3 units, Aut (Parks) by arrangement

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

205. Applications of Probability and Statistics in Geology—(Enroll in Geology 205.)
3 units, Spr (Switzer) TWTh 3:15

206. Metallurgical Separations—Multi-stage separations used in the extraction and purification of metals: solvent extraction, ion exchange, countercurrent decantation leaching, fractional solidification, and zone refining; also electrolytic separations.
3 units, Spr (Bartlett) MWF 9, alternate years, given 1973–74

207. Metal Refining Processes—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.
3 units, Win (Parlee) MTTh 2:15

210. Solution Mining—Metallurgical and fluid engineering aspects of in situ and dump leaching of ores, role of rock fragmentation and permeability, use of nuclear explosives, heat and fluid pressure effects on extraction rates and recovery, extraction from brines.
2 units, Spr (Bartlett) TTh 9, alternate years, given 1972–73

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

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 on aqueous chemical equilibria, emphasizing solubility and sorption on solids, and colloid stability. Independent study, lectures, problems, and discussions. Prerequisite: Chemistry 171 or equivalent. Recommended: 227 and some experience with surface chemistry. (See Chemical Engineering 215.)
3 units, Spr (Parks) 3 lecs. by arrangement, alternate years, given 1972–73

226. Corrosion and Electrometallurgy — (Enroll in Materials Science and Engineering 226.)
3 units, Win (Stevenson) MWF 10, alternate years, given 1972–73

227. Applied Aqueous Thermodynamics—Techniques of predicting probability and extent of heterogeneous chemical reactions including dissolution, precipitation, oxidation, and reduction. Hydrometallurgy and geochemistry are emphasized. Prerequisite: Chemistry 171 or consent of instructor.
3 units, Win (Parks) by arrangement

228. Extractive Metallurgy Seminar—Lectures, student seminars, and report preparation on selected topics in extractive 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.
3 units, Spr (Parlee) by arrangement, alternate years, given 1972–73

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 and discussion.
4 units, Win (Kruger) TTh 8–10

233. Rate Processes — Applied chemical kinetics and diffusion with emphasis on heterogeneous reactions and associated mass transport encountered in chemical metallurgy and geochemistry.
3 units, Aut (Bartlett) MWF 9

234. Rate Processes in Chemical Metallurgy—(Continuation of 233.) 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, Win (Bartlett) MWF 9

235. Geomorphology and Photogeology — (Enroll in Geology 235.)
5 units, Aut (Rich) MWF 10; lab. W 1:15–4:05; field trips by arrangement

236. Metallurgical Systems Engineering Seminar—Metallurgy as a profitable business. The case method is used to study the design of metallurgical processes and plants and related socio-techno-economic problems. Introduction to cost engineering. The approach is heuristic but previous problem solving experience is essential. Recommended prerequisites: 234 and Engineering 161.
3 units, Spr (Bartlett) M 1:15; two hours by arrangement, alternate years, given 1972–73

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

271. Geochemistry — (Enroll in Geology 271.) Prerequisites: 121B and 171, or 1 and Chemistry 171.
3 units, Win (Krauskopf) TTh 9; lab. T 1:15–4:05 or W 1:15–4:05

276A. Field Trip — A ten-day field trip to various mining and metallurgical operations,
including Ruth and McGill, Nevada; Bingham, Garfield, Tintic, Price, Utah. Each student is required to prepare one chapter for the trip guidebook during winter quarter. Transportation provided but living expenses are the student’s responsibility.

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

276B. Field Trip—Similar to 276A except it visits mining and metallurgical operations in California and Arizona, including San Manuel, Ray, Hayden, Pima, Magma, Mission, Eagle Mountain, Boron, Twin Buttes, Lake Shore, and Inspiration.

3 units, Spr vacation (Staff) by arrangement, alternate years, given 1972–73

281A. Introduction to Ore Deposits — The nature, classification, mineral associations, and origin of ore deposits. Lectures on topics in: development of ore genesis theory, magmatic and hydrothermal processes; sources, migration, and deposition of hydrothermal minerals; paragenesis and zoning; surficial processes, including weathering and supergene enrichment. Prerequisites: 121B and 105, or consent of instructor.

2 units, Aut (Williams, Park) TTh 9

281B. 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: 281A or consent of instructor.

4 units, Win (Park, Williams) TTh 10; two labs, 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 (Johns, Remson) TTh 10; field trips and seminars 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) MWF 9

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. 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

295. Structural Setting of Major Mining Districts— In most photogeologic analyses of mineral deposits it is pointed out that the linear elements in the illustrations clearly indicate the geological fabric of the area. It is then often expressed, as an extension from this basis, that the interlocking patchwork of lineaments can lead to the discovery of mineral resources, be they solid minerals or liquid fuels. Examination of the inferred 1:1 correspondence forms the basis for this course, which involves seminar presentation and discussion of the structural environment of mines and mineral deposits. Regional tectonics and the significance of major and minor lineaments, jointing and other rock fabric elements will be integrated to assess the structural setting. Emphasis will be placed on structure at all levels in the definition of 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 and maps, placing emphasis also on aerial photography, etc. Prerequisite: Geology 235 or consent of instructor.

3 units, Win (Lyon) seminar TTh 1:15–3:05, alternate years, given 1973–74
296. Airborne Exploration: Advanced Photogeologic and Radar Techniques—The key to most exploration is a thorough evaluation of geological structure. This course relates advanced photographic and radar interpretation to larger-scale structures, for rapid reconnaissance, as in the initial search for mineral districts. Particular emphasis is placed upon physics (reflectance, scattering, etc.) in understanding the relationship between 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, of film-filter combinations and radar wavelengths will be evaluated. Includes laboratory and field study. Term paper for fourth unit. Prerequisite: Geology 235 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—In a more detailed study of smaller areas (1-10 sq. mi.), as around individual mineral deposits, one must use a sophisticated approach in the evaluation of the complex geological structures. This course relates the thermal behavior of the surface materials to the underlying geology, for detection of faults, folds, and anomalous heat flows, using infrared and microwave measurements. The effect of moisture distribution on the thermal behavior is stressed, and the relationship is used to map the buried faults, and to indicate proximity to ground water, etc. Thermal infrared and microwave response from open water bodies (thermal pollution, ocean current patterns, etc.); seasonal effects of vegetation; cultural patterns (roads, irrigation); and atmospheric effects will be evaluated and their influence on the interpretation demonstrated. Airborne geomagnetics, gamma-ray, and other geophysical measurements in exploration are covered in addition. Includes laboratory and field work with infrared instrumentation, and field evaluation of infrared imagery taken over varying geological materials and structures. Term paper for fourth unit. Prerequisite: Geology 235 or consent of instructor.

3 to 4 units, Win (Lyon) TTh 1:15; lab TTh 2:15-4:05, alternate years, given 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 problem in economic geology, engineering geology, mining, mineral processing, or metallurgy.

Any quarter (Staff) by arrangement

304. Applied Geomathematics I: Computer Applications in Geology and Exploration—Course provides an introduction to the case of computers and mathematical methods in geology and in the exploration and utilization of earth resources. The course provides a brief introduction to FORTRAN IV programming and includes selected topics from elementary statistics, probability, regression, and numerical taxonomy. Emphasis is placed on constructing and using dynamic computer simulation models. Most of the mathematical techniques are developed within the course, but a general degree of mathematical proficiency is assumed. Work in the course consists of problem solving, development of computer programs, and application of existing programs.

5 units, Aut (Harbaugh) MWF 10

305. Applied Geomathematics II: Decision Making in Exploration and Development of Earth Resources—Emphasis is placed on the use of computers and applied mathematics in making economic and scientific decisions in geology and in the exploration and development of earth resources. Topics treated include the use of data storage and retrieval systems, statistical models of mineral occurrence, and the estimation of outcome probabilities that accompany specific search models. Emphasis is placed on the development of integrated sequential decision making systems that incorporate branching probability trees and which involve relevant economic considerations, including taxation, discount rate, expected monetary value, the utility function concept, and government policies. Illustrations are drawn largely from the petroleum industry, but the methods are broadly applicable in all branches of economic geology. Prerequisites: some experience in
5 units, Win (Harbaugh) MWF 10

308. Rock Mechanics and the Design of Underground Structures—Application of theory and laboratory studies, to determination of underground stress fields, to design of underground structures, and design of large open excavations. Prerequisite: 200 or Geology 200, or consent of instructor.
3 units, Spr (Staff or Visiting Professor) by arrangement, alternate years, given 1972–73

371. Geochemistry of Ore Solutions—(Enroll in Geology 371.) Prerequisite: 271 and 282.
2 units, Spr (Krauskopf) by arrangement, alternate years, given 1973–74

372. Organic Geochemistry and the Geochemical Environment of Life—(Enroll in Geology 372.) There are no formal prerequisites although introductory courses in geochemistry and organic chemistry are helpful.
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: 281B 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.
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 1972–73

390. Geology of Energy Sources—Course will also 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 1972–73

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 1972–73

471. Seminar in Geochemistry—(Enroll in Geology 471.)
2 units, Spr (Krauskopf) by arrangement

GEOLOGY

Emeriti: Arthur D. Howard, A. Myra Keen, Charles F. Park, Jr. (Professors)
Chairman: Konrad B. Krauskopf
Associate Chairman: Frank W. Dickson


PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The program leading to the degree of Bachelor of Science in Geology provides a

* Joint appointment with Applied Earth Sciences.
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 50 units. All undergraduate geology majors are expected to complete the core course sequence, regardless of their intended subsequent specialization in geology. The core course sequence is as follows:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpreting the Earth</td>
<td>Aut,Win,Spr</td>
<td>5</td>
</tr>
<tr>
<td>Earth History</td>
<td>Spr</td>
<td>4</td>
</tr>
<tr>
<td>Framework of Geology</td>
<td>Spr</td>
<td>4</td>
</tr>
<tr>
<td>Introduction to Field Geology</td>
<td>Sum</td>
<td>4</td>
</tr>
<tr>
<td>Structural Geology</td>
<td>Spr</td>
<td>5</td>
</tr>
<tr>
<td>Mineralogy and Crystal</td>
<td>Aut</td>
<td>4</td>
</tr>
<tr>
<td>Petrology</td>
<td>Win</td>
<td>4</td>
</tr>
<tr>
<td>Sedimentary Geology</td>
<td>Win</td>
<td>4</td>
</tr>
<tr>
<td>Stratigraphic Geology and Win</td>
<td>Sum</td>
<td>4</td>
</tr>
<tr>
<td>Advanced Field Geology</td>
<td>Spr</td>
<td>5</td>
</tr>
</tbody>
</table>

The core course sequence places emphasis on problem solving, and it provides an early introduction to field geology in Geology 18B which is conducted during a period of about two weeks immediately preceding autumn quarter and would normally be taken just before Geology 121A. A student can enter the core course sequence as early as his freshman year, but entry in the sophomore or junior year is also feasible. If the student enters as late as the beginning of his junior year, however, it is essential that he have completed most of the requirements in mathematics, chemistry, and physics, as well as having taken courses equivalent to Geology 1 and 2, if he is not to be delayed 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 these subjects, his general quantitative ability, and the speed at which he wishes to gain 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 107). 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 41: 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 43: Physics 59 and 60 (Advanced Freshman Physics) 8

Chemistry

1. For the majority of students majoring in geology and with mathematical preparation (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 advisor: Chemistry 1, 2, and 3 (General...
Chemistry for students in chemistry, biology, and medicine).

Maximum possible required units in mathematics, physics, and chemistry 40
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 his 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 commonly exceed the number of elective units available to a student. Thus the following lists of recommended electives should simply be viewed as guidelines in constructing an individual curriculum. Interdisciplinary programs of study are encouraged.

Recommended Electives (Courses considered of special importance are marked with an asterisk.)

Courses

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<th>Qtr. Unit</th>
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<tr>
<td>Geol. 223. Sedimentary Petrology</td>
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<td>Geol. 235. Principles of Geomorphology</td>
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<td>Geophys. 190. General Geophysics</td>
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<td>Geophys. 191. Geophysical Field Techniques</td>
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<tr>
<td>Chem. 171. Physical Chemistry</td>
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<td>Math. 130. Ordinary Differential Equations</td>
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2. For students planning emphasis in sedimentary geology:

A.E.S. 304. Applied Geomathematics I | Aut 5 |
A.E.S. 305. Applied Geomathematics II | Win 5 |
*Geol. 107. Introduction to Probability and Statistics in Geology | Win 3 |
*Geol. 112. Principles of Paleontology | Win 3 |
Geol. 171. Introduction to Geochemistry | Aut 3 |
Geol. 201. Fall Field Geology | Aut 3 |
Geol. 210. Introduction to Marine Geology | Spr 5 |
Geol. 218. Introduction to Micropaleontology | Aut 5 |
*Geol. 220. Optical Mineralogy | Aut 5 |
*Geol. 223. Sedimentary Petrology | Spr 6 |
Geol. 235. Principles of Geomorphology | Aut 5 |
*Geol. 260. Geochronology | Spr 4 |
Geophys. 190. General Geophysics | Aut 3 |

3. For students planning emphasis in theoretical geology:

A.E.S. 304. Applied Geomathematics I | Aut 5 |
A.E.S. 305. Applied Geomathematics II | Win 5 |
*Geol. 107. Introduction to Probability and Statistics in Geology | Win 3 |
*Geol. 171. Introduction to Geochemistry | Aut 3 |
*Geol. 200. Physical Processes of Geology | Aut 5 |
*Geol. 203. Instrumental and Analytical Techniques in Earth Sciences | Aut 1 |
Geol. 205. Applications of Probability and Statistics in Geology | Spr 3 |
Geol. 271. Geochemistry | Win 3 |
*Geophys. 190. General Geophysics | Aut 3 |
Geophys. 250. Geomagnetism | Win 3 |
Geophys. 295. Advanced General Geophysics | Aut 3 |
*Chem. 171. Physical Chemistry | Aut 3 |
*Math. 130. Ordinary Differential Equations | Win 3 |

4. For students planning emphasis in paleontology:

*Geol. 107. Introduction to Probability and Statistics in Geology | Win 3 |
*Geol. 112. Principles of Paleontology | Spr 5 |
Geol. 119. Vertebrates of the Past | Aut 4 |
Geol. 171. Introduction to Geochemistry | Aut 3 |
Geol. 210. Introduction to Marine Geology | Spr 5 |
*Geol. 214. Advanced Invertebrate Paleontology II | Aut 4 |
Geol. 218. Introduction to Micropaleontology | Aut 5 |
*Geol. 260. Geochronology | Spr 4 |
*Biol. Sci. 1. Introductory Biology | Aut 5 |
*Biol. Sci. 102. Invertebrate Biology | Spr 4 |
Biol. Sci. 111H. Marine Invertebrates | Sum 5 |
Biol. Sci. 112H. Marine Invertebrates | Sum 5 |
Biol. Sci. 175H. Problems in Marine Biology | Spr 15 |
Biol. Sci. 222H. Biological Oceanography | Aut 15 |
Courses Qtr. Unit

5. For students planning emphasis in engineering geology:

A.E.S. 200. Introduction to Rock Mechanics Win 3
*A.E.S. 284. Engineering Geology Aut 4
*Geol. 100. Introduction to Environmental Earth Sciences I Win 5
Geol. 171. Introduction to Geochemistry Aut 3
*Geol. 200. Physical Processes of Geology Aut 5
*Geol. 220. Optical Mineralogy Aut 5
Geol. 222. Igneous & Metamorphic Petrology Win 6
Geol. 223. Sedimentary Petrology Spr 6
Geol. 235. Geomorphology and Photogeology Aut 5
*Geol. 285. Hydrogeology Win 5
Geol. 286. Development of Groundwater Resources Spr 3
*Geophys. 190. General Geophysics Aut 3
Geophys. 191. Geophysical Field Techniques Spr 4
Engr. 11. Applied Mechanics: Statics and Stress Analysis Aut, Win, Spr 4
Civil Engr. 114. Mechanics of Materials Aut 4
Civil Engr. 190. Soil Mechanics and Foundations Aut 4

6. For students planning emphasis in economic geology:

A.E.S. 101. Elements of Mining Aut 3 to 5
A.E.S. 200. Introduction to Rock Mechanics Win 3
*A.E.S. 281A. Introduction to Ore Deposits Aut 2
*A.E.S. 281B. Ore Deposits Win 4
*A.E.S. 283. Laboratory Study of Opaque Minerals Win 4
A.E.S. 287. Minerals, Politics, and Economics Win 3
A.E.S. 296. Airborne Exploration Win 3 to 4
A.E.S. 297. Airborne Exploration Spr 3 to 4
A.E.S. 304. Applied Geomatics I Aut 5
A.E.S. 305. Applied Geomatics II Win 5
*Geol. 107. Introduction to Probability and Statistics in Geology Win 3
*Geol. 171. Introduction to Geochemistry Aut 3
*Geol. 220. Optical Mineralogy Geol. 222. Igneous and Metamorphic Petrology Win 6
Geol. 271. Geochemistry Win 3
*Geol. 292. Ore Genesis Spr 3
Geol. 393. Genesis of the Metallic Ores Spr 6
*Geophys. 190. General Geophysics Geophys. 191. Geophysical Field Techniques Aut 3

7. For students planning emphasis in geochemistry:

*Geol. 107. Introduction to Probability and Statistics in Geology Win 3
*Geol. 171. Introduction to Geochemistry Aut 3
*Geol. 271. Geochemistry Geol. 203. Instrumental and Analytical Techniques in Earth Sciences Win 3

Courses Qtr. Unit

Geol. 220. Optical Mineralogy Aut 5
Geol. 222. Igneous and Metamorphic Petrology Win 6
Geol. 223. Sedimentary Petrology Spr 6
*Chem. 111. Quantitative Analysis Spr 3
*Chem. 112. Quantitative Analysis Laboratory Spr 3
Chem. 121. Organic Chemistry Aut 4
*Chem. 171. Physical Chemistry Aut 3

Teaching Credential for Secondary Schools—In cooperation with the School of Education, the Department offers a program leading to a Standard Teaching Credential in Geology for secondary-school earth-science teachers. For details about the program, inquiries should be addressed to the School of Education.

HONORS PROGRAM IN GEOLOGY

The Geology Honors Program is designed to give a limited number of undergraduates with superior scholastic records, interest, and ability the opportunity to undertake independent study and research during their last year or two of undergraduate training. Admission to the program is by invitation of the faculty of the Department of Geology and is contingent upon (a) a minimum grade average of B in all University work, and (b) prior completion of Geology 1, 2, 18A,B, 121A,B, and 105. Entry is possible at any time after the end of the sophomore year. The Honors Program consists of the following:

1. The core courses in geology, mathematics, physics, and chemistry required of all geology majors.
2. Geology 150A,B,C and 6 units of Geology 155.

Details of the program will be determined in consultation with the student's adviser, subject to the approval of the department faculty. Those completing the program satisfactorily will receive the degree of Bachelor of Science in Geology with Honors upon the recommendation of the faculty of the Department of Geology.

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 his eighth quarter of undergraduate work and before the end of his 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.

MASTER OF SCIENCE

Objectives — To round out the student's training for professional work in geology or geochemistry, 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 — For admission to the Graduate Division of the University, the applicant must have taken the Aptitude Test (Verbal and Quantitative) of the Graduate Record Examination. The candidate must fulfill the following requirements:

1. be registered in the graduate school for at least three quarters.
2. complete 45 units, at least 6 of which must be independent work on a research problem. The average of all grades for courses in the School of Earth Sciences must be a B or better. No Geology courses numbered below 100, and not more than 10 units of Geology courses numbered below 200, will be counted toward the required 45 units of work.
3. make up deficiencies in previous training. Previous training should include courses that are approximately equivalent to those of the core curriculum leading to the B.S. degree in Geology at Stanford, plus at least one course in economic geology.
4. Demonstrate in one of the following ways knowledge of basic principles and research methods in the general field of study: (a) By writing a thesis, as may be recommended at the discretion of individual advisers. (b) By preparing a report, ordinarily a term paper written for the 6 units of research, to be submitted to at least two faculty members.

Courses taken for the Master of Science degree must include at least 4 units in each of four of the following fields:

- Biology
- Business
- Chemistry and geochemistry
- Civil and industrial engineering
- Computer science
- Economic geology
- Economics
- Electrical engineering
- Environmental earth sciences
- Exploration
- Geomorphology and photogeology
- Geophysics and structural geology
- Industrial engineering
- Law
- Materials science
- Mathematics and statistics
- Mechanical engineering and applied mechanics
- Mineralogy
- Mineral engineering
- Paleontology and stratigraphy
- Petrography and petrology
- Petroleum engineering
- Physics

These courses must be junior, senior, or graduate courses (courses numbered 100 or higher). The courses must not include seminars or problems courses.

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—For admission to the Graduate Division of the University, the applicant must have taken the Aptitude Test (Verbal and Quantitative) of the Graduate Record Examination. 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.

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. 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 (Compton) MWF 8 lab and field trips by arrangement
Win (Page) MWF 9 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 per week required. Field trips are scheduled in lieu of some laboratory sessions. Enrollment limited to four laboratory sections of 15 students each. Prerequisite: 1.

4 units, Spr (Krauskopf) MWF 9; lab. M 7:00-9:50 p.m.; TTh 1:45-4:05

4A. 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 (——) MTWTh 8

12. Field Seminar—The principal component of this course is a week-long back-pack trip through an area where rocks and earth structures are exceptionally well exposed, as the Grand Canyon. The trip, scheduled for the spring recess, will be followed by approximately two discussion sessions during spring quarter. A brief report on some aspect of the area visited will be prepared during spring quarter. Students who wish to do somewhat more extensive laboratory or library research may register for 3 units rather than 2. Transportation by private cars; trail food purchased as a group (transportation and food cost per student in 1970 was $20 for 7 days). Prerequisites: 1 and consent of instructor.

2 units, Spr (Staff) by arrangement

13. Interrelating Some Earth Processes — A careful look at a small part of the Earth to see how its present condition has been caused by all processes affecting it in the past. The course will start with a local Earth system (perhaps a stream — depending on the class's interest) and then gradually expand to include all its attachments in space and time. The purpose will be to give as thorough a feel for the system as possible and thereby an understanding of its future, including its uses by Man. Methods can include field study, lab measurements, reading, and discussion, as the class judges most useful. Individual and small-group studies will be encouraged. Grades will be based on discussion, presentations to the group, or written reports. Prerequisite: 1 or equivalent. Students who have taken more advanced courses will not be admitted.

4 units, Spr (Compton) T10; other work by arrangement

18A. 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. The interrelationships among observation, experimentation, deductive, and inductive reasoning, and theoretical analysis of actual problems will be stressed throughout the course. Lectures, one four-hour laboratory or field trip per week. No formal prerequisites but 1 and 2 are highly recommended.

4 units, Spr (Jahns and Rich) MWF 9; lab. and field trips by arrangement

18B. Introduction to Field Geology — The scale and complexity of the natural geologic environment present a stimulating challenge to the beginning earth scientist. This course represents a concentrated two-week introduction to the basic problems of geologic investigation in the field. Primary focus is placed on demonstration and practice in methods of systematic observations, recording, and analysis of basic geologic data leading to the production and interpretation of geologic maps. Integration and synthesis of local observations with regional geologic setting are stressed and the course closes with each student preparing a modest independent report on the geologic development of the area studied. The location of the field area will vary from year to year but each selected site is within a geologically well known region exhibiting a diverse suite of rock types, clearly defined structure, and ready accessibility. The course is conducted from a tent camp at one or more localities in the western states. The course is scheduled for the two-week interval immediately
preceding the beginning of Autumn Quarter; details of the schedule and instructor(s) for each year are given in the Summer Sessions Bulletin. Graduate students must obtain permission of the instructor to enroll. Prerequisites: 1, 2 and ISA or equivalent or consent of instructor(s).

4 units, Sum (Staff)

100. Environmental Earth Sciences I—History and problems of urban growth, public and private planning processes, land-use determinants, land evaluation, survey of the natural environment, pollution, computer storage of land data, weather and climate. Principles and methods are applied to field problems in the Peninsula area.

5 units, Aut (Mader, Remson) MWF 11, lab., seminars, and field work by arrangement

101. Environmental Earth Sciences II — Techniques for collecting and analyzing urban data, methods of projecting population and economic data, review of urban land-use systems. Earthquakes, faulting, landslides, erosion, sedimentation, and other geologic environmental effects. Use of topographic and geologic maps in environmental design. Prerequisite: 100 or consent of instructors.

5 units, Win (Dickinson, Mader) MWF 11; lab., seminars and field work by arrangement

102. Environmental Earth Sciences III — Procedures and methods for selecting goals and preparing city and regional plans, programs and methods for implementing urban plans and policies. Environmental aspects of oceans, hydrology, soils, and resource development. Prerequisite: 100, 101 or consent of instructors.

5 units, Spr (Mader, Remson) MWF 11; lab., seminars and field work by arrangement

103. Geologic Problems—Supervised reading, written reports thereon.

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

105. Structural Geology—Study of the nature and origin of folds, faults, structures of metamorphic and plutonic rocks, and deformation of the earth's crust. A portion of the course will examine the mechanics of rock deformation and will apply these principles to the analysis of natural geologic structures.

Prerequisites: 1 and 2. Recommended: 18A and B.

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

107. 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) TWTh 3:15

117. 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, several afternoon coastside field trips, and one all-day shipboard field trip required. A term paper on a marine topic is also required; students are encouraged to complete an independent investigation of a marine problem in the field rather than a library research problem.

4 units, Spr (Ingle) MWF 10; laboratory demonstrations, research conferences, and field trips by arrangement; alternate years, given 1973-74

121A. Mineralogy and Crystal Chemistry—Elementary crystallography and hand specimen mineralogy together with an introduction to the crystal chemistry of the most im-
important rock forming minerals; emphasis is placed on the silicates. The laboratory portion of the course will focus on acquiring basic familiarity with physical properties and diagnostic techniques for recognition of the common rock- and ore-forming minerals. Prerequisites: 1, 18A, 18B and/or Chemistry 1 or 4 (may be taken concurrently).

4 units, Aut (Williams) TTh 1; lab. TTh 1:15–4:05

121B. Petrology—Introduction to the classifications, associations, and genesis of igneous and metamorphic rocks. Topics in silicate equilibria, chemical principles of metamorphism, and fabrics of deformed rocks. Laboratory study of rock-forming minerals, textures, and structures. One or two one-day field trips to local areas that display rocks of special interest. Prerequisite: 121A or consent of instructor.

4 units, Win (Dickson) TTh 10; lab. W 1:15–4:05 plus one lab.
by arrangement

122A. Sedimentary Geology—Study and inquiry into sedimentary and geomorphic processes and the petrology of sedimentary rocks. Topics in silicate equilibria, chemical principles of metamorphism, and fabrics of deformed rocks. Laboratory study of rock-forming minerals, textures, and structures. One or two one-day field trips to local areas that display rocks of special interest. Prerequisite: 121A or consent of instructor.

4 units, Win (Dickinson) TTh 11; lab. TTh 1:15–4:05

122B. 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, 18A and 18B.

4 units, Win (Ing) MWF 11; one three-day field trip is required; additional field trips and research conferences by arrangement

130A,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 section, 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, 18A, 18B, 105, 121A, 121B, and 122A; 122B recommended; or enrollment by consent of instructor(s).

8 units, June 15–July 23 (Staff)

130B. Preparation of comprehensive geologic report on field area studied during 130A; work done on campus.

4 units, July 26–August 11 (Staff)

150A. Honors Seminar in Geology—Directed reading and discussion of fundamental geologic knowledge and theory, recent geologic research, and current geologic problems; oral and written reports. Registration by invitation only.

2 units, Aut (Staff) by arrangement

150B. Honors Seminar in Geology—Continuation of 150A.

2 units, Win (Staff) by arrangement

150C. Honors Seminar in Geology—Continuation of 150A, B.

2 units, Spr (Staff) by arrangement
155. Honors Research in Geology — Independent field and laboratory investigations under faculty supervision; written report. Registration by invitation only.

1 to 6 units, any quarter (Staff) by arrangement

200. Physical Processes of Geology — Field, laboratory, and theoretical studies of physical geologic processes such as intrusion, folding and fracturing, and flow of ice, lava, and debris. Includes application of rheology, mechanics, and boundary conditions to solutions of problems in structural geology, geomorphology, and engineering geology. Prerequisite: Calculus.

5 units, Aut (Johnson) 4 lectures and one lab. per week; research project, field trip, and seminar by arrangement, given 1972-73

201. Fall Field Geology — A course for students wishing to study geological problems by field and laboratory methods. During week-ends 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 130B, and for graduate students in Earth Sciences desiring enhanced training in field geology. Prerequisites: 130B for undergraduates; consent of instructor for graduate students in Earth Science Departments. Generally some experience in the field will be required.

3 units, Aut (Dickson) 1 lecture per week plus several Saturdays in the field

205. 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: 107 or consent of instructor.

3 units, Spr (Switzer) TWTh 3:15

210. Introduction to Marine Geology — General survey of the topography, structure, and geologic history of the ocean basins and submerged continental margins. Review of selected topics in physical oceanography including deepwater and shallow water waves and major current systems. Discussion of marine sedimentary processes, characteristic patterns of sediment distribution, and the interaction between sediments, water, and organisms. Paleooceanographic and paleoclimatologic analysis of deep-sea cores and deep-sea biostratigraphy. Extensive reading from the current scientific literature. An independent and original investigation of a marine problem serves as a basis for a required term paper. Prerequisites: 122A, 122B, or consent of instructor.

5 units, Spr (Ingle) MWF 11; coastal and shipboard field trips and research conferences by arrangement, alternate years, given 1972-73

235. Geomorphology and Photogeology — A general inquiry into the origin and evolution of the landscape coupled with the study of air photos as an aid in geologic interpretations. Stress is placed on the evolutionary development of some principal landform patterns in various climatic regions, on the quantitative geologic and geomorphic interpretation of landforms, and on the dynamic forces and processes that modify the landscape. The basic principles and practices of photogrammetry, necessary to obtain quantitative data from air photos, will be introduced and used to prepare photogeologic maps of specific areas.

5 units, Aut (Rich) MWF 9; lab W 1:15–4:05; field trips by arrangement

285. Hydrogeology — Theory of underground water, analysis of field data and pumping tests, geologic groundwater environments, solution of problems. Prerequisites: Physics 21 or 51, and Mathematics 22. Recommended: 1, 2 and 105.

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

286. Development of Groundwater Resources — Continuation of 285 with emphasis on practical applications. Field techniques used in groundwater surveys and exploration, well development, groundwater law, chemistry of underground waters. Prerequisite: 285.

3 units, Spr (Remson) TTh 11; lab by arrangement, alternate years, given 1972–73
301. Problems in Various Fields of Geology and Geochemistry.
Each quarter (Staff) by arrangement


320. Tectonics—Significant topics of structure and orogenesis. Examination of tectonics on land in relation to ocean floor spreading and rigid plate tectonics. Two lectures and one seminar per week, plus reading and term report. Prerequisite: an introductory course in structural geology.
3 units, Aut (Page) TTh 10; seminar W 4:00-5:30

400. Research in Various Fields of Geology and Geochemistry.
Any quarter (Staff) by arrangement

2 units, any quarter (Remson) by arrangement

MINERALOGY, PETROLOGY, AND GEOCHEMISTRY

171. Introduction to Geochemistry—Application of elementary chemical principles to geologic problems, such as weathering, sedimentation, ore formation, and magmatic differentiation. Introduction to thermodynamic functions and the phase rule. Lecture, discussions, problem sets. Prerequisites: 1, 121A, Chemistry 3 or 5. Geology 121A may be taken concurrently.
3 units, Aut (Krauskopf, Parks) MWF 9

203A. Instrumental and Analytical Techniques in Earth Sciences—An introduction to the apparatus and applications of instrumental and analytic techniques in current use in geologic and mineralogic research. Emphasis on underlying physical and chemical principles, strengths and limitations, not on use of equipment by the individual student. The goal is to develop the background of the student to the point where the appropriate techniques and instruments can be selected with respect to a specific research problem. Topics to be covered include: X-ray diffraction analysis, both single crystal and powder methods; X-ray fluorescence, including electron microprobe; electron microscopy; infra-red spectrometry of rocks and minerals; emission spectroscopy; atomic absorption spectrometry and flame photometry; gravimetric analysis of rocks and minerals; stable and radioactive isotopes.
1 unit, Aut (Luth and others) T 3:15-5:00

203B. Instrumental and Analytical Techniques in Earth Sciences—A continuation of 203A.
1 unit, Win (Luth) by arrangement

220. Optical Mineralogy — (a) Elementary study of optical properties of crystals; emphasis on polarizing microscope as instrument of research. (b) Systematic study of important minerals, their determination by optical methods. Prerequisites: a good course in crystallography and mineralogy and Physics 55, or equivalent.
5 units, Aut (Hutton) TTh 11; lab. TTh 1:15-4:05 and one lab. by arrangement

222. Igneous and Metamorphic Petrology—Interpretation of igneous and metamorphic rocks based largely on features observed with the petrographic microscope. Prerequisites: 121B, 171, and 220.
6 units, Win (Compton) MW10; lab. TTh 1:15-4:05 and one lab. by arrangement

223. Sedimentary Petrology—(Formerly 157 and 207.) Interpretation of sedimentary rocks based largely on features observed with the petrographic microscope. Laboratory work emphasizes volcanioclastic rocks, sandstones, and limestones, but includes lutes, cherts, and phosphorites. Aspects of depositional, diagenetic, and incipient metamorphic mineralogy, texture, and fabric are treated. Auxiliary field work emphasizes bedding styles and paleocurrent indicators characteristic of different environments and mechanisms of sedimentation. Prerequisites: 122A and 220.
6 units, Spr (Dickinson) TTh 9; lab. TTh 1:15-4:05 and one lab. by arrangement

230. Phase Equilibria in Natural Systems I — An introduction to the interpretation, analysis, and prediction of phase equilibria in binary and ternary systems of interest to Earth Scientists. Primary emphasis is on developing skill in the utilization of the variables pressure, temperature, and composition in the analysis of mineral equilibria. Examples used in the lectures and problems are selected from the literature to illustrate equilibria important in: Igneous Petrology (melting and crystallization in the crust and
mantle); Metamorphic Petrology (subsolidus reactions involving hydrous phases and systems with more than one volatile component); and Sulfide Petrology (sulfide systems and sulfide-water systems). The goal is to provide sufficient background information so that the student will be able to interpret and utilize current literature.

3 units, Aut (Luth) by arrangement

231. Laboratory Studies in Phase Equilibria — Independent study on individual projects involving experimental determination of mineral equilibria in natural and synthetic systems at high pressure and temperature. Prerequisites: 230 and consent of instructor.

1 to 5 units, Win (Luth) by arrangement

232. Phase Equilibria in Natural Systems II — Quaternary and higher order phase equilibria as related to natural systems. Analysis and development of thermodynamic aspects of phase diagrams in terms of volume, entropy, and chemical potential in addition to pressure, temperature, and composition. Emphasis on analysis of dependent and independent variables as used in macroscopic thermodynamics under conditions where pressure and temperature gradients are present. Prerequisite: 231. Recommended: Materials Science 181.

3 units, Spr (Luth) by arrangement

271. Geochemistry — Application of physical chemistry to geologic problems of igneous and metamorphic rocks. Distribution of chemical elements in geologic environments. Prerequisites: 121B and 171, or 1 and Chemistry 171.

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

282. Ore Genesis — The modes of origin of ore and gangue mineral associations. Lectures on: characteristic associations of minerals; chemical factors of ore component transport and mineral deposition; 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

327. Seminar in Igneous Petrology — Analysis of current problems in igneous petrology and closely allied fields, with emphasis on new data and concepts.

2 units, Win (Johns) by arrangement

371. Geochemistry of Ore Solutions — Prerequisite: 271.

2 units, Spr (Krauskopf) by arrangement, alternate years, given 1973–74

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

2 units, Spr (Kvenvolden) by arrangement

471. Seminar in Geochemistry.

2 units, Spr (Krauskopf) by arrangement

PALEONTOLOGY AND STRATIGRAPHY

111. 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, Spr (Evitt) MWF 11

112. 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. Prerequisites: 2 or consent of instructor.

5 units, Win (Evitt) MWF 10; lab. W 1:15-4:05 and one lab. by arrangement, given 1974

115. Introduction to Biological Oceanography — Readings and lectures on marine orga-
nisms, their ecology, relationships, and geographic distribution, and a survey of current methods and facilities for study. A term paper is required. Prerequisites: one year Biology or one year Geology (or equivalent).

3 units, Spr (Staff) MWF 10; field trips by arrangement

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

4 units, Aut (Evitt) MTWTh 11

214. Advanced Invertebrate Paleontology—Significant topics on morphology, taxonomy, and distribution of invertebrate fossils. Prerequisite: 112.

4 units, Aut (Silberling, Staff) lectures, seminar, and lab. by arrangement, alternate years, given 1973–74

216. 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: 112 or consent of instructor.

5 units, Win (Evitt) 3 lec. and 2 labs. by arrangement, alternate years, given 1972–73

218. Introduction to Micropaleontology—Study of microscopic marine fossils including diatoms, ostracods, and radiolarians with emphasis on foraminiferans. 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. Prerequisites: 122B with 112 highly recommended.

5 units, Aut (Ingle) TTh 9; two lab. discussion periods by arrangement, alternate years, given 1973

260. Geochronology — General review of paleontologic, radiometric, and paleomagnetic methods of dating and correlation with emphasis on stratigraphic applications. Consideration of basic assumptions, utility, and resolution of techniques based on different groups of fossil organisms and on physical and chemical approaches as applied to different parts of the geologic record. Prerequisite: 122.

4 units, Spr (Silberling) MWF 9, given alternate years

317. Stratigraphic Palynology—Detailed laboratory study of assemblages of microfossils smaller than 200 micra from Cambrian and younger strata, supplemented with lectures and discussions. Prerequisite: 216.

Spr (Evitt) units and hours by arrangement, alternate years, given 1972–73

GEOPHYSICS

Chairman: George A. Thompson

Professors: Allan V. Cox, Robert L. Kovach, Ronald J. P. Lyon, George A. Thompson

Associate Professors: Jon F. Claerbout (on leave 1972–73)

Assistant Professor: Amos M. Nur. Visiting: David M. Boore

Research Associate: Richard J. Blakely

OFFERINGS AND FACILITIES

Geophysics is the branch of earth science concerned with exploration of the earth and its history by physical measurements. The undergraduate and graduate programs are designed to provide (1) the background of fundamentals necessary to the study of geophysics and (2) course work in geophysics to coordinate and organize the required background with the principles of geophysics. The four-year undergraduate program leads to the degree of Bachelor of Science. The objectives of the graduate program are to prepare students for positions in the exploration industry, geophysical research programs, governmental work, and education. The Department of Geophysics is housed in the Ruth Wattis Mitchell Earth Sciences Building and the Henry Salvatori Laboratory of Geophysics. The Department has a number of research facilities among which are a seismic observatory, a rock-magnetism laboratory, time-sharing computer facilities,
a 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 his 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>Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 1, 2, 3 or 4, 5. General</td>
<td>Aut,Win, 8 or 9</td>
<td>13 or 18</td>
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<td>Chemistry</td>
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<td>Spr 8</td>
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<tr>
<td>Math. 10, 11, 22, 23 and 44 or 41, 42, 43 and 44. Analytical Geometry and Calculus</td>
<td>Any 18</td>
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<tr>
<td>Math. 130. Ordinary Differential Equations</td>
<td>Aut or Win 3</td>
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<tr>
<td>Geology 121A. Mineralogy and Crystal Chemistry</td>
<td>Aut 4</td>
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<tr>
<td>Geology 121B. Petrology</td>
<td>Win 4</td>
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<tr>
<td>Geophysics 185 (A, B, C, D, or E)</td>
<td>Aut, Win, Spr 6</td>
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<tr>
<td>Geophysics 190. Elementary Geophysics</td>
<td>Aut 4</td>
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<tr>
<td>Physics 51, 53, 54, 55 and 56. Elementary Physics</td>
<td>Win, Spr, Aut 14</td>
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<tr>
<td>Physics 100, 111. Mechanics</td>
<td>Win, Spr 6</td>
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<tr>
<td>Physics 120. Electricity and Magnetism</td>
<td>Aut 3</td>
<td></td>
<td></td>
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<tr>
<td>Geology 18A. Framework of Geology</td>
<td>Spr 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geology 130A, 130B.* Advanced Field Geology</td>
<td>Sum 12</td>
<td></td>
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</tr>
</tbody>
</table>

* A student who takes 130A and 130B during the summer following his junior year will normally graduate at the end of winter quarter in his senior year.

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.

**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.

**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 Sol-
ids, 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. He must pass the Departmental qualifying examination. He must fulfill the requirements of the minor department, if a minor is elected. He must pass the University oral examination, which is essentially a defense of the dissertation problem. He 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 and the University oral examinations. They will be given an additional one year in which to submit their dissertations.

COURSES

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 world wide distribution of earthquakes and volcanoes; how to determine the magnitude, energy, location, and depth of earthquakes; earthquake prediction. Prerequisites: Mathematics 41 or 11, and enrollment in Mathematics 42 or 21.

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


3 units, Aut (Cox) MWF 8

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

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

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

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

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

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

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

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

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

4 units, Spr (Kovach, Thompson, Lyon) 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, Win (Kovach) MWF 10

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


3 units, Aut (Boore) MWF 9

271. Wave Propagation — Basic concepts: equations, wave motion, polarization, energy, intensity. Representation theorems, dislocation-body force equivalences. Reflection, 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: consent of instructor.

3 units, Win (Boore) MWF 9

272. The 1906 San Francisco Earthquake—The study of past earthquakes provides valuable insight into what to expect from future shocks. This seminar will use as a text the classic report published by the Carnegie Institute. This report contains much information not only of historical interest, but also of current relevance.

2 units, Spr (Boore) by arrangement

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) given 1973–74

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) given 1973–74

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 non-linear 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) MWF10, alternate years, given 1972–73

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

326. Tectonophysics I — Theories of elasticity, viscoelasticity, friction and fracture as related to geophysical processes. Applications to crustal and mantle deformations, faulting, earthquakes and creep problems, as well as mechanical behavior of rocks. Special emphasis on current problems, such as mechanics of plate tectonics. Prerequisites: calculus, differential equations.

3 units, Win (Nur) MWF11

327. Tectonophysics II — Transport theories and related phenomena in geophysical processes. Fluid, electrical, and thermal flow in rocks, with particular emphasis on the mechanics of fluid flow in porous, deformable solids. Discussion of effective stress laws, dilatancy, and role of fluids in earthquakes, aftershocks, creep, and time dependent strain in the crust. Application to earthquake prediction and fault studies. Prerequisite: Geophysics 326.

3 units, Spr (Nur), T10; Th 10–12

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

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

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

PETROLEUM ENGINEERING

Emeritus: Frederick G. Tickell (Professor)  
Chairman: Frank G. Miller

Professors: Sullivan S. Marsden, Jr., Frank G. Miller, Henry J. Ramey, Jr. (on leave 1972–73)

Associate Professor: William E. Brigham

Assistant Professor: Acting: Rajagopal Raghavan

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.

Laboratory Facilities

The Department occupies the Lloyd Noble Petroleum Engineering Building devoted 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 are also located in the Mitchell Building.

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.

Courses Taken by All 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>General Chemistry (Quantitative Treatment)</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>
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<tr>
<td>Comp. Sci. 106</td>
<td>Introduction to Computer Science</td>
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<tr>
<td>Math. 10, 11, 21, 22, 23, 44</td>
<td>Analytical Geometry and Calculus</td>
<td>18</td>
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<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations or Statistics</td>
<td>110</td>
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<tr>
<td>English 1, 2</td>
<td>Freshman English</td>
<td>6</td>
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<tr>
<td>Physics 51, 53, 55</td>
<td>Mechanics, Sound, Electricity, Light, and Heat</td>
<td>12</td>
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<td>Physics 54, 56</td>
<td>Laboratory</td>
<td>2</td>
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<td>Engr. 11</td>
<td>Engineering Mechanics (Statics and Strength of Materials)</td>
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<tr>
<td>Engr. 12</td>
<td>Engineering Mechanics (Dynamics)</td>
<td>4</td>
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<tr>
<td>Engr. 21</td>
<td>Mechanics of Fluids</td>
<td>4</td>
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<tr>
<td>Engr. 32</td>
<td>Introduction to the Thermosciences</td>
<td>3</td>
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<tr>
<td>Engr. 41</td>
<td>Circuits, Electronics, and Electromechanics</td>
<td>4</td>
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<td>Engr. 161</td>
<td>Engineering Economy</td>
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<td>Geol. 1</td>
<td>Geoscience I</td>
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<td>Geol. 2</td>
<td>Geoscience II</td>
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<td>Geol. 105</td>
<td>Structural Geology</td>
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<td>Geol. 121B</td>
<td>Petrology</td>
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<td>Pet.E. 103</td>
<td>A Survey of the Petroleum Industry</td>
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<td>Pet.E. 150A, 150B</td>
<td>Formation Evaluation</td>
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<td>Geophys. 190</td>
<td>General Geophysics</td>
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<td>Geophys. 191</td>
<td>Geophysical Field Techniques</td>
<td>4</td>
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<td>Engr. 102</td>
<td>Optimization</td>
<td>3</td>
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<tr>
<td>Oper. Res. 152</td>
<td>Introduction to Operations Research</td>
<td>3</td>
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<td>Drama 120A</td>
<td>Exposition</td>
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<td>Drama 120C</td>
<td>Discussion</td>
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<td>Drama 132</td>
<td>Group Communication</td>
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<td>Physics 57</td>
<td>Atomic Physics</td>
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<td>Mech. Engr. 230</td>
<td>Heat Transfer</td>
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<td>Free Electives</td>
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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 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 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. 270A</td>
<td>Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270B</td>
<td>Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270C</td>
<td>Oil Reservoir Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Pet.E. 270D</td>
<td>Applications of Computers in Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 272</td>
<td>Advanced Natural Gas Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 274</td>
<td>Introduction to Research Methods</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 275</td>
<td>Fundamentals of Well-Test Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Electives*</td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

Total ........................................ 45

* Electives are to be selected with the approval of the student's adviser.

ENGINEER

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

A minimum of two years (six quarters) of graduate study is required. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. The candidate must complete 90 units of course work, no more than 10 of which may 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 must have a B average in courses given by the School of Earth Sciences. He must prepare a thesis meeting the approval of the supervising instructor and the University Committee of the Graduate Division.

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 (3 ea.)
- Bus. 210–211. Management Accounting (3 ea.)
- Bus. 220–221. Business Finance (3 ea.)
- Bus. 303. Economic Forecasting (4)
- Bus. 321. Investment Management (4)
- Bus. 366. Management Information Systems (4)
- Ind. Eng. 229. Engineering Economy (2)
- Ind. Eng. 230. Capital Budgeting (3)

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)
- Comp. Sci. 237A,B,C. Advanced Numerical Analysis (3 ea.)
- 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)
- Chem. E. 210. Viscous Flow Theory (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. 257. Minerals, Politics and Economics (3)

His record must indicate outstanding scholarship. He must pass the Departmental
qualifying examination. He must fulfill the requirements of the minor department, if a minor is elected. He must pass the University oral examination, which is essentially a defense of the dissertation problem. He 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

**150A. Formation Evaluation**—Lectures, problems. Methods for evaluating commercial significance of rock formations penetrated in exploratory drilling. Drilling muds, core analysis, mud logging, electric logging. Prerequisites: 103 and Physics 53.

3 units, Aut (Raghavan) 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 hydrocarbons; properties of subsurface waters. Prerequisite: 103.

3 units, Aut (Raghavan) MWF 9


3 units, Win (Raghavan) 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, 151A, or 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 or 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 1972–73

**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

**173. Special Topics in Petroleum Engineering**—Lectures, problems. 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 (Raghavan) 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 (——) MWF 10; given every year except 1972–73

Any quarter (Staff) by arrangement


3 units, Aut (Marsden) MWF 1:15


3 units, Win (Brigham) 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, 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) T 9–11 and Th 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, Raghavan) 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, Quinn McNemar, Daniel M. Mendelowitz, Wilbur Schramm, Jesse B. 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: Frank Brunetti, Richard E. Clark, 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. Requirements for degrees and credentials differ even when the candidate is preparing for both at the same time. Candidates may work for a degree only or for a credential only.)

**Degree Credential**

- A.M. Standard Teaching Credential (Secondary)
- Standard Designated Services Credential with a Specialization in Pupil Personnel Services
- Standard Supervision Credential (requires two years of postgraduate education)

**GRADUATE DEGREES**

Students who wish to be candidates for the Ed.D. or Ph.D. degree are urged to write to the Vice-Chairman for Doctoral Programs, Committee for Academic Affairs, School of Education, for full information. 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, Doctoral Study Office, Room 24.

**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 the degree of Master of Arts or Doctor of Philosophy 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 his adviser, to emphasize certain aspects of the work, depending on his special interests and his professional objectives. Each candidate will select faculty advisers relevant to his field of concentration to assist him in planning his program of study and in projecting research plans for his 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
- Curricular and Instructional Studies (with concentrations in any of the following fields:  
  - Art  
  - Elementary Education  
  - Foreign Languages (Second Language Learning)  
  - General Curriculum  
  - Language Arts or English  
  - Mathematics  
  - Music  
  - Physical Education  
  - Science  
  - Social Studies  
- Humanistic Studies:  
  - History of Education  
  - Philosophy of Education  
- Mathematical Methods in Educational Research
- Political and Economic Studies
- Psychological Studies:  
  - Child Development  
  - Counseling Psychology  
  - Educational Psychology
Sociological and Anthropological Studies
Teacher Education

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
- Counseling
- Curriculum and Instruction (with specializations in the following areas: Art, Language Arts or English, Mathematics, Foreign Languages [Second Language Learning], Music, Physical Education, Physical Education with Specialization in Dance, Science, Social Studies, Elementary Education, General Curriculum)
- Early Childhood Education
- 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.

More detailed information about the Master of Arts program 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 the Graduate Division. No thesis is required.

Lists of current advisers, programs of study, and order of procedure 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, English, French and Italian, German, History, Humanities, Linguistics, Mathematics, Physical Sciences, Physics, Political Science, Religious Studies, Slavic, Sociology, Spanish and Portuguese, and Speech and Drama. 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 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 candidate's attending a series of summer quarters.

** 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.
4. A minimum of 45 quarter units of graduate study is required. At least 36 of these units must be completed at Stanford. Transcripts of all academic work previously taken must be submitted to the Master of Arts Secretary in the School of Education, if not already on file.

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 his teaching subject and in professional education or grades in these courses equivalent to those required for his 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 the Graduate Division.

**Residence** — Nine quarters of graduate study (a minimum of 108 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 his 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, approve 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 the Graduate Division. Students working toward this degree in the School of Education are ordinarily preparing for the
direction of research work in public school systems or in specialized institutions, or are preparing to conduct research as faculty members of colleges or universities.

**Residence** — Nine quarters of graduate study (a minimum of 108 units) beyond the baccalaureate degree are required for the doctorate, which must include a minor field of study if the candidate does not hold a 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 the Graduate Division. 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 his program of work for the degree in conference with advisers relevant to his 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 the Graduate Division. 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 his 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 his basic credential authorizes him 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 teaching credentials 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. A brief summary of these credentials follows.

* Stanford does not offer training at this time for the credential in elementary education.
Candidates preparing for the Standard Teaching Credential with a specialization in Secondary School Teaching can also complete requirements for a Master of Arts degree in Education. Consult Master of Arts secretary for information.

This program must be completed in sequence. Candidates may be admitted for any quarter to complete academic requirements or to take supplementary course work, but the formal secondary teaching program begins ONLY in summer quarter of each year. The program consists of four quarters of study at the University and half-time teaching responsibilities as an intern in secondary schools in the vicinity of Stanford from September until June.

1. Eligibility. Graduates in the humanities and sciences, from colleges and universities of recognized standing, with little or no course work in professional education are eligible to apply if they have maintained at least a B- academic average in undergraduate and graduate courses. Because the number of internships is limited, persons meeting minimum requirements are not assured of admission to 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. Personal interviews. A personal interview with the applicant, by a Stanford staff member at the University or in the candidate's locality, is generally required.

5. Notice of admission. Candidates will be notified of their acceptance into the program no later than April 1, 1973. Candidates must reply within two weeks, or no later than April 15.

6. 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.

7. 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.

8. There are miscellaneous tests to be completed at designated times during the program.

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.

STANDARD DESIGNATED SERVICES CREDENTIAL WITH A SPECIALIZATION IN PUPIL PERSONNEL SERVICES

Stanford University is authorized to recommend candidates for the Standard Designated Services Credential with a Specialization in Pupil Personnel Services, which is necessary for certification in counseling.

DESCRIPTION OF THE PROGRAM

The counselor training program is characterized by a self-correcting, individualized systems-based approach to education. The goals of the system are to prepare specialists competent and concerned to prevent as well as remediate human problems.

Currently there are nine integrated subsystems comprising the core of the program: 1. general counseling competencies 2. decision making competencies 3. behavior change competencies 4. research and evaluation competencies 5. group counseling competencies 6. counseling foundations competencies 7. preventive systems design competencies 8. systems change and consultation competencies 9. supervised intervention competencies in campus and field settings

Each sub-system consists of behavior objectives (competencies) and the criteria by which each may be judged. In many sub-systems resources for fulfilling each competency are specified, and the student progresses at a self-managed rate in fulfilling them. Thus, completion of the training program is contingent upon fulfilling the competencies rather than spending a pre-designated amount of time in class. Rapid progress in fulfilling the competencies leads to the opportunity to engage in self-selected activities of interest in close cooperation with the faculty.

Counseling and case conferences are conducted at the Stanford Institute for Behavioral Counseling. Field coordinators who supervise each student's practicum may also participate in the training activities.

Two programs for counseling are available, depending upon the candidate's present or anticipated teaching experience:

1. Candidates who desire to qualify as school counselors and who have had three full-time years of recognized teaching experience in public schools or private schools of equivalent status must obtain a Master's or higher degree in an academic area or in counseling and must satisfactorily complete the following graduate level courses or their equivalent:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educ. 223</td>
<td>Public School Law</td>
<td>3</td>
</tr>
<tr>
<td>Educ. 230</td>
<td>Foundations of Counseling</td>
<td>3</td>
</tr>
<tr>
<td>Educ. 231</td>
<td>Counseling in Groups</td>
<td>3</td>
</tr>
<tr>
<td>Educ. 232</td>
<td>Research in Counseling: Research and Introduction to Systems</td>
<td>2</td>
</tr>
<tr>
<td>Educ. 233</td>
<td>General Counseling Competencies</td>
<td>3</td>
</tr>
<tr>
<td>Educ. 234</td>
<td>Decision Making Competencies</td>
<td>3</td>
</tr>
<tr>
<td>Educ. 235</td>
<td>Decision Making: Evaluation of Information Sources</td>
<td>1</td>
</tr>
</tbody>
</table>
Candidates who desire to qualify as school counselors and who have not had (or will not be able to obtain) three years of recognized full-time teaching experience may qualify for the credential by meeting the following minimum requirements:

a) All the requirements listed under "1."
b) A total of approximately 90 quarter units in graduate level course work to be planned with the adviser and to include preparation in the field of education and other disciplines.

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, D, 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 recruitment. Desirable prerequisite: reading knowledge of a European language other than English.

5 units, Spr (Weiler) M 2:15-4:05 and by arrangement

110. Introduction to Models in Social Science—(Same as Sociology 119 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.

4 units, Aut (March) M 1:15-3:05; sections M10 or 11

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, deal-
ing 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, Staff) W 7–10 p.m. and 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 (Nixon) TWF 9

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 9, alternate years, given 1973–74

160. Introduction to Statistical Methods I—(Enroll in Statistics 160, formerly Statistics 107.) Especially designed as a non-mathematical 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.
4 units, Aut (Switzer) MTWThF 3:15
Spr (—) MTWThF 1:15
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)

177. Physiology of Exercise—Physiological adaptations of the human organism to exercise stress.
3 units, Aut (Ruff) lec. T 8–10; lab. Th 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 units, Aut (Gross) W 7–10 p.m.
4 units, Sum (Gross) MTWTh 1:15 and by arrangement

201. History of Education in the United States—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.) The examination of a specific contemporary institution. (The institution to be considered varies each year.) How does the institution function? What are its problems? What are the alternatives? Ideology, social structure and process, institutionalization and professionalization, normative regulation. In 1973 the course will focus on the social institutions of leisure and play.
4 units, Win (March) MW 8:30–10:00
203X. History of Childhood, Family, and Education—An historical survey examining the changing nature and social meaning of childhood and the family in America. Attention will be paid to understanding the role of schooling in the total pattern of education from the point of view of the child and the family.

3 units, Spr (Staff) MW 11 and one hour by arrangement

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 (Pacheco) W 10-12 and by arrangement

Spr (Thomas) TTh 1:15-3:05

205. Philosophies of Education—The epistemology, axiology, and metaphysics of contemporary philosophies compared for their significance in guiding educational policy and research.

4 units, Aut (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.

3 units, Aut, Win, Spr, Sum (Bock) M 12-2

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. Undergraduates with some background in personality theory or sociological analysis will be accepted. Enrollment limited to fifty, some of whom will be invited to join the advanced seminar (308) for which this course is a prerequisite.

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, Win (Newby) M 4:15-6:05, W 4:15-5:05

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

4 units, Aut (Eisner) MW 4:15-6:05

214. Educational Technology in Developing Countries—(Same as Communication 257.)

3 to 5 units, Spr (McAnany, Staff) by arrangement

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 (Shavelson) by arrangement
Sum (Staff) MTWTh 10 and by arrangement

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), given 1973-74

218. Computer Models of Social Behavior—(Same as Computer Science 127, Political Science 180M, Psychology 154, and Sociology 179.) Models of human behavior in social situations. Particular attention is given to the problems involved in specifying simulation models, determining their properties, and testing them. Enrollment limited to 20. Prerequisites: knowledge of at least one programming language; advanced courses in social science; consent of instructors.

4 units, Spr (Feigenbaum, March)

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

4 units, Win (Eisner) MW 1:15-3:05

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

3 units, Win (Hatton) Th 7-10 p.m.

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, Aut (Hatton) Th 7-10 p.m.

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, Aut (Hatton) Th 7-10 p.m.

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 (Staff) M 7-10 p.m.

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, Mayhew) Th 7-10 p.m.

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

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

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

3 units, Win (Sears) 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 indi-
vidual 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

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 (Zifferblatt) by arrangement

233. General Counseling Competencies — Students are expected to learn and present evidence of competency in listening, responding appropriately to verbal and non-verbal cues, helping clients formulate behavioral objectives and assess evidence of progress.

3 units, Aut (Thoresen, Zifferblatt) by arrangement

234. Decision Making Competencies—Students are expected to learn and present evidence of competency in helping clients learn how to make decisions wisely and in using test information to help generate alternatives and estimate chances of success.

3 units, Win (Staff) by arrangement


1 unit, Spr (Staff) by arrangement


2 units, Aut (Zifferblatt) 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. Coordinated with Education 230–236. Prerequisite: consent of instructor.

4 units, Aut, Win, Spr (Thoresen, Zifferblatt, Staff) by arrangement

239A,B. Observation of Study Skills and Developmental Reading in College, and Directed Teaching of Study Skills and Developmental Reading — Two-quarter practice, to be taken in sequence. Two-hour weekly seminar plus individual conferences with instructor supplement required observation (239A) and directed teaching (239B) of regular college class in developmental reading, study skills. Prerequisite: consent of instructor.

4 units, Aut, Win, Spr (Browning) 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

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 (Grommon) 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 (Olkin) 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, analysis of covariance. Prerequisites: 250B or equivalent and consent of instructor.

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

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). A basic laboratory course designed for majors outside of Psychological Studies with no background in experimental educational psychology, or for first-year Psychological Studies majors with a deficiency in experimental methods. Prerequisite: consent of instructor. Enrollment limited to 20, with preference given to first- and second-year students.

3 units, Aut (Staff) 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. Prerequisites: Statistics 160 or equivalent.

3 to 4 units, Aut (Shavelson) MW 2:15–4:05

255. Human Abilities — (Same as Psychology 155.) The nature, development, and measurement of intellectual abilities. Prerequisites: Psychology 1 and Statistics 160, or equivalent.

3 units, Spr (Cronbach) 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. 3 units, Sum (Eisner) MTWTh 3:15

261B. 2 units, Aut (Eisner) T 4:15–6:05

261C. 2 units, Win (Eisner) T 4:15–6:05

261D.* 1 unit, Spr (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) MTWTh 3:15

262B. 2 units, Aut (Grommon) T 4:15–6:05

262C. 2 units, Win (Grommon) T 4:15–6:05

263A,B,C. Curriculum and Instruction in Secondary School Mathematics — Purposes

* This course requirement may be waived at the discretion of the instructor.
and programs of mathematics in secondary curriculum; teaching materials, methods.

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


264A. 3 units, Sum (Politzer) 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 (Ruff) MTWTh 3:15
266B. 2 units, Aut (Nixon) T 4:15-6:05
266C. 2 units, Win (Nixon) T 4:15-6:05
266D.* 2 units, Spr (Nixon) T 4:15-6:05

267A,C,D. 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 (Bridgham) MTWTh 3:15
267C. 2 units, Win (Bridgham) T 4:15-6:05
267D.* 2 units, Spr (Bridgham) T 4:15-6:05

268A,B,C,D. 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, Win (Gross) T 4:15-6:05
268D.* 2 units Spr (Gross) Th 4:15-6:05

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) by arrangement

282. Linguistics and the Teaching of English—(Same as Linguistics 270.) Linguistic aspects of the problems of teaching English. Attention will be paid to English as a foreign language, standard English for dialect speakers, and English as subject matter for native speakers. Prerequisite: English 208 or Linguistics 267.

3 units, Spr (F. Politzer) MWF 10

283. Spanish Linguistics—(Same as Spanish 190.)

3 units

288. Methods of Teaching French—(Same as French Teacher Training 288.)

3 units, Win (Politzer), alternate years, given 1973-74

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

2 units, Aut (Lohnes) TWTh 11

292. Methods of Teaching Spanish—(Same as Spanish 210.)

2 units, Win (Staff) TTh 11

Sum (Petersen) MTWThF 11

295. Language Laboratory Techniques—(Same as Language Laboratory 215.)

2 units, Spr (Metcalfe) TTh 1:15

Sum (Metcalfe) MTWThF 11 (short term)

298. Practice Teaching in Foreign Languages 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.
4 units, Win (Pacheco) W 7-10 p.m.

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 and by arrangement

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) W 9-11 and by arrangement

303A. Philosophical Analysis of Educational Problems — A topical seminar offering critical analysis of an educational problem. Focus in 1973: 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 bi-lingual and bi-cultural curricula. Special attention will be given to Chicano Studies curricula. Prerequisite: consent of instructor.
4 units, Win (Pacheco) W 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, Aut (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 (Thomas) TTh 2:15-4:05 Spr (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 2:15-4:05

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 units, Spr (Bock) W 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) Th 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. Enrollment will be limited to fifteen, the selection, if necessary, to be made at the first meeting.

3 to 5 units, Spr (Inkeles) TTh 9

310/210. Research Problems in Sociology of Education—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 relationship between social structure and acquisition of behavior. Data and theories on socialization of children into systems (political, educational, religious, economic) will be discussed. Particular attention will be given to social class and ethnic differences in socialization processes and outcomes. Theories of socialization will be reviewed with respect to their implications for socialization of children of minority and other disadvantaged groups. Class will be arranged to accommodate lectures and small group discussion.

3 units, Spr (Hess) 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 (Newby) M 7–9 p.m. and by arrangement

312B. Interaction Processes in Education—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, given 1973–74

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 other students with consent of instructor.

4 units, Spr (Calfee) MWF

318. Advanced Educational Psychology: 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.

4 units, Win (Gage) MW 3:15–5:05, 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.

2 to 3 units, Aut (Sears) TTh

320A,B,C. Advanced Educational Administration—Designed primarily for advanced degree candidates in school administration. Prerequisite: 220 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. Pre-requisite: 221 or equivalent or consent of instructor.

3 units, Spr (Staff) M 7–10 p.m.


4 units, Aut (Kirst) MW 11:00–12:30

323D. 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, Spr (Kirst) MW 11:00–12:30

324. Current Issues in Higher Education—Analysis of historical background, emergent characteristics, and alternate resolutions of principal issues facing colleges and universities.

3 units, Aut (Mayhew) T 3:15–6:05

325A. School Facility Planning—An analysis of principles, methods, and problems in relating educational programs to school facilities, including an assessment of current planning practices at the elementary, secondary, college, and university level. Basic course in relating educational planning to school facilities.

3 units, Aut (MacConnell, Staff) M 7–10 p.m.

325B. School Facility Planning: Educational Specifications—An analysis of conditions and problems involved in school planning for selected metropolitan cities, suburban communities and rural districts. Special emphasis on emerging concepts in education related to school facilities and the role of the educational facilities planner.

3 units, Win (MacConnell, Staff) M 7–10 p.m.


3 units, Spr (MacConnell, 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 and by arrangement

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 and by arrangement

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.

3 units, Spr (Levin) by arrangement

327. Research Seminar on Organizations—(Same as Sociology 213.) Designed for advanced students interested in organizational and administrative problems. Specifically concerned with research design and/or data analysis problems in on-going organizational research. This is a small, special-topic seminar that works directly on research in progress. Basic purpose is to give students a taste of data collection and analysis problems. Each student will be assigned tasks and will write papers dealing with specific problems within the context of the larger research activity. Prerequisite: Fundamentals of Organization Theory (329), Sociology 204 or 105.

4 units, Aut (Baldridge) T 7–10 p.m.

328. Policy Research in the Social Sciences—(Same as Sociology 219.) An analysis of the ways social science can be used to aid in policy decisions, especially in complex organiza-
tions and educational areas. The focus is on the marshalling of social science evidence and research that can be used to make practical policy decisions. Areas of concern include: problem identification and definition; searching for relevant, manipulable variables; gathering research upon which decisions can be made; offering alternative policy recommendations based on the same data; determining political and/or educational consequences of various recommendations. Students will work in teams, each selecting a different area for policy analysis.

4 units, Spr (Baldridge) T 7–10 p.m.

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, Win (Baldridge) MW 9–11 and by arrangement

334. Counseling Center Practicum—Experience in college counseling center operations, including testing and counseling. Placements made through Stanford Counseling and Testing Center. By consent. May be repeated for credit.

2 to 4 units, Aut, Win, Spr (Browning)
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. Consent of instructor required.

1 to 6 units, Aut, Win, Spr (Thoresen, 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 2:15–4:05

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.

3 units, Win (Shaftel) T 7–10 p.m.

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 C&I 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, Spr (Bush) MW 2:15–4:05
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 of the field and on the development of critical skills in reviewing substantive and methodological aspects of current research. For advanced doctoral students in Psychological Studies and other areas. Admission by consent of instructor. 3 units, Win (Shavelson) 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. 3 units, Aut, Win (Elashoff) MWF 1:15, alternate years, given 1972-73

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 (Sears) Th 3:15–5:05

353. Problems in Measurement—(Same as Psychology 249.) 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: 250B and 252, or Psychology 152 and 248, or equivalent. 3 to 4 units, Spr (Cronbach) MW 2:15–4:05, alternate years, given 1972-73

354. Curriculum Evaluation—Functions of evaluation, outcomes to be measured, design of evaluation programs, qualities desired in evaluation instruments. For advanced doctoral students concerned with curriculum research. Prerequisite: consent of instructor. 3 to 4 units, Aut, Win (Cronbach) MW 10–12, alternate years, given 1972-73

355. Instrumentation Workshop — For students developing achievement tests, ability tests, questionnaires, or other instruments. Each student pursues his own project and participates in critical review of the projects of others. Prerequisite: consent of instructor. 1 to 4 units, Aut (Staff) 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

357. Seminar in Physical Education Curriculum — Research in physical education curriculum and instruction. 3 units, Win (Nixon) MWF 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

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 Theory in Art Education — Analyses of current curriculum theories and their application to curriculum construction in art education. 4 units, Sum (Eisner) MW 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

385. The Role of Non-Standard Dialects in Education—Problems of defining standard and non-standard variations of speech. Differences between standard and non-standard dialects with special reference to social dialects in the U.S.A. and Black English. Applicability of foreign language teaching methods in instruction in a second dialect. Non-standard dialects and literacy. Prerequisite: an introductory course in linguistics and/or a course in Methodology of Teaching Language. 3 units, Win (Politzer) M 4:15–6:05 and by arrangement

388. Foreign Language Education and Bilingual Education in the Elementary School
398. Experimental Psychology of Reading — Review of research literature on the reading process, and acquisition of reading. Emphasis on critical evaluation of process research, and on interaction of psychological, linguistic, and educational aspects of reading. Prerequisite: consent of instructor.

3 to 4 units, Spr (Staff) TTh 9

399. 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 1973–74

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

2 units, Sum (Staff) MTWThF 8–10
(June 25–July 6)

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

2 units, Sum (Staff) MTWThF 8–10
(July 9–20)

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) TTh 2:15–3:45, given 1973–74

401B. Seminar in the History of American Education: Urban Education — Research seminar, focusing in 1973 upon urban school systems. Students will write and discuss seminar papers. Prerequisite: 302 (formerly
listed as 401A), 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 programs designed to "improve" educational experiences for students from low-income and minority backgrounds. It involves visits to ongoing programs, interviews with teachers, aides, administrators and others in the field. Members of the seminar will become familiar with various aspects of these programs but will concentrate on one feature, such as methods of evaluation, theoretical rationale for curriculum development, family and community involvement, institutional and organizational effects, etc.

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. Prerequisite: 204 or 205 or consent of instructor.

4 units, Win (Pacheco) W 10-12 and by arrangement
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. Topics may include, but will not be restricted to, the following: the school as a community; social freedom and education; anarchist theories of education; social aims of education.

4 units, Spr (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.

3 units, Aut, Win, Spr (Hess, Sears) W 1:15-3:05

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) W 2:15-4:05


1 to 3 units, Aut, Win, Spr (Hess, Sears) W 1:15-3:05

415. Seminar in Educational Psychology—Topical seminar for advanced students. Admission by consent of instructor.

2 to 4 units, any quarter (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. Prerequisite: 329 or equivalent.

4 units, Aut, Win, Spr (March, 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.

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

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 (Staff) by arrangement

423. 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 1972 examined the 30 volumes of hearings
before the U.S. Senate Select Committee on Equal Educational Opportunity.

3 units, Win (Kirst) by arrangement

424 A, 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 3:15–6:05
424B. 3 units, Spr (Mayhew) T 3:15–6:05

425 A, B, C. Seminar in School Facility Planning—Designed for advanced candidates in school administration. The autumn quarter will be conducted as a seminar; the winter quarter will be devoted to master-planning the school plant; and the spring quarter to the development of educational specifications for the school plant. Prerequisite: 325 or equivalent, or consent of instructor.

425A. 3 units, Aut (MacConnell, Staff) Th 3:15–6:05
425B. 3 units, Win (MacConnell, Staff) Th 3:15–6:05
425C. 3 units, Spr (MacConnell, 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 (Thoresen, Zifferblatt, Staff) T 7:30–9:30 p.m., biweekly

432. Seminar in Student Personnel—A discussion of the development of student personnel in higher education in terms of historical trends, past, present, and future, with particular emphasis on current trends and possible future developments.

3 units, Aut (Mayhew) Th 3:15–6:05

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: 340.

4 units, Spr (Eisner) TTh 3:15–5:05

441 A, B. Doctoral Seminar in General Curriculum—A seminar for doctoral students in General Curriculum emphasizing important issues in practice, research and theory. The seminar will focus on problems of inquiry in the field. Prerequisite: 340 (may be taken concurrently).

3 to 4 units, Aut, Win (Eisner, Walker) T 7–9 p.m.

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 5 units, Win (Shaftel) Th 4:15–6:05 and by arrangement

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

452. 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. Open to all graduate students, and to juniors and seniors with consent of the instructor.

3 to 5 units, Win (Textor) by arrangement

Any quarter (Staff) by arrangement

459. Seminar on Physical Education Issues—Selected issues and problems in physical education.
3 units, Spr (Nixon) MWF 9

462 A, B, C. Seminar in English Education.
462A. History of English as a School Sub-
ject and of the Preparation of Teachers of English.
3 units, Aut (Grommon) by arrangement

462B. Curricular Developments Related to English in the Schools.
3 units, Win (Grommon) by arrangement

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) 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 210 A,B,C.) Discussion of current work in mathematical models, with emphasis on theoretical concepts and problems of data analysis. For advanced students.
1 to 3 units, Aut, Win, Spr (Suppes, Elashoff) 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 (Elashoff, Olkin) by arrangement

494. Seminar in Science Education—Consideration of searchable problems in science education, relevant research, and research strategies which may be applicable. For advanced students.
2 units, 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 searchable problems.

496A. The historical development of social studies education; analysis of the social, curricular, and instructional theories of the various contemporary schools of thought in the social studies.
1 to 4 units, Win (Staff) W 7–10 p.m.

496B. The identification of searchable problems in the social studies and the development of an appropriate design for conducting the research.
1 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
Secretary of the Faculty: To be named.

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. Undergraduate programs in Architecture and Urban Design, and a graduate program in Urban Design, are offered within the Departments of Civil Engineering and Mechanical 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 his 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 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.

The additional science courses should be selected by the student with some consideration of his 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 his program course work selected from a variety of disciplines in order

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 his 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 counted toward 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 his 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

**Course No.** | **Subject** | **Units**
--- | --- | ---
Engr. 11 | Applied Mechanics: Statics and Stress Analysis | 4
Engr. 12 | Applied Mechanics: Dynamics | 4
Engr. 21 | Mechanics of Fluids | 4
Physics 110 | Intermediate Mechanics | 3
Chem. Engr. 140 | Fluid Dynamics | 3
Chem. Engr. 140L | Fluid Dynamics Demonstration Laboratory | 1
Mech. Engr. 33 | Introductory Fluids Engineering | 3

**More advanced courses**

- Appl. Mech. 280A,B | Biochamanics | 3, 3
- Civil Engr. 107 | Mechanics of Fluids | 3
- Civil Engr. 114 | Mechanics of Materials | 4
- Physics 111 | Intermediate Mechanics | 3

### 2. Electromagnetism, Electric Circuits, and Devices

**Course No.** | **Subject** | **Units**
--- | --- | ---
Engr. 41, 41A, 42, 42A | Circuits, Electronics and Electromechanics | 4, 1, 4, 1
Engr. 44 | Basic Electronics | 3

**More advanced courses**

- Elec. Engr. 101 | Circuits I | 3
- Elec. Engr. 141 | Electromagnetic Fundamentals | 3
- Physics 120 | Intermediate Electricity and Magnetism | 3

### 3. Thermodynamics

**Course No.** | **Subject** | **Units**
--- | --- | ---
Engr. 32 | Introduction to the Thermosciences | 3
Physics 170 | Thermodynamics, Kinetic Theory and Statistical Mechanics | 3
Chem. 171 | Physical Chemistry | 3
Mat.Sci. 181 | Thermodynamics and Phase Equilibria | 4

**More advanced courses**

- Chem. Engr. 110 | Equilibrium in Thermodynamic Systems | 3

### 4. Materials Science and Properties

**Course No.** | **Subject** | **Units**
--- | --- | ---
Engr. 50 | Introductory Science of Materials | 3
Mat. Sci. 180 | Atomic Arrangement in Solids | 5
Mech. Engr. 111 | Failure Prevention | 3
More advanced courses
Civil Engr. 118. Materials Engineering  
Mat. Sci. 185. Mechanical Behavior of Solids  
Mat. Sci. 188. Electrical, Optical, and Magnetic Properties of Materials  
Mat. Sci. 190. Polymer Science  
Mat. Sci. 191. Engineering Properties of Polymers  
Mat. Sci. 192. Biomaterials

5. LOGIC AND COMPUTER SYSTEMS
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. 155. 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  
Engr. 185. Industrial Control Systems  
Indus. Engr. 108. Work Design and Measurement
More advanced courses
Engr. 206. Control System Analysis and Design  
Indus. Engr. 160, 184. 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  

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, experimentation, and communication. Analysis is concerned with the formulation and solving of mathematical models, primarily by use of deductive reasoning. Synthesis places emphasis on problem definition, ideation, inductive reasoning, and optimization. Experi-
mentation 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 his 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). The following Interdisciplinary Majors may be accredited under General Engineering: Engineering Science, Resource Strategy, and Product Design.

Stanford also has provided for accreditation of other Interdisciplinary Majors and of Innovative programs: Majors and programs which on careful examination are found to meet the ECPD accreditation criteria will be designated General Engineering. 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 non-accredited 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>
</tbody>
</table>
### Chemical Engineering
- Chem. Engr. 120. Separations Processes
- Chem. Engr. 120L. Separations Processes Demonstration Laboratory
- Chem. Engr. 130. Chemical Kinetics: Theory with Applications to Reactor Design
- Chem. Engr. 140. Fluid Dynamics
- Chem. Engr. 140L. Fluid Dynamics Demonstration Laboratory
- Chem. Engr. 150. Heat and Mass Transfer
- Chem. Engr. 150L. Heat and Mass Transfer Demonstration Laboratory

### Civil Engineering
- C.E. 107. Mechanics of Fluids
- C.E. 114. Mechanics of Materials
- C.E. 130. Transportation
- C.E. 143. Specifications and Contracts
- C.E. 160. Water Resources Engineering
- C.E. 170. Man and His Environment
- C.E. 180. Elementary Structural Analysis
- C.E. 190. Soil Mechanics and Foundations
- C.E. 197. Engineering Synthesis, 4 units, or C.E. 198. Senior Report, 1 unit plus restricted electives in Civil Engineering

### Electrical Engineering
- E.E. 101, 102, 103. Circuits and Networks
- E.E. 111, 112, 113. Electronics
- E.E. 121, 122. Laboratory
- E.E. 141. Electromagnetics and Waves
- E.E. 181. Introduction to Computer Organization, Machine and Assembly Languages
- E.E. 126, 139, or 274 Laboratory or Project
- Restricted Electives (any Elec. Engr. course)

### Industrial Engineering
- I.E. 100. Industrial Organization and Management
- I.E. 108. Work Design and Measurement
- I.E. 120. Quality Control
- I.E. 133. Industrial Accounting
- I.E. 141. Utilization of Computers
- I.E. 160. Analysis of Production Systems
- I.E. 164. Production Engineering Project
- I.E. 199. Senior Seminar
- Engr. 161. Engineering Economy
- Restricted Electives

### Materials Science and Engineering
- Math. 46. Advanced Calculus
- Math. 130, 131. Differential Equations
- Physics 58, 59. Physics Laboratories
- Chem. 173. Physical Chemistry
- M.S. & E. 180. Atomic Arrangements in Solids
- M.S. & E. 181. Thermodynamics and Phase Equilibria
- M.S. & E. 182. Rate Processes in Materials
- M.S. & E. 185. Mechanical Behavior of Solids
- M.S. & E. 188. Electrical, Optical and Magnetic Properties of Materials
- M.S. & E. 188L. Electronic Properties Laboratory
- Restricted Elective (Any course in M.S. & E.)

### Mechanical Engineering
- M.E. 101. Visual Thinking
- M.E. 103. Manufacturing Technology
- M.E. 107. Mechanical Systems
- M.E. 111. Failure Prevention
- M.E. 113. Engineering Design
- M.E. 131A, B.C. Thermosciences
- Engr. 104. Dynamic Response
- M.E. 181. Engineering Vibrations
- Any M.E. course in the 100 or 200 series

### 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
- A.A. 100. Introduction to Aeronautics and Astronautics
- A.A. 131. Experimentation in Aeronautics and Astronautics
- Civil Engr. 114. Mechanics of Materials
- Mech. Engr. 131A. Thermosciences: Thermodynamics
- A.A. 200A. Engineering Analysis of Flight Vehicles
- A.A. 192. Vector Analysis and Cartesian Tensors
- Math. 130. Ordinary Differential Equations
- A.A. 210A. Fundamentals of Compressible Flow
- Restricted Electives

### Engineering Science
- Math. 130, 131 or 45, 46
- Restricted basic-science electives (Math, Physics, etc.)
- Restricted engineering-science electives (Engr. courses)

* A detailed list of suitable courses in each of these two categories is available in the Office of the Dean (it is too lengthy to include here).
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 1 3
* Refer to Mechanical Engineering section of this bulletin for graduate programs in Product Design.

Resource Strategy
Anthro. 131. Comparative Social Systems 5
Civil Engr. 130. Transportation Engineering 3
Civil Engr. 160. Water Resources Engineering 4
Civil Engr. 170. Man and His Environment 3
Econ. 118. Developing Economies 5
Educ. 212. Comparative Education 4
Indus. Engr. 50. Human Values in a Technological Society 3
Indus. Engr. 100. Organizations: Theory and Management 4
Electives approved by adviser 5

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 and Urban Design Programs
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. Undergraduates interested in Urban Design should contact the Design Division for information on possible programs.

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). Special advisers and a brochure to assist students in course planning are available through the Office of the Dean of Engineering.

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 * Write for full brochure from the Dean's Office, School of Engineering.
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. 3. 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 (Staff) — Its prerequisites provide basic engineering background
Biol. 153. The Physiological Basis of Behavior (Kennedy)
Aero. and Astro. 229A. Physiology for Engineers and Scientists
Civ. Engr. 170. Man and his Environment
Indus. Engr. 50. Human Values in a Technological Society

CO-METHOD B.S. AND M.S. DEGREE PROGRAMS IN ENGINEERING

A Stanford undergraduate in the School of Engineering may work simultaneously toward the B.S. and M.S. degrees. The purpose is to permit taking some graduate level courses that apply toward the M.S. degree while still an undergraduate and to defer some undergraduate requirements to what would normally be the M.S. year. Both degrees may be granted simultaneously or at the conclusion of different quarters.

To qualify for both degrees, a student must:
1. apply after the beginning of his eighth quarter and before the end of his eleventh quarter, or during the second quarter before he would normally receive his B.S. degree;
2. include with his application a proposed B.S.-M.S. program of courses;
3. be admitted by the school or department in which he 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 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" program may be addressed to the Dean of Engineering at Stanford or to the above listed colleges. For a description of the four-two program, see the section titled "Master of Science".

**FOREIGN STUDY**

In addition to the regular opportunity available to all Stanford engineering students for study at one of the Stanford overseas campuses, a special opportunity exists whereby engineering students may spend their junior year in residence at the Instituto Tecnologico y de Estudios Superiores de Monterrey in Mexico. The student pursues a regular program of engineering courses, so little if any delay results in graduation. Instruction is in Spanish, so adequate language preparation is needed—either one year of college Spanish or high school equivalent. The student achieves a genuine fluency in a second language, and an opportunity to live in a different cultural setting.

A similar opportunity exists in France, at the Ecole National Superieure de Mécanique of Nantes, to which substantially the same remarks apply.

**GRADUATE ADMISSION**

Application for admission with graduate standing in the School should be made to the Director of 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
- Aerodynamics
- 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
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

CHEMICAL ENGINEERING

Optimization
Newtonian and Non-Newtonian Fluid Mechanics
Hydrodynamic Stability
Chemical Energy Conversion
Applied Chemical Kinetics
Properties of Liquids
Surface Reactivity
Adsorption and Catalysis
Bioengineering

CIVIL ENGINEERING

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 and Space Engineering
Signal Processing Systems
Solid State Devices and Systems
Solid State Phenomena and Materials
Statistical Theory of Communication and Control

ENGINEERING SCIENCE

Bioengineering
Nuclear Engineering
Other interdisciplinary and interdepartmental programs

ENGINEERING-ECONOMIC SYSTEMS

Applied Economics
Decision Analysis
System Analysis
Long Range Planning
Public Decision-Making

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
Thermodynamics  
Heat Transfer  
Fluid Mechanics  
Plasma Gasdynamics  
Engineering Design  
Kinematics, Control Systems  
Product Design  
Nuclear Engineering

OPERATIONS RESEARCH
Applied Probability  
Control Theory, 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 appreciation of their field of study. For example, most departments in the School offer courses concerned with properties of materials, and a student interested in an aspect of materials engineering can often gain appreciable benefit from the related courses given by departments other than his 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.

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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: Donald Baganooff, Daniel B. DeBra, Bruce B. Lusignan

Assistant Professor: John R. Manning

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
SCHOOL OF ENGINEERING

engineering is and what engineers do. Creativity, design, and decision making. Open to any student.

3 units, Aut (Ashley) 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 experiential. Although attendance at all labs is mandatory, participation in individual experiments is optional. Does not fulfill the University Distribution Requirement for Math/Science/Technology. Pass/no credit.

2 units, Aut (Roth) W 1:15-5:05
Win, Spr (Wilde) T 1:15-5:05

7. 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

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: Statics and Stress Analysis — Equilibrium and analysis of stresses and deformations in linearly elastic members under load. Tension and compression, shear, thin-walled pressure vessels, torsion, beams, and moment of inertia of areas. Prerequisites: Mathematics 42 and Physics 51.

4 units, Aut (Mayers) MTWF 9
Win (Staff) MTWF 9
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 43 and Physics 51.

4 units, Aut (Bershader) MTWF 9
Win (Richards) MTWF 9
Spr (Baganoff) MTWF 9
problem session by arrangement

21. Mechanics of Fluids—Physical properties of fluids and their effect on flow behavior; the equations of motion for incompressible ideal flow, including the special case of hydrostatics; energy and momentum principles; the control volume analysis; real fluid effects—laminar and turbulent flows; specific engineering applications. Laboratory exercises. Prerequisite: 12 or consent of instructor.

4 units, Aut (Hsu) MWF 9; lab M or T 1:15-4:05
Win (Franzini) 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. Prerequisite: freshman calculus and physics.

3 units, Aut (Eustis) MWF 8
Win (Reynolds) MWF 8

41, 42. Circuits, Electronics, and Electro-

41. 4 units, Aut (Staff) MWF 9;
    2-hour problem session
    Win (Staff) MWF 10;
    2-hour problem session
    Spr (Staff) MWF 9;
    2-hour problem session

42. 4 units, Win (Staff) MWF 9;
    2-hour problem session
    Spr (Staff) MWF 10;
    2-hour problem session

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

42A. Laboratory II—To accompany 42.
    1 unit, Win, Spr (Staff) 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; digital devices and logic circuits; signal wave-forms and ac circuits; power, small-signal, and feedback amplifiers; integrated circuits; analog computers; modulation; instrumentation. Lectures and laboratory work. Not intended for those who take 41. Prerequisite: calculus.

    4 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, Win, Spr (Staff) MWF

101A,B. Writing Creatively—It is not true that students of engineering and science are poor writers; it is true that many believe that they are, and that self-concept determines behavior. Engineering students do have special perceptual vocabularies and they are encouraged in this course to exercise them in the unfamiliar context of writing as an expressive art form. This perspective is used consistently throughout the course, although a variety of writing forms are explored—not all of which would normally be termed "creative writing." This is a two-quarter course which satisfies the University writing requirement; students will normally remain enrolled for the second quarter. It does not satisfy the University distribution requirement for Math/Science/Technology.

    3 units, Aut, Win (J. Manning) alternate years, given 1973–74

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 (Smith) MWF 11
    Win (Powell) MWF 11


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

155. Industrial Control Systems—A survey of control systems and design techniques for

3 units, SPR (Wilde) MWF 1:15

161. Engineering Economy—Economic decision making for alternative engineering designs. Use of compound interest and depreciation calculations to compare the relative economy of both technical investments and plant operating procedures before and after Federal income taxes. Several methods are employed for analysis of multiple alternatives, simple risk, retirement, replacement, resource allocation, and public works projects. May be taken by freshmen. Recommended for sophomores.

3 units, AUT, Win (Ireson) TTh 10; one hour by arrangement
Spr (Eliassen) 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

175. Radiation Measurements Laboratory—Principles and techniques of radiation detection and measurement: ionization chambers, proportional, Geiger-Muller and scintillation detectors, solid state detectors; statistical analysis of counting; beta and gamma spectrum analysis; radiation safety. Prerequisite: consent of instructor.

3 units, AUT (Staff) lab. one afternoon by arrangement

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

177. Radioactivation Analysis — (Same as Chemistry 145.) The use of radioactivation as a research tool; radioactivation, properties of radioisotopes, sources of irradiations, activation analysis, practices and uses in biology, chemistry, and engineering.

3 units, Win (P. Kruger) TTh 11; one lab. by arrangement

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 COURSE 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

202. Foundations of Optimization—Finding the optimum values of design or operating variables affecting a given economic objective. Classical indirect methods, constrained derivatives, nonlinear and generalized polynomial optimization, direct elimination and climbing techniques.

3 units, Win (Wilde) MWF 11

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, Spr (Staff) 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 linear, quadratic optimization, and multi-variable control. Laboratory experiments. Prerequisite: 105.

3 units, Win (Franklin) TTh II; 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 1972–73

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 proposed 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) one evening per week by arrangement

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)
W 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 under the direction of a faculty member. By consent only.

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

ENGINEERING in BIOLOGY and MEDICINE


Stanford has a great deal of research and teaching related to engineering in biology and medicine, even though it has no department of bioengineering. A brochure is available which lists faculty from many departments whose research and teaching interests may prove helpful to the engineering student interested in approaching the medical and biological sciences in his studies, as well as indicating many of the relevant courses spread across the departments and schools of the University. This brochure can be obtained from the School of Engineering office or from the Chairman of the Committee.

There are ten themes around which such research has become organized: Biomaterials; Biomathematics; Biomechanics; Biophysics; Biostatistics; Design for Medical Applications; Environmental Engineering; Information Processing for Biomedical Systems; Information Processing in Biological Systems; and Integrated Circuits for Medical Electronics. For example, in the Biomechanics program, research is being conducted on cardiovascular mechanics, respiratory mechanics, bone elasticity, mechanical behavior of the vestibular apparatus, and dynamics of the eye. Laboratory facilities are being used at the National Aeronautics and Space Administration's Ames Research Center. The program in Integrated Circuits for Medical Electronics has a superb facility for the application of modern integrated circuit technology to medical electronics.

The research and courses available should satisfy many of the needs of students wishing to confront biology and technology in their studies, though, of course, there are other programs which may be better for some students than any of the opportunities listed here—some students may wish to join the Artificial Intelligence project of the Computer Science Department, while others may wish to take an M.D. and commit themselves to clinical work. Students are advised to consider their career plans in structuring their studies.

At present, there is no graduate Engineering degree in Biology or Medicine per se. Instead, students are advised to enter the Department with the research that is of most
interest to them. The requirements for the Master's Degree and for the Ph.D. qualifying exam are then those of the student's major department, though the student will work with his advisers to make his course sequences as relevant to biological and medical engineering as possible, using suggestions made below. Students at the Masters level who are planning programs in Engineering in Biology and Medicine are advised to consider the programming flexibility inherent in the degree Master of Science in Engineering.

It is suggested that, by the end of his first post-Master's year, a Ph.D. candidate request the formation of a committee, probably interdepartmental, of three or four faculty, to help him choose appropriate advanced courses both within and without the School of Engineering, to advise him as to how his particular talents—engineering, biological, and medical, can be used most effectively.

In rare cases where a student's background makes it unrealistic for him 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.

National Institute of Health Fellowships are available to support graduate study in health-related fields, while National Science Foundation Fellowships are available for students in Science and Engineering. These are competed for on a national basis. In addition, departments of the School of Engineering have a certain number of fellowships and teaching or research assistantships.

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 he is admitted to both, each school will encourage his pursuit of the other degree. The Medical School curriculum is now so flexible that a medical student can devote half of his 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.

**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, Charles R. Steele

**Assistant Professor:** J. David Powell

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

**Lecturers:** John Billingham, Richard M. Carlson, Wayland C. Griffith, Harold P. Klein, Harvard Lomax, Eric Ogden, Jiro Oyama, Donald R. Young

**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, aeroelastic, 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
- Aerelasticity
- Aerophysics
- Aerospace Structures
- Aerospace Systems Synthesis and Design
- Analytical and Experimental Methods in Solid and Fluid Mechanics
- Biomedical Solid and Fluid Mechanics
- Flight Mechanics
- Caskinetics
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—Aeroelastic 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

**Facilities for Instruction and Research**

The work of the Department is centered in the new 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 Département of Aeronautics and Astronautics as well as the activities of other engineering departments allied in space exploration and aerospace technology.

Included among the present and planned facilities in the new 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 are 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.

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 thruster 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" × 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 new 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 equipped for televising lectures and containing a lecture theater.

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 near-by 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 and astronautical sciences, a candidate must complete 24 units of basic course work to be selected from the same areas as listed for the Engineering Curriculum, 9 units of mathematics, 9 units of advanced physical science courses in an aerospace-related area of specialization interest to the candidate, and 3 units of approved electives, making in all 45 units of course work. A detailed list of the requirements can be obtained upon request to the Department. No thesis is required. A minimum grade point average of 2.75 is expected.

For those students who do not wish to meet the Department's specific requirements for the Master’s degree, less specialized programs are available leading either to a Master of Science in Engineering or a Master of Science in Engineering Science. These programs are described on page 82 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 his 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 his 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 $4,000 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. Prerequisites: Mathematics 43 or Engineering 21.

3 units, Aut (Hoff) 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, Ogden, Oyama, Young) TTh 3:15-4:30

131. Experimentation in Aeronautics and Astronautics — Introductory treatment of principles of experimentation; importance of experiment in aeronautics and astronautics; theory of measurements, scaling problems, dynamic response, and evaluation and reporting of results; laboratory experiments selected from the various fields of aeronautics and astronautics.

3 units, Win (Bershader, Baganoff) 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, Chang) 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. Theorem 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—Examination of the dynamic, aerodynamic and structural considerations which govern the configuration of flight vehicles, including atmospheric cruisers, boosters and entry gliders. Examples of analytical methods will be taken from current development projects, and the roles of testing, digital computation and analogue simulation will be explained. Vehicle equations of motion. Definition and study of questions of performance, dynamic performance, static stability, dynamic stability, and control. Behavior of lift, drag and thrust. Special performance problems. Static stability and trim.
Prerequisite: 100 (may be taken concurrently) or equivalent.

3 units, Aut (Ashley) MWF 9


3 units, Win (Ashley) MWF 9

200C. Engineering Analysis of Flight Vehicles—Continuation of 200B: Further consideration of currently interesting examples of flight vehicle analysis, with emphasis on derivation of the associated theory and on the role of digital computation. Cases treated might include, but not be limited to, the following: subsonic cruising performance, supersonic transport drag and noise reduction; booster trajectory optimization, interceptor dynamics, lifting reentry, variable geometry, and problems of flight at very low speed. Prerequisite: 200B.

3 units, Spr (Ashley) 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 multi-poles); 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, Chang) 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, aeronautical 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; noise suppression attempts. Prerequisite: 201.

3 units, Spr (Karamcheti, Chang) MWF II

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.

3 units, Spr (Koutsoyannis) MWF 9 plus lab. 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.)

208. Transonic Flow Theory — (Enroll in Applied Mechanics 245.)

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

210A. Fundamentals of Compressible Flow — Fundamentals of the flow of a perfect gas from the standpoint of the aeronautical engineer; basic thermodynamics; steady and unsteady one-dimensional flow; shock waves; simple expansion waves.

3 units, Aut (Vincenti) MWF 10

210B. Fundamentals of Compressible Flow — Continuation of 210A: Description of unsteady three-dimensional motion of a fluid; dilatation, rate of strain, vorticity, and circulation; stream functions; basic field equations for motion involving friction and heat flow; thermodynamical relations for a flowing fluid; changes and production of entropy and vorticity; Navier-Stokes equations; some features of flow with friction and heat flow; equations and some general results for inviscid motion—isentropic, homentropic, and irrotational flows; discontinuous inviscid motion—normal and tangential discontinuities; unsteady one-dimensional motion—method of characteristics, sound and finite waves, simple waves, rarefaction and compression waves, development of shock discontinuity. Prerequisites: 192 and 210A (or Mechanical Engineering 131B).

3 units, Win (Karamcheti) MWF 1:15

210C. Fundamentals of Compressible Flow — Continuation of 210B. Some exact solutions of steady homentropic flow—source, vortex, and Prandtl-Meyer flows; supersonic flow past a cone and a wedge; acoustic or linearized theory of unsteady and steady flows resulting from the motion of a slender body; pulsating and oscillating spheres and cylinders; source, doublet, and vortex solutions; subsonic and supersonic steady flow past a thin airfoil; subsonic and supersonic steady flow past a slender body of revolution; elements of the theory of characteristics — method of solution for steady two-dimensional and axisymmetric flows. Prerequisite: 210B.

3 units, Spr (Karamcheti) 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 (Baganoff) MWF 2:15

213. Flow Past Paraboloids — A survey of analytical and numerical techniques in a number of branches of fluid mechanics, based upon the calculation of flow past one simple family of bodies. Elliptic paraboloids (including as special cases the parabola, flat plate, and paraboloid of revolution) in subsonic, transonic, supersonic, and hypersonic streams with small and large viscosity.

3 units, Spr (Van Dyke) MWF 8, alternate years, given 1973–74

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 nonequilibrium flow. Accuracy, stability, and programming complexity are considered.

2 units, Win (Lomax) TTh 9, given 1972–73

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, di-
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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 131 or consent of instructor.

3 units, Aut (Chang) 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 tube, 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, alternate years, given 1972–73

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 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—Interaction of radiation and matter from the atomic/molecular optics point of view, with emphasis on applications to experimental methodology. Unified treatment of radiation, refraction, and absorption by methods of classical and quantum physics. Special topics include spectral interferometry and the fundamentals of laser action in gases. The growing use of the laser as an important diagnostic tool for interferometric, scattering, and holographic studies will be discussed as time permits.

3 units, Aut (Bershader) TTh 1:45–3:05, alternate years, given 1972–73

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, origin of the planetary system. 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.)

228. Interplanetary Gasdynamics—(Enroll in Applied Mechanics 249.)

229. Cardiovascular Dynamics and Respiration—Applications of hydrodynamic principle to the study of blood and gas flows in cardiovascular and respiratory systems. The mechanical action of the heart. Hydrodynamics of aortic valve. Blood flow in aorta

3 units, Aut (Chang) MWF 10, alternate years, given 1972–73

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


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 straight and curved beam, 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; stress functional variational principle with applications to redundant structures, bending/torsion of plates with nonuniform planforms and shear lag problems; thermal effects; introduction to stress and strain functional (Reissner) variational principle. Prerequisite: 240A or consent of instructor.

3 units, Win (Mayers) MWF 2:15

240C. Analysis of Aerospace Structures — Unified approach to structural analysis; sandwich and composite structures; applications of classical and modified variational principles to kinematic and constitutive nonlinear 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 aerodynamic and design concepts for use in configuration analysis including airplane layout, wing design, high lift systems, drag, stability and control requirements, and tail sizing. Application to a hypothetical aeronautical system; applied structural fundamentals with emphasis on fatigue and fail-safe considerations; design load determination; weight estimation; propulsion system performance and installation; engine types; environmental problems such as noise and smoke, performance estimation including take-off, climb, cruise, and landing. Direct and indirect operating costs prediction and interpretation; future types of aircraft including V/STOL, supercritical wing, uncompromised cargo and SST; aircraft functional systems such as hydraulic, electrical, environmental control; avionics; importance and achievement of aircraft reliability and maintainability.

241A. 3 units, Aut (Shevell, Mayers) MWF 2:15

241B. 3 units, Win (Shevell, Mayers) MWF 3:15

241C. 3 units, Spr (Shevell, Mayers) MWF 2:15

stability, including small departures from equilibrium or steady motion, are considered throughout the course. Prerequisite: Engineering 12 or equivalent.

3 units, Aut (Breakwell) MWF 12


3 units, Aut (Chao) 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 (McIntosh) MWF 3:15, alternate years, given 1972–73

244B. Aeroelasticity — Presentation of the field of aeroelasticity from a unified viewpoint applicable to all types of flight vehicles. Introduction to aeroelastic operators and unsteady aerodynamics. Forced response, static and dynamic eigenvalues of a simplified system. Aeroelastic analysis of representative one-dimensional and two-dimensional structures. Prerequisite: 244A or equivalent.

3 units, Win (Ashley) MWF 3:15, alternate years, given 1972–73

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 (Ashley) MWF 3:15, alternate years, given 1972–73

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 308.)


3 units, Aut (Steele) MWF 1:15, given 1972–73


3 units, Win (Steele) MWF 1:15, alternate years, given 1972–73


3 units, Spr (Steele) MWF 1:15, alternate years, given 1972–73

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 (Staff) MWF 1:15, alternate years, given 1971–72

249. Modern Developments in Shell Theory — Elements of differential geometry and tensors. The shell theory obtained from a reduction of the equations for a three-dimensional continuum. The alternate theory of a Cosserat surface. General behavior of solutions. Prerequisites: 245A, and either 247 or 248A.

3 units, Spr (Steele) TTh 11:00-12:15, given 1973–74

253A.B. Waves and Vibrations—(Enroll in Applied Mechanics 203A,B.)

256A,B.C. Mechanics of Composite Systems—Classification and description of composite materials. Discussion of current technical applications. Review of typical matrix and reinforcement properties, properties of

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

256A. Static Problems. 3 units, Aut (Chao) TTh 11:00–12:15

256B. Project Work. 3 units, Win (Chao) TTh 11:00–12:15

256C. Dynamic Problems. 3 units, Spr (Chao, Herrmann, Lee)

260A. Aerospace Structures Laboratory — Systems and associated techniques required by transducers, recorders and controllers commonly used in both static and dynamic aeronautical structural testing are studied; techniques required in ground servicing and maintenance inspection are indicated; electrical resistance wire gauges, semi-conductor gauges, displacement, velocity and pressure transducers, thermocouples, thermistors, heat-flow discs, radiation transducers, accelerometers, oscillographic and strip chart recorders, scanners, analog-to-digital converters, and digital data systems.

260B. Aerospace Structures Laboratory — Continuation of 260A: Visual and optical techniques, including thermally sensitive paints; strain transfer techniques, photo grid methods, interferometric methods, optical projectors and comparators; brittle lacquers, photoelastic coating tests, analog and model techniques; nondestructive test systems for field use including liquid penetrant, eddy-current, magnetic and ultrasonic tests.

260C. Aerospace Structures Laboratory — Continuation of 260B: Radiant, inductive and convective heat systems; automatic test systems for heat problems of high speed flight and pressure cabin loadings.


3 units, Spr (Powell) MWF 8

271A. 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 1973–74

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 1973–74


3 units, Win (DeBra) MWF 8


3 units, Spr (Bryson) TTh 11:00–12:15

273. Digital Autopilots — Digital control with emphasis on aerospace applications where computing capacity is limited. Design aspects including scaling, word length, and sampling rates. Effect of sharing processor between many control functions. Prerequisite: Engineering 205 or equivalent.

3 units, Aut (Powell) MWF 10

3 units, Spr (DeBra) MWF 8


3 units, Win (Breakwell) MWF 11


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


3 units, Aut (Breakwell), given 1973-74

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; nonlinear resonances. Prerequisite: 279A.

3 units, Spr (Breakwell) MWF 10

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 Mechanical Engineering 131A or consent of instructor. Recommended: 210A or equivalent.

3 units, Win (Seifert) MWF 11

280B. Advanced Chemical Propulsion—Topics selected from hybrid rockets, air-breathing propulsors, combustion, gas-particle flows, ablative heat transfer and thrust vector control. Prerequisite: 280A.

3 units, Spr (Seifert, Staff) TTh 9, given 1972-73


3 units, Aut (Seifert) TTh 11:00-12:15


3 units, Win (Chang) MWF 10

285. Magnetoaerodynamics—The dynamics of partially and fully ionized gases, em-

3 units, Spr (Chang) MWF 10, alternate years, given 1972-73

287. 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: successful completion of a 200-level course in gas dynamics, fluid mechanics, or chemical thermodynamics.

2 units, Spr (Griffith) WF 3:15

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 9:00-10:40


3 units, Spr (Chao) T 9 and Th 9:00-10:40

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
Visiting Professor: Thomas C. T. Ting
Assistant Professors: David M. Barnett, Wilson C. Hayes, Russell L. Mallett

Affiliated Faculty

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

Laboratories in the School of Engineering. Individual accommodation is provided for the work of each research student. Weekly seminar meetings acquaint the students with a great variety of subjects in their field, and give opportunity to practice speaking on a selected topic.

A variety of research projects are also conducted in Applied Mechanics. Qualified students participate in these as research assistants, engaged in thesis research, in close working association with the faculty director and fellow students. The projects include original experimental and theoretical investigations in the strength and deformability of elastic and anelastic elements of machines and structures; fracture mechanics, vibrations and nonlinear dynamics; analysis, synthesis, and control of systems; flow dynamics of liquids and gases, including geophysical and astrophysical applications; and biomechanics.

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 special experimentation in conjunction with other
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 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, 252 (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 (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. 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


203A. 3 units, Win (Chao) TTh 2:15–3:30
203B. 3 units, Spr (Chao, Herrmann, Lee) TTh 11:00–12:15 (Enroll in Aeronautics and Astronautics 256C.)
205. Experimental Stress Analysis — Stress and strain. Fundamentals of photoelasticity. Strain gage techniques. Static and dynamic strain measurement methods and instrumentation. Brittle lacquers. Prerequisite: Civil Engineering 114 or equivalent.

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


206A. 3 units, Spr (Herrmann) TTh 2:15-3:30, alternate years, given 1973-74
206B. 3 units, Aut (Herrmann) alternate years, given 1974-75

207. Theory of Plates — Analysis of stress, deformation in plates bent by transverse loads. Applications to circular, rectangular, other shapes. Vibrations of plates. Prerequisite: Civil Engineering 114.

3 units, Win (Mallett) MWF 9


3 units, Spr (Mallett) MWF 9


3 units, Aut (Lee) MWF 10


3 units, Win (Lee) MWF 11

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: 212A.

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 (Ting) MWF 2:15, alternate years, given 1972-73


3 units, Win (Ting) MWF 2:15, alternate years, given 1972-73

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 10 and Th 9-11

224. Rigid Body Space Mechanics — 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 1972-73

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.)

3 units, Win (Kane) W 2:15-4:05 plus one hour by arrangement, alternate years, given 1972-73

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

3 units, Win (Kane) T 2:15-4:05 plus one hour by arrangement, alternate years, given 1972-73

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. Singular Optimization Problems and 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.
2 units, Win (Spreiter) TTh 8:15-9:30, alternate years, given 1972-73

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) TTh 8:15-9:30, alternate years, given 1973-74

246. Geophysical Fluid Dynamics—Introduction to fluid flow and wave phenomena in the atmosphere, oceans, and interior of the Earth, and their mathematical representation. 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 8:15-9:30, alternate years, given 1972-73

249. Interplanetary Gasdynamics—Review of observations supporting the use of continuum fluid models to represent conditions in the interplanetary medium. Physical concepts, equations, and fundamental properties of solutions for hydromagnetic flow, waves, and discontinuities of finite amplitude including shock waves. Theory of spherically symmetric steady solar wind, and its interaction with the Earth, Moon, planets, comets, and the interstellar medium. Transient effects and relation to geomagnetic storms and other solar-terrestrial phenomena.

3 units, Win (Spreiter) TTh 8:15-9:30, alternate years, given 1972-73

250. Mathematical Methods in Applied Mechanics—Introduction to complex variables, analytic functions thereof, with special emphasis on engineering applications, including conformal mapping and contour integration. Introduction to the Laplace transform with application to vibration and wave propagation problems. Prerequisite: Mathematics 45 and 130 or equivalent.

3 units, Aut (Mallett) MWF 11

250H. Mathematical Methods in Applied Mechanics—As 250, but assuming an initial knowledge of analyticity and the Cauchy-Riemann relations; applications carried correspondingly further.

3 units, Aut (Lee) 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 (Lee) MWF 8

251H. Mathematical Methods in Applied Mechanics—As 251, but assuming an initial
knowledge of trigonometric Fourier series and their application in separation of variables applied to elementary partial differential equations. Somewhat more general and extensive treatment of the topics covered in 251.

3 units, Win (Mallett) MWF 8


3 units, Spr (Mallett) T 8–10, Th 8

269A,B,C. Mechanics of Composite Systems—(Enroll in Aeronautics and Astronautics 256A,B,C.)

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


3 to 6 units, Spr (Hayes) by arrangement

280A. Biomechanics: Anatomy and Physiology—Gross anatomy and physiology of human musculoskeletal, circulatory, and respiratory systems. Introductory cell physiology and histology. Prerequisite: graduate standing or consent of instructor.

3 units, Aut (Hayes) MW 4:15–5:30


3 units, Win (Hayes) MW 4:15–5:30

285. Special Problems in Orthopaedic Biomechanics—Multidisciplinary approach (engineers, physical therapists, and orthopaedic surgeons) to biomechanical analysis of common orthopaedic procedures. Clinical relevance will be emphasized. Prerequisite: 280B.

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 (Herrmann, Lee, Mallett) Th 3:45

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


298. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)


Aut, Win, Spr (Staff) by arrangement


Aut, Win, Spr (Staff) by arrangement

CHEMICAL ENGINEERING*

Chairman: David M. Mason

Professors: Andreas Acrivos, Michel Boudbart, David M. Mason, Douglass J. Wilde.

Consulting: Pierre Van Rysselberge

Assistant Professors: George M. Homsy, John E. Lind, Jr., Robert J. Madix, Channing R. Robertson

Lecturer: Alan S. Michaels

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 back-

* The curriculum leading to the B.S. degree in Chemistry is described elsewhere in this bulletin.
ground 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 prospective program with an adviser, especially if he 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.


The M.S. program is intended for students who wish to engage primarily in course work in Chemical Engineering and related sciences and is normally pursued by students wishing to qualify for the Ph.D. degree, as described below. The M.S. degree is awarded without a formal thesis after a minimum of three quarters of study subject to the following restrictions:

Unit and Course Requirements—A minimum of 36 units is required for the M.S. degree, at least 21 of which must be chosen from among the graduate-level lecture course offerings in Chemical Engineering. The remaining courses may include graduate or advanced undergraduate technical courses in the basic sciences or the School of Engineering. Credit toward the M.S. will not be given for courses normally required for the B.S. degree or for Chemical Engineering 270 through 277. Credit will not be given for courses normally taken to fulfill the requirements for the B.S. degree or 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.

D O C T O R  O F  P H I L O S O P H Y

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 to him in his 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: Optimization, Newtonian & Non-Newtonian Fluid Mechanics, Hydrodynamic Stability, Chemical Energy Conversion, Applied Chemical Kinetics, Properties of Liquids, 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 energy 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 (Homsy, Robertson) 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 (Lind) MWF 10

120. Separations Processes — Application of the equilibrium-stage concept to design of mass-transfer devices; phase relationships; countercurrent multistage extraction and distillation processes, simplified graphical and computer design methods; chromatographic separations, thermal diffusion, reverse osmosis, zone refining. Prerequisite: 110 or equivalent.

3 units, Spr (Acrivos) MWF 9

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

1 unit, Spr (Acrivos) by arrangement


3 units, Spr (Boudart) WF 2:15–3:30

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. Prerequisite: Mathematics 130 or equivalent recommended.

3 units, Aut (Robertson) TTh 8:30–9:45

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 (Lind) by arrangement

160. Introduction to Optimal Process Design—The class takes a proposed design of an existing manufacturing process and seeks either to establish its optimality or to improve it, using techniques of optimization theory.

3 units, Win (Wilde) Th 1:15–4:05

170. Industrial Control Systems—(Enroll in Engineering 155.)

180. Optimization—(Enroll in Engineering 102.)

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

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, Spr (Homsy) by arrangement

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: review of cardiovascular system; introduction to protein chemistry; hydrodynamic models of blood flow; urodynamics; modeling the human thermoregulatory system; electrochemistry, electrokinetics and biological fuel cells; ion-specific electrodes; kinetics of free and supported enzymes; unconventional protein production; models for the natural and artificial kidney; biopharmaceutics; lung oxygenator design; membrane transport in synthetic and biological systems; introduction to irreversible thermodynamics.

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

202. Foundations of Optimization— (Enroll in Engineering 202.)


3 units, Aut (Homsy) TTh 1:15–2:30

204. Kinetics of Chemical Processes—Elementary steps; sequences at the steady-state. Reaction networks. Theoretical principles and application to the study of chain and catalytic reactions.

3 units, Win (Boudart) WF 2:15–3:30

205. Transport in Reacting Systems—Physical problems of engineering interest where transport of mass energy and momentum in multicomponent systems is accompanied by homogeneous or heterogeneous chemical reactions. Selected topics include behavior of non-isothermal porous catalyst, thermal properties of reacting fluids, combustion and electrode processes; facilitated transport; oscillatory reactions.

3 units, Mason, by arrangement, given 1973–74

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, Aut (Lind) TTh 10:30–11:45

207. Classical Thermodynamics—Rigorous formulations of classical thermodynamics from different viewpoints, including the analysis of stability of single and multiple component systems.

3 units, Spr (Lind) TTh 9:00–10:15, alternate years, given 1972–73


3 units, Spr (Lind) TTh 9:00–10:15, alternate years, given 1973–74

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; elements of turbulent shear flows.

210A. 3 units, Win (Acrivos) MWF 8
210B. 3 units, Spr (Acrivos) MWF 8

211. Hydrodynamic Stability—The application of hydrodynamic stability theory to diverse flow problems; buoyancy-driven and surface-tension-driven convection, the Orr-Sommerfeld equation, stability of parallel shear flow, nonlinear theories and energy methods. Prerequisite: 210A, B.

3 units, Aut (Acrivos) MWF 8, alternate years, given 1973–74

212. Advanced Optimal Design—The class takes a proposed design of an existing manufacturing process and seeks either to establish its optimality or to improve it, using advanced techniques of optimization theory.

3 units, Spr (Wilde) by arrangement


215. Special Topics in Applied Chemistry and Chemical Engineering—in many separation processes involving the transfer of energy and/or mass between phases, phenomena involving surface or interfacial forces, or special molecular organization at phase boundaries, have profound effects upon interphase momentum, heat, and mass-
transport kinetics. This seminar will examine in depth a few industrially important "interface-governed" phase-transfer processes, to illustrate the roles of interfacial dynamics and adsorption phenomena in separation operations. Cases to be studied include (1) surface/interfacial tension gradients and their effects on gas absorption by liquids, distillation, and liquid/liquid extraction; (2) nucleation and phase-transformation processes (condensation and crystallization); (3) gas- and vapor-transport through monomolecular films on liquids; (4) foam- and froth-fractionation; and (5) membrane-transport and separation processes.

3 units, Win (Michaels) by arrangement

270–277. Research Seminars in Chemical Engineering—Discussion of recent developments and current research in specialized fields. Open to qualified students with consent of instructor; units by arrangement.

Aut, Win, Spr (Staff) by arrangement

270A,B,C. Fluid Mechanics (Acrivos)
271A,B,C. Adsorption and Catalysis (Boudart)
272A,B,C. Applied Chemical Kinetics (Mason)
273A,B,C. Bioengineering (Robertson)
274A,B,C. Optimization and Control (Wilde)
275A,B,C. Surface Reactivity (Madix)
276A,B,C. Transport and Equilibrium Properties of Fluids (Lind)
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: Wilhelm Flügge, Eugene L. Grant, 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 Professors: James Douglas, Kaare Höeg, Haresh C. Shah

Assistant Professors: 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 avail-
able in fluid mechanics, sanitary engineering, civil engineering materials, soil mechanics, 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 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 sanitary engineering laboratory facilities, the materials laboratory complex that houses the materials, concrete, and soil mechanics laboratories, and the Ryan Nuclear Laboratory. New structural engineering laboratories are in the planning stage. 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. Environmental Engineering seminars meet frequently and provide a broad coverage of environmental problems. 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.

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 Materials, Construction Management, Engineering-Economic Planning, Environmental Engineering, Hydrology, Hydromechanics, Nuclear Civil Engi-
neering, 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 is required for candidates to be recommended for the M.S. degree.

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 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. In addition, a number of Water Quality Office, Environmental Protection Agency Trainee-ships, which provide tuition plus at least $200 per month, 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. 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.
   4 units, Spr (Douglas) TTh 11; lab. MW 1:15–5:05 or TTh 1:15–5:05

   3 units, Win (Hsu) MWF 10

   4 units, Win (Richards) MTTThF 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

   3 units, Aut (Richards) TTh 10; lab. M 1:15–3:05

120. Introduction to Urban Planning — A study of the urbanization process, the city in history, case study projects.
   3 units, Aut (Staff) TTh 11:00–12:15

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, asphalt, concrete as highway materials; design and construction procedures for highway embankments, undercourses, and pavements. Prerequisite: junior standing.
   3 units, Win (Oglesby) MWF 3:15

140. Advanced Surveying — Additional study of surveying. Prerequisite: 40 or equivalent.
   3 or more units, 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 (Douglas) WF 8
   lab. M 1:15–4:05
   Spr (Parker) WF 8
   lab. M 1:15–4:05

160. Water-Resources Engineering — Introduction to hydrologic measurements, runoff
computations, groundwater, water law, reservoir design, frequency analysis, dams, spillways, conduits, economy of water-resources development. Prerequisite: 107, Engineering 161.

4 units, Spr (Linsley) MWF 9 and W 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 (Eliassen) MWF 8

171. Environmental Planning—Case studies of urban and regional planning related to environmental engineering projects such as water supplies; wastewater collection, treatment, and reclamation; transportation; solid waste management; energy supply systems; and the relationship of land use planning to environmental quality control. Prerequisite: 170 or equivalent.

3 units, Win (Eliassen) MWF 10

172. Air Pollution—(Enroll in Mechanical Engineering 137.)

173. Energy and Society—(Enroll in Mechanical Engineering 180.)

174. Nuclear Science — (Enroll in Engineering 174.)

175. Radiation Measurements Laboratory —(Enroll in Engineering 175.)

176. Nuclear Energy—(Enroll in Engineering 176.)

177. Radioactivation Analysis — (Enroll in Engineering 177.)

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: Engineering 11 and 114.

4 units, Aut (Gere) MWF 9 and T 2:15-4:05

181. Design of Steel Structures — Elastic and plastic design of steel beams, girders, columns, trusses, frames; design of riveted, bolted, welded connections; design of steel buildings and bridges. Prerequisite: 180.

3 units, Win (Staff) MWF 8

182. Design of Reinforced Concrete Structures — Reinforced concrete beams, slabs, columns, footings; straight-line and ultimate strength theory; introduction to pre-stressed concrete and shell roof design. Prerequisites: 114, 180, and 181.

3 units, Spr (Staff) MWF 10

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 (Höeg) MWF 11; lab. hours arranged separately for each design group

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. 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, construc-
tion 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. Prerequisites: knowledge of fundamentals of fluid mechanics (e.g., Engineering 21) and of computer programming, or consent of instructor.

4 units, Spr (Street) TTh 8 and WF 12

205. Fluid Mechanics of Sub-Surface Flow—Basic concepts of groundwater flow and dispersion of pollution in the groundwater. Darcy's law, Fick's law applied to dispersion, potential flow theory with application to groundwater and seepage flow. Formulation of boundary value problems and solution by analytical and computer techniques. Applications to seepage from reservoirs, flow beneath dams, etc. 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, Aut (Street) MTThF 11

206. Fluid Mechanics of Closed Conduits—Selected topics in fluid mechanics; review of fundamental principles of turbulent flow and application to closed conduits; pipe systems and branching of pipes; unsteady flow, flow establishment and 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 engineered channels; hydraulic jump; channel transitions. Gravity flow systems for waste water removal. 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 (Staff) MWF 9 and W 2:15-4:05

209. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)

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


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. The Balanced Community—Design projects exploring solutions to self-sustaining alternative urban forms. Prerequisite: 120 or equivalent or consent of instructor.

3 units, Win (Staff) TTh 4:15-5:30

221A. Sociology of Urban Growth—(Enroll in History 233.)

221B. Graduate Colloquium in Historical Patterns of Urbanization in Nineteenth and Twentieth Century Europe—(Enroll in History 320.)

222. Water Resources Planning—Integration of technical, economic, political and social factors in decisions relating to water resources. Prerequisite: 160 or 266 or equivalent.

3 units, Spr (Ortolano) MWF 11

223. Economics of Public Works—A qualitative 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, na-
tional 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 public works. Government, including organization, legislation, and operation at the federal, state, and local levels. Interest groups, technical experts, and the public. Behavior of organizations, officials, and other individuals. Extensive use is made of cases giving detailed descriptions of actual controversies.

3 units, Win (Roggeveen) TTh 11 and F 3


3 units, Spr (Roggeveen) MWF 10

226. Quantitative Planning Techniques —Selected aspects of operations research with an emphasis on determining the relevance of these techniques for civil engineers engaged in planning. Topics include Lagrange multipliers, linear and dynamic programming, and an introduction to simulation techniques. Recent applications will be discussed. Prerequisite: Mathematics 43 or equivalent.

3 units, Aut (Ortolano) MWF 10

227. Economics and Engineering Planning —An examination of the relevance of quantitative economics to engineers engaged in planning projects in the public sector. The course surveys basic concepts in micro-economics including theories of consumer demand, production, welfare economics and externalities. In addition, emphasis is placed on the evaluation of costs and benefits from public projects, and alternative criteria for making decisions. Prerequisite: 223 and 226, or consent of instructor.

3 units, Win (Ortolano) MWF 11

228A,B,C. Selected Topics in Urban Planning—A discussion of various aspects of urban planning. Specific topics will be announced on a quarterly basis.

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

229A,B,C. Urban Planning Internship —Work experience in the planning offices of local governmental agencies and private consultants. Requires one full day each week in an office.

2 units, Aut, Win, Spr (Staff) 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, Win (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
Win (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 de-
cision 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.

3 units, Aut (Fondahl) TTh 8 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, Win (Fondahl) MWF 9 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

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 Engineering Economic Planning Programs.

2 units, Spr (Parker) W or Th 2:15-4:05

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

266. Engineering Hydrology — The hydrologic cycle; runoff relations, unit hydrographs, flood routing, frequency analysis, probabilistic yield determinations. Application to typical water-resources planning problems. For students with no previous course in hydrology.

4 units, Aut (Franchini) MWF 9; lab. W 2:15–4:05

267. Hydrologic Simulation—Simulation of the hydrologic cycle through the use of watershed models, calibration of models, uniqueness and optimization of parameters; stochastic generation of precipitation and streamflow. Prerequisite: 266 or a previous hydrology course.

4 units, Win (Linsley) MWF 9; lab. W 2:15–4:05

268. Advanced Hydrology—Selected topics in hydrology with emphasis on the latest developments. Prerequisite: 267.

4 units, Spr (Linsley) MWF 8 and M 2:15–4:05

269A. Water Studies Seminar—Discussions by faculty and students on study and research of water problems at Stanford.

1 unit, Aut (Staff) W 4:15–6:05

269B. Water-Resources Engineering Seminar—Discussions on all phases of water-resources engineering including reports on current research at Stanford.

1 unit, Win (Ortolano) 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) MWF 8

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

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 2:15–3:05

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 as related to stream pollution and water quality control; the ecology of streams, lakes, and other water resources, kinetics and energetics of microbial growth; identification and control of microorganisms in water and wastes. Prerequisite: 273.

3 units, Win (McCarty) TTh 10; lab. T 1:15–4:05 or W 2:15–5:05

275A. Water Quality Control Processes I—Laboratory and pilot plant studies of physical and chemical processes for the treatment of water and wastewaters. Prerequisites: 273 and 273A.

3 units, Win (Leckie) M 1:15–5:05 and Th 1:15–4:05

275B. Water Quality Control Processes II—Laboratory and pilot plant studies of biological processes for the treatment of water and wastewaters. Prerequisite: 274.

3 units, Spr (Leckie) M 1:15–5:05 and Th 1:15–4:05

276. Nuclear Methods in Environmental Engineering—Methods to study the occurrence, origin, behavior, dispersion, transport and ultimate fate of materials in the
atmospheric, hydrologic, and biospheric environments. Uses of radioactive, stable, and activable tracers in environmental studies. Applications in air pollution, water pollution, hydrology, and waste disposal. Prerequisite: 278 or consent of instructor.

3 units, Spr (P. Kruger) TTh 11:00–12:15


3 units, Spr (P. Kruger) MWF 11

278. Environmental Radioactivity—Review of the sources of radioactivity in man's environment from space, nature, fallout, nuclear power, etc.; the transport of radioactivity throughout the biosphere; and the means of controlling the radiation hazard to man. Prerequisite: 170 or equivalent with consent of instructor.

3 units, Win (P. Kruger) MWF 10

279A. Water Quality Control Seminar — Discussions on all aspects of water quality control engineering science including reports on current research at Stanford. Guest speakers, discussion groups and assigned reading.

1 unit, Win (Leckie) Th 4:15–6:05

279B. Environmental Engineering Seminar — Discussions on all aspects of environmental engineering. Guest speakers, discussion groups and assigned reading.

1 unit, Spr (Leckie) 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.

3 units, Win (Gere) MWF 8

281C. Finite-Element Method of Structural Analysis — Continuation of 281A,B: Theory of finite elements applied to problems in continuum mechanics: frames, membranes, plates, shells, and three-dimensional solids. Prerequisite: 281B.

3 units, Spr (Cyr) MWF 8

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 11

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 and Hoeg) MWF 9

285. Advanced Structural Design—Design of various types of structures (buildings, auditoriums, bridges, etc.) in steel, concrete, and timber; use of structural models; general aspects of design; lateral load analysis and design; and related design problems. Prerequisite: 282.

4 units, Aut (Staff) TTh 8; lab. W 2:15–4:05


4 units, Win (Staff) TTh 8; lab. 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, Win, Spr (Staff) W 4:15–6:05

290. Soil Mechanics — Re-examination of basic principles with emphasis on the mechanics of soil behavior. Discussion of stress-strain relations and shear strength; defor-
mation analyses; two-dimensional consolidation; theories of elasticity and plasticity. Prerequisite: 190 or equivalent.

3 units, Win (Hoeg) 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 (Hoeg) MWF 10

292. Earth Structures—Earth dams, embankments, and natural slopes; site investigation; soil properties and compaction; analyses of seepage and slope stability, seepage control and landslide prevention; earthquake effects; performance observations; case studies. Prerequisite: 190 or equivalent.

3 units, Spr (Hoeg) TTh 9; one hour by arrangement

293. Experimental Soil Mechanics—Laboratory testing with triaxial, direct shear, and simple shear equipment. Model experiments and special projects to suit individual or class interest.

2 units, Spr (Hoeg) by arrangement


2 units, Aut, Spr (Hoeg) by arrangement

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

296A. Structural Dynamics—Vibration and dynamic response of simple structures to periodic and impulsive loadings; one-degree through infinite-degree-of-freedom systems. Prerequisites: 180, and Engineering 12.

3 units, Win (Gere) MWF 9

296B. Matrix Theory of Structural Dynamics—Vibration and dynamic response of complex structures using matrix methods for linear and nonlinear analysis, including programming for a digital computer. Prerequisites 281B and 296A.

3 units, Spr (Weaver) MWF 9, given 1973–74

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 1973–74

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. Prerequisites: 114 and ordinary differential equations.

3 units, Spr (Gere) MWF 10

299. Independent Study in Civil Engineering—Directed study for graduate students on subject of mutual interest to student and staff member. Student must 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—Required of all post-Master's students to serve as orientation to the selection of a research topic.

1 unit, Aut (Staff) by arrangement

399. Advanced Engineering Problems—Individual projects on selected topics. Provides for independent graduate work under the direction of a faculty member on a subject of mutual interest. Student must find faculty sponsor. A written report is usually required.

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


Aut, Win, Spr (Staff) by arrangement
ELECTRICAL ENGINEERING

Emeriti: Leland H. Brown, Joseph S. Carroll, Gerald L. Pearson, Hugh H. Skilling, Frederick E. Terman (Professors)
Chairman: John G. Linvill
Associate Chairmen: Ralph J. Smith, James B. Angell
Visiting: David C. Lai
Instructors: Acting: Michael S. Frankel, Gur- sharan Sidhu
Lecturers: G. David Forney, Victor H. Grin- nick, Frank Herman, Marcian E. Hoff
Senior Research Engineers: John P. Katsu- frakis, 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 se- quence given earlier in the general discus- sion of the School of Engineering. Inter- disciplinary 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 pos- sible for a Stanford undergraduate to work simultaneously toward the B.S. and M.S. de- grees. Information on this program is avail- able in the Office of the Dean of the School of Engineering.

ADVANCED DEGREES

The practice of the profession of Electrical Engineering demands a strong foundation in the physical sciences, a broad knowledge of engineering techniques, and an understand- ing 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 pro- fession. 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 recom- mended. For those who plan to work in highly technical development or fundamen- tal research, additional graduate study is desirable.

The Electrical Engineering Department of- fers graduate courses in the following areas:

- Bioelectronics
- Computer Applications
- Computer Systems
- Electromagnetic Theory and Microwaves
- Electronic Circuits and Devices
- Information Theory and Systems
- Integrated Circuits
- Network Theory
- Optics and Optical Devices
- Plasmas
- Quantum Theory and Applications
- Radioscience
- Solid State Materials and Properties
- Systems Theory

Descriptions of courses will be found in the following pages.

A one-year program of graduate study in electrical engineering may lead to the de- gree of Master of Science. A two-year pro- gram, 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, is recommended for those with the desire and ability 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 his program adviser prepares his own 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 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 his adviser, prepares a program of study to meet his 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 his 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 his adviser, to determine whether he has met the prerequisites for advanced courses. 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 his 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. Only after the Application for Doctoral Candidacy has received official Departmental approval does the student become a candidate for the degree.

In the first quarter after receiving the Master of Science degree the student should submit to the Departmental Office one copy of the Application for Doctoral Candidacy form for preliminary Departmental approval. Official Departmental approval will be given after successful completion of the qualifying examination and satisfying the foreign language requirement. (See 3 below.)

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).

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 in the Humanities or Social Sciences; (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 Thomas H. Bredt, Edward S. Davidson, Jerome A. Feldman, Gene H. Golub, and Edward J. McCluskey, Chair.

A student should indicate his preference for this degree at the time he applies 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.


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 individual objectives and indicate how his 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 he submits his application for candidacy for the degree. His 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 his time to graduate courses in electrical engineering and the balance of his time to courses in biology or medicine. A candidate for the Doctor of Medicine degree who plans to apply his academic year of "University Time" toward this Master's degree would devote about half of his 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 his 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**
- 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

**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
101. Circuits I—Analysis of simple circuit models, with a view to discovering their funda-
mental characteristics as transmission networks. Forced and natural components of
response, natural frequencies, the complex-frequency plane, resonance; transfer func-
tions and the roles of their poles and zeros. The use of digital computers in circuit anal-
ysis. Elementary signal-flow graphs. Impulse response: its calculation and its use in ob-
taining 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) MWF 10
Win (Manning) MWF 8

102. Circuits II—Use of transfer functions
(continued), the Laplace transformation, de-
velopment and application of Fourier series.
Sampling and bandwidth concepts. The sin-
usoidal steady state: electric power systems,
introduction to frequency dependence, im-
pedance matching, transformers. Circuit the-
eorems and analytical techniques. Prerequi-
site: 101 (or, by consent, Engineering 104
plus supplementary reading).

3 units, Win (Tuttle) MWF 10
Spr (Manning) MWF 8

103. Elementary Network Theory — Impe-
dance matching, transmission properties,
distortion, spectra. Two-terminal-pair net-
works: characterization and use. Filters and
other examples. Symmetry. Elementary syn-
thesis. General analysis of circuits (net-
works), matrices. Prerequisite: 102.

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 semi-
conductors, leading to the operating prin-
ciples and terminal characteristics of both
discrete semiconductor devices and integrat-
ed circuits. Development of various model-
ing 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, ampli-
fication, 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 (Phillips) MWF 11

112. 3 units, Win (Gibbons) MWF 8
    Spr (Phillips) MWF 11

113. 3 units, Aut (MacDonald) 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
    3-hour lab. weekly by arrangement

122. 2 units, Aut, Spr (-----) T 1:15
    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).

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.

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.

142. Electromagnetic Waves — Continuation of 141. Plane waves in conducting and non-conducting media, reflection and refraction, guided waves and transmission lines, standing waves, radiation. Prerequisites: 141 and 103 (103 may be taken concurrently).

180. 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


189. 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
report or a written examination is required and a letter grade is given. If a letter grade based on written work is not appropriate, student should enroll in 190.

By arrangement

192. Special Seminars—Seminars associated with and supplementing various courses are offered when there is sufficient interest.

COURSES FOR UNDERGRADUATE OR GRADUATE STUDENTS

200A,B,C. Seminar—Special section of 201 A,B,C (see description below) open to students holding assistantships and registering under limited tuition grants.

200A. 0 units, Aut (Staff) Th 11
200B. 0 units, Win (Staff)
200C. 0 units, Spr (Staff)

201 A,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 (Staff) Th 11
201B. 1 unit, Win (Staff)
201C. 1 unit, Spr (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.

206. Models, Men, and Machines—(Enroll in Engineering-Economic Systems 223.)


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.


216. Principles and Models of Semiconductor Devices—Quantitative description and modeling of the physical processes of transport, storage, generation and recombination of carriers in semiconductors. Development, based on the models of the physical processes, of circuit or functional models of transistors and diodes, applicable to both small- and large-signal cases. Prerequisite: 113 or graduate standing in electrical engineering.


Electrical Engineering 131
231. Introduction to Lasers—An introductory course in laser devices and applications (no quantum mechanics background required). Numerous 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, Staff) by arrangement

238. Electric and Magnetic Properties of Solids—The electric and magnetic properties of solids are examined from a fundamental point of view. The necessary elementary concepts of quantum mechanics are introduced. Free electron theory, band theory, effective mass approximation, dielectric and ferroelectric materials, magnetic materials, ferromagnetism, and superconductivity. Prerequisites: Physics 57 and preferably 111 or Engineering 50.

3 units, Aut, Spr (Spicer) MWF 1:15


3 units, Aut (Manning) MWF 10

Win (Heffner) MWF 9


3 units, Win (Eshleman) 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, antennas, television image formation, statistics, noise waveforms, heat flow. Prerequisite: 102.

3 units, Aut (Goodman) MWF 2:15

Win (Crawford) 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 (Tuttk) MWF 8

271. Nonlinear Network Analysis—Introduction to the analysis (steady-state and transient) of networks containing nonlinear elements, both passive and active. Energy considerations. Discussion of methods of analysis with emphasis on approximate methods (graphical, numerical, analytical), particularly averaging and iterative techniques. Resonance. The describing function. Oscillators (waveshapes, amplitude limita-
tion), elementary control systems. Generation of harmonics and subharmonics. Parametric amplifiers. Stability. Use of the digital computer in appropriate cases. Prerequisites: 103, 113, Engineering 105, and ability to use digital computation facilities.

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. Prerequisites: Computer Science 111, or equivalent programming experience.

3 units, Aut, Win (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, Win (Gray) MWF 1:15

279. Information Transmission and Modulation—(Formerly 278F.) Signals and circuits for information transmission in electronic systems; modulation, 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. Prerequisites: 103 and Statistics 116 or equivalent.

3 units, Spr (Gray) MWF 3:15

280A,B. Computer Applications Laboratory—"Hands-on" experience in innovative, real-time applications of digital computers as signal processors or portions of control systems. Previous topics include pattern recognition with computer-controlled TV camera, and bloodpressure control using a computer-simulated model of an animal reaction to a pressure-elevating drug. Experimental research projects are developed in cooperation with Electrical Engineering, the Medical School, and other research laboratories. Should be taken for two consecutive quarters. Limited enrollment. Prerequisite: Computer Science 111 or equivalent programming experience. Corequisite: 274.

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


3 units, Win (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 (Stone) MWF 2:15

286A,B. Systems Programming — Structure of assemblers, linkage editors, loaders, macro facilities, interpreters, and compilers. Introduction to operating systems. Same content as Computer Science 140A,B. Prerequisite: 181 or equivalent.

286A. 3 units, Win (Bredt) TTh 9:30–10:45

286B. 3 units, Spr (Bredt) 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 de-
fine 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

312. Integrated Circuit Technology—Fundamental principles of monolithic integrated circuit technology. Technological limitations on integrated circuit design. Lectures and laboratory instruction including phototransfer, oxide masking, diffusion, and thin film deposition. Laboratory portion is limited in enrollment. Prerequisite: 113.

2 to 3 units, Aut, Spr (Meindl)

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. Students are encouraged to suggest and define their own topics, and normally work on one project for the entire academic quarter. Limited enrollment. Prerequisite: previous or concurrent registration in any one of the following: 214, 216, 218, 219, 316.

3 units, Aut, Win, Spr, Sum (Angell)

316. Transistor Electronics — Quantitative analysis of the performance of transistors and solid state diodes in tuned, video, low-noise and low-drift amplifiers, in parametric amplifiers, and in nonlinear switching and regenerative circuits; based on the network theory of 214 and the device models developed in 216. Prerequisites: 214 (or 266 may be acceptable after consultation with instructor) and 216.

3 units, Spr (Angell)


4 units, Spr (Dutton)

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 (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)

324A. 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)
324B. Applications of Quantum Theory—Quantum mechanics applied to the analysis of systems of interest to the engineer and applied physicist. Topics include: multiple-photon processes, field quantization, Brillouin and Raman scattering, and electrons in crystals. Prerequisite: 324A.

3 units, Aut (Pantell)

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 Schroedinger 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)

328A, B. Physics of Semiconductor Devices—Band structure in solids, effective mass, transport theory from Boltzmann's equation, recombination. The Hall effect; measurement techniques. The p-n junction, the transistor, surface effects, the Schottky barrier. Tunnel effects, the Esaki diode, the JFET and other field-effect devices. High field effects; Gunn effect and avalanche mechanisms. Prerequisite: 111 and 322A or equivalent.

3 units, Win, Spr (Kino)

329A, B. Solid State Electronics Laboratory—Experimental projects on semiconductor crystal growth, gaseous diffusion of impurities, Hall effect, minority-carrier diffusion and drift mobility, thermoelectricity, electroluminescence, Gunn effect, optical absorption, plasma reflection, Schottky barriers, etc. Registration by consent of instructor. Prerequisite: 328A 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, including Ge, GaAs, NaCl, ruby, Cu, and Al. Prerequisites: One group of the following: 322A and 322B (may be concurrent); Physics 230 and 231 (may be concurrent); or Materials Science and Engineering 233 (338A); or consent of instructor.

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, Staff)

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; dispersive and anisotropic media. Prerequisite: 243 or equivalent.

3 units, Win (Lawrence) alternate years, given 1972–73

344. Guided Waves—Microwave network theory and normal mode theory; the Foster reactance theorem; reciprocity; equivalent circuits for a cavity; impedance of a diaphragm; variational techniques; quasi-static techniques. Perturbation theory of cavities and wave guides; applications to measurements. Mixed TE-TM modes, the sheath helix. Periodic systems, the disc loaded wave
guide, and the tape helix. Wave propagation in anisotropic media. Scattering matrices. Prerequisite: 244 or equivalent.

3 units, Aut (Kino) alternate years, given 1973–73

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 (Goodman)

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. Prerequisite: 243 or equivalent.

3 units, Spr (Helliwell) alternate years, given 1973–74


3 units, Spr (Goodman)

350. Radioscience Seminar — Student-faculty discussion of research problems in the fields of ionospheric and magnetospheric physics; radio propagation in, and radio emission by, ionized media; solar terrestrial relations; and radio and radar astronomy, and plasma physics.

1 unit, Aut, Win, Spr (Staff)

351. Plasma Wave Theory—(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 1972–73


3 units, Aut (Bracewell) alternate years, given 1972–73

354F. 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 (e.g., meteor trails), and from turbulent and thermal fluctuations in a plasma. Propagation through planetary atmospheres and scattering from planetary surfaces. Emphasis on physical descriptions and on applications to communications, radar astronomy, and space probes. Prerequisite: 243 or consent of instructor.

3 units, Aut (Eshleman) 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, magnetionic 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

357A. Applied Physics Measurements I—(Enroll in Applied Physics 350.)

357B. Applied Physics Measurements Laboratory I—(Enroll in Applied Physics 351.)

358A. Quantum Electronics—(Enroll in Applied Physics 358.)

358B. Quantum Electronics Laboratory—(Enroll in Applied Physics 359.)

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. Prerequisite: 363 or equivalent.

1 unit, Aut, Win, Spr (Bryson, Kailath)


4 units, Aut (Kailath, Staff)
Spr (Tuttle)
Sum (Staff)

364A. Optimal Trajectories and Control Logic—(Enroll in Aeronautics and Astronautics 278A.)

364B. Optimal Estimation and Control Logic in the Presence of Noise—(Enroll in Aeronautics and Astronautics 278B.)

366. Multivariable Systems Theory—Structural properties—controllability, observability, canonical forms. Applications to pole-shifting, decoupling, system realization and identification. The course will be a sequel to EE363 and EE378, where similar problems are studied for scalar systems.

1 to 3 units, Spr (Kailath) MWF 2:15


3 units, Spr (Widrow)

375. Information Systems Seminar — Lectures and discussion of advanced topics and research areas in information systems: selected topics such as shift registers, rate distortion theory, algebraic systems theory, simultaneous communications, etc.

1 unit, Aut (Hellman)
1 unit, Win (Gray)
1 unit, Spr (Goodman)

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 (Staff)


3 units, Win (Cover)

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 MC (McCluskey) MWF 11
Win (Staff) MWF 11
Sum (Staff) MWTTh 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 (Staff) 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,
McCluskey) 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

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. Prerequisite: Statistics 116 or equivalent; 286B or systems programming experience.

3 units, Aut (Bredt) MWF 11
Spr (Enroll in Computer Science 246)

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 (Staff)

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 epitaxial, oxidation, diffusion, evaporation, sputtering, and photolithographic processes with emphasis on techniques for achieving advanced device performance. May be repeated for additional credit. Prerequisite: 312 and consent of instructor.

3 units, Win (Meindl)

413. Ion Implantation Techniques—Theory of ion implantation and related processes, with applications to the study of solid-state materials and the fabrication of solid-state devices.

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.

3 units, Aut, Win, Spr

Section 1 Gibbons
Section 2 Heffner
Section 3 Pearson
Section 4 Shockley
Section 5 Spicer
Section 6 White

417. Integrated Circuit Applications—Computer assisted analysis, and design, fabrication, and application of integrated circuits and transducers in electronic systems such as optical-to-tactile reading aid for the blind, implantable ultrasonic blood flow-meter, microprobe for biopotential sensing, gas chromatograph, and ultrasonic imaging device.

1 to 4 units, Aut, Win, Spr
Section 1 Angell
Section 2 Dutton
Section 3 Lineill
Section 4 McWhorter
Section 5 Meindl


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.

3 units, Aut, Win, Spr
Section 1 Chodorow
Section 2 Kino
Section 3 Quate

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 1972–73

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.

3 to 4 units, Aut, Win, Spr
Section 1 Harris
Section 2 Siegman
438A. Theory of Solids—(Enroll in Applied Physics 377.)


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

Section 1 Crawford

Section 2 Helliwell

450. Radioscience Laboratory—Experimental, observational, and theoretical problems of the ionosphere, magnetosphere, troposphere, and radio and radar astronomy.

3 units, Aut, Win, Spr

Section 1 Bracewell

Section 2 da Rosa

Section 3 Eshleman

Section 4 Helliwell

Section 5 Lusignan

Section 6 Manning

Section 7 Peterson

Section 8 Villard

Section 9 Waterman

451. The Laboratory Plasma—(Enroll in Engineering 211.)

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


3 units, Win (Buneman) alternate years, given 1972–73

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, economies, and data management used in simulating media such as plasmas, gases, the atmosphere, electron and/or hole distributions, etc. on a large computer; introduction to low level languages. For doctoral candidates in Electrical Engineering, Mechanical Engineering, Aeronautics and Astronautics, Applied Physics, or Computer Science.

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.

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

Section 1 Cover

Section 2 Franklin

Section 3 Goodman

Section 4 Gray

Section 5 Hellman

Section 6 Kailath

Section 7 Luenberger

Section 8 Padulo

Section 9 Tuttle

Section 10 Widrow

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 (Davidson) 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, Turing machines. Prerequisites: 284 and one of 382, Philosophy 162, or Computer Science 156.

3 units, Spr (Davidson), alternate years, given 1972–73

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 Davidson
Section 4 McCluskey
Section 5 Peterson
Section 6 Stone

ENGINEERING-ECONOMIC SYSTEMS

Chairman: William K. Linvill
Associate Chairman: Donald A. Dunn
Professors: Donald A. Dunn, Willis W. Harman, Ronald A. Howard, William K. Linvill, David G. Luenberger
Associate Professors: Richard D. Smallwood.
Acting: John T. McAlister, Jr.
Assistant Professor: Edward J. Sondik, James L. Sweeney. Acting: Dimitri P. Bertsekas, Shmuel S. Oren
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 course work in economics is not required, but will prove helpful in graduate study in this field.

PROGRAMS OF STUDY

There are three programs of study, all at the graduate level, leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy in Engineering-Economic Systems.

MASTER OF SCIENCE

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 meet-
ing 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**

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. Only after the Application for Doctoral Candidacy has received official Departmental and University approval does the student become a candidate for the degree.

In the first quarter after receiving the Master of Science degree the student should submit to the Departmental office one copy of the Application for Doctoral Candidacy form for preliminary Departmental approval. Official Departmental approval will be given after successful completion of the qualifying procedure.

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. 145), (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 15 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 his ability to solve system problems in the field environment. Those students who have not had adequate previous experience typically serve one or more internships under the general supervision of the Engineering-Economic Systems staff.

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 civilian and military systems, and in government agencies planning and executing public works and economic development projects. Opportunities also exist to participate in economic and industrial planning in developing countries.

The duration of an internship will normally be between six and twelve months, but depends upon the time required to complete each project successfully. While interning, the student will live on location and work as an employee responsible to the company or agency concerned. The Engineering-Economic Systems faculty will locate and screen suitable internship opportunities in a variety of areas, but the student bears the responsibility for selecting an appropriate problem and for arranging conditions of employment. The faculty will review 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 research. After returning to the University, the student will complete this phase of his program by reexamining his 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 his experience the general insight that he 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. The internship experience develops the student's appreciation for the relation between general and applied work and guides him in selecting a meaningful research topic.

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.

**Areas of Application**

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 to as many specific problem areas as possible. A practitioner, to be responsible and effective, must combine general system knowledge with the important specific factors relevant to the problem at hand. The opportunity for students to receive this important aspect of a systems education exists primarily in the internship program, in various applied research projects that may be in progress within the Department, and in special courses that concentrate on the application of system concepts to specific areas.

While the resources of the Department for providing direct experience with a large number of practical problems is limited, the spectrum of interests and the range of problem areas investigated is not. Thus, at any one time there may be only a limited number of specific problem areas that are being actively pursued by the faculty, although the range of problems encountered over a span of years will be great.

Specific areas that have been studied in the past include industrial systems, public systems, development systems, and human systems. Industrial systems studies involve problems of organizing the complex activities of a production-distribution system and of selecting a strategy for corporate research, development, marketing, and facility expansion. Public systems are involved with both local and national problems of our society. Problems of housing, health services, transportation, water resources, power resources, communication, and criminal justice are examples. Development systems are related to problems of local, regional, and national development both within the United States and in foreign countries. Human system studies involve problems of man-machine systems, communications, automated instruction, educational system planning, human resource development, motivation, and personal development.

The above list of application areas is not intended to be either exclusive or exhaustive. In particular, only a small subset of these problems is being pursued adequately by the faculty at any time. On the other hand, there is represented in the faculty some level of interest in each of these problem areas. In addition, new system areas will be undertaken whenever technically interesting and practically significant problems arise, and there is adequate faculty and student interest and commitment to sustain them.

**Financial Assistance and Admission**

A limited number of fellowships and research assistantships are awarded annually. The fellowships are usually awarded to newly entering students; the assistantship is used primarily for advanced graduate students. 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. Research assistants can, and normally do, carry out their thesis work and write their theses as an integral part of the commitments of their assistantship.

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 are 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 profession both now and for the years to come. Although the exact course program will vary, depending on a given student's background, the objective is to assure that each student has an adequate foundation on which to build his professional education. The stronger a student's background in foundation courses, the greater will be his flexibility to move from area to area as career opportunities develop.

Engineering is distinguished from science by its emphasis on decisions concerning commitment of resources. The engineering-economic systems profession is characterized by its broad concern with the physical, economic, social, and political implications of systems decisions. The central focus of graduate study in systems is a set of portable concepts or tools of thought that apply to a broad spectrum of system problems. The three primary aspects in system work are: (1) intersystem relationships—how system planning decisions depend on a system's relationship to other systems at the same and other levels of the systems hierarchy; (2) economics and decision analysis—logical balancing of the economic and other factors that affect a decision; and (3) system analysis—development of the models for structuring and procedures for optimizing that formalize the selection among systems alternatives. 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*, 231A*, B

3. Applications and Research
   1) Models, Men, and Machines: 223
   2) Public Policy Analysis: 211, 249, 280
   3) Research, Seminars: 291, 292, 293, 300, 341, 350

* 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

tions, maximum principle, control of linear systems with quadratic cost functions. State estimation problems, interpretation of Kalman filters as an example of least squares and as an application of decision analysis. Applications. Concurrent registration in Mathematics 113 and 114 is desirable.

3 units, Aut, Win, Spr (W. Linvill, Oren) TTh 3:15-4:30

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, 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, Spr (Bertsekas) TTh 1:50-3:05

263B. System Optimization — Linear operators; inverses; adjoints, pseudo-inverses. Minimization of functionals; calculus of variations, Feuchel 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


3 units, Aut (Sweeney) MW 11:00-12:15

211. Economics of Public Works — Analysis of public policy in relation to government production of services and regulated industries, criteria for public investment, price and non-price rationing of services, financing of services, political and bureaucratic behavior, intergovernmental relations. Prerequisite: 210 or 212A.

3 units, Win (Dunn) MW 11:00-12:15
212A,B. Price and Income Theory—Modeling of economic phenomena. The first quarter emphasizes micro-economic theory and analysis: theory of consumer, of production; partial and general equilibrium analysis; market structure; pricing of outputs and of productive factors; conditions for efficient resource allocation; relation of equilibrium allocations to efficient allocations. The second quarter emphasizes macro-economic theory and analysis: national income accounting; determinants of national product, employment; business cycles; inflation; economic growth.

3 units, Win, Spr (Sweeney) MW 9:30–10:45

231A,B. 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. First quarter self-contained; second quarter emphasizes project in which teams of students analyze current decision problems drawn from a variety of sources. Prerequisite: 221 or equivalent.

3 units, Win, Spr (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. Emphasis 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: Engineering-Economic Systems 221 or consent of instructor.

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

249. Urban Economic Analyses—(Enroll in Economics 249.)

280. Telecommunications Systems and Public Policy—(Same as Communication 280.) Fundamentals of telecommunications 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 system theory, such as optimization theory and decision theory, as well as areas of applications, such as regional development, health systems planning, and transportation planning. Topics will be announced on a quarterly basis.

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

341A,B,C. Seminar in Public Finance — (Enroll in Economics 341A,B,C.)
INDUSTRIAL ENGINEERING

Emeritus: Eugene L. Grant (Professor)
Chairman: W. Grant Ireson
Associate Professor: Roy E. Lave, Jr.

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 on 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, man-machine systems, and program management. 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 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 has complied with the prerequisites for the courses listed on his program for the M.S. degree.

ENGINEER

The Engineer degree is designed for students desiring the maximum academic preparation for a career of professional practice in the activities and areas described previously.

The Engineer degree requires two years of academic work beyond the Bachelor's degree. Normally a program of study for the Engineer degree will include the courses required for the M.S. plus approximately 30 units of additional courses of a more advanced level and a thesis. Up to 15 units may be allowed for the thesis. The purpose of the thesis is to prove the professional competence of the candidate and not necessarily to make an original contribution to knowledge.

DOCTOR OF PHILOSOPHY

The Doctor of Philosophy degree is for students desiring careers in teaching or research as opposed to professional practice.

The degree of Doctor of Philosophy is offered under the general regulations of the University. The program requires a minimum of three years (nine quarters) of graduate study, at least one year of which must be at Stanford. The first year is usually represented by the M.S. program. The completion of an acceptable dissertation may occupy most of the third year of study.

The program of study will be arranged by the candidate with the advice of a Faculty Committee of three appointed by the Department head and having as chairman the faculty member who will direct the thesis work. The final program must be approved by the Department.

ASSISTANTSHIPS AND SCHOLARSHIPS

A limited number of fellowships and assistantships with stipends of $750 to $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 (Ireson) 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, Win (——) TTh 
8:00-9:50

108. Work Systems Design and Measurement—Concepts and techniques of designing and improving work performance and productivity of men and man-machine systems. Work flow sequences, human physiological information processing capabilities and resultant principles of job design. Measurement and evaluation of work with respect to time and wages. Prerequisite: 120 (or concurrent registration), or a course in statistical methods.

3 units, Spr (Thompson) MWF 11

120. Quality Assurance — This course will examine the various aspects of modern quality assurance, for products, services, and public goods (e.g., air and water). The setting of standards, the determination of performance, and the methods for achieving standards will be discussed. Major emphasis will be on quality assurance for industrial processes and products. Quality Control charts and Acceptance Sampling Plans will be covered. Opportunities for visits to local industries will be provided. Prerequisite: Statistics 40 or 116.

3 units, Win (Daetz) MWF 11

133. Industrial Accounting — 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, Win (Riggs) 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 (——) 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, Win (——) MWF 1:15
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 11
Win (Carlson) MWF 9

164. Production Engineering Problems — Each student will participate in a major term project. Special attention will be given to problem identification and definition. Students may work individually or in groups of from two to four. Students will be expected to apply analytic methodology obtained from previous course work, but the emphasis will be on the creativity exhibited
in the synthesis of feasible solutions to real problems. Not open to graduate students. Prerequisite: 160.

3 units, Win (Carlson, Staff) MWF 1:15

191. Directed Study — Directed study on subject of mutual interest to student and staff member. Student must find a sponsor and submit a one-page description of plan.
1 or more units (Staff) by arrangement

199. Senior Seminar—Class discussions of current problems and methodologies. Emphasis given to reading current literature. Students will be encouraged to critically evaluate recent work. Concentration on broad problems requiring initiative, ingenuity, and the judicious selection and integration of analytical techniques from all previous course work. Prerequisite: 164.
3 units, Spr (Carlson) 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 making. Design of interactive computer graphic systems.
3 units, Aut (Thompson) MWF 10

209. Analytical Methods for Industrial Engineers — Course is designed for first year graduate students who need a detailed course in the recent advances of linear algebra, linear programming, statistics and probability theory, engineering economy, decision analysis, and computer programming.
6 units, special session only, Aug. 20—Sept. 14 (Staff) MTWThF 8-12 and 1:15-5:05

210. Systems Analysis and Synthesis I—A first-year graduate course in mathematical methods of systems analysis. Topics covered include: logic and proofs; difference equations; Z-transforms and their use in difference equation; conditional probability and Bayes theorem; Markov chain analysis; dynamic programming and its application to non-union optimization. Prerequisite: 209 or equivalent and one year of calculus.
3 units, Aut (Di Giulio) MWF 9

211. Systems Analysis and Synthesis II—Continuation of 210 with topics including: application of dynamic programming to capital budgeting and economic decision-making; decision systems analysis using utility concepts; Markov decision models with application to repair/replacement of stochastically failing systems. Prerequisite: 210, Statistics 116 or 40.
3 units, Win (Di Giulio) MWF 10

212. Systems Analysis and Synthesis III—Continuation of 210 and 211 for those students who want to continue in Systems Analysis and Synthesis after the first year. Course will concentrate on design and operational control of systems. Topics include: Markov and semi-Markov models of random systems under control; Bayes estimation and invariant prior problems; non-linear system optimization and control with Pontryagin’s maximum principle; the design of two large scale systems—one domestic and the other worldwide. Prerequisite: 211, Statistics 219 or 110. Recommended: Engineering 202 and Engineering-Economic Systems 231A.
3 units, Spr (Di Giulio) MWF 10

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 1973-74

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 (Oakford) MWF 1:15
Spr (Oakford) MWF 8
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 industrial environment. The importance of management judgment and effective written and oral expression is stressed. Seminar format is used, with emphasis on case analysis and discussion. Prerequisites: 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 (Thompson) T 1:15-3:05, Th 1:15 and one hour by arrangement

239A, B, C, D. Programming, Planning and Budgeting of Research and Development—A course on the research and development process with emphasis on R&D's potential role in Brazil. Includes marketing of R&D, management and control of R&D projects, types of R&D organizations, resource allocation and budgeting, identifying R&D opportunities, design of R&D information systems, contract types. Includes case study lectures by professionals from R&D organizations and visits to R&D sites. 239A is an introduction to R&D management. It should be taken in conjunction with 234. 239B requires study of the literature on R&D. 239C focuses on the personal experiences of researchers. 239D requires the execution of a research project. Prerequisites: IPEA students or consent of instructor.

2 units, Aut, Win (_____) by arrangement
3 units, Spr (_____) by arrangement
6 units, Sum (_____) 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, time-sharing, 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 (Daetz) MWF 1:15

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 8


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 10; lab T 2:15-5:05

264. Advanced Analysis of Production Systems—Advanced topics in production planning and control, inventory accumulation, assembly line balancing, facility location, and industrial growth. Not open to undergraduates. Prerequisite: 260 or equivalent.

3 units, Spr (Carlson) MWF 9

280. Seminar in Biotechnology — Special topics in Man-Machine Systems, including Management Information Systems and Hospital Information Systems. Emphasis on computer-aided decision-making by means of optimal formatting and display of information concerning available alternatives. Prerequisites: 208 or consent of instructor.

3 units, Win (Thompson) Th 2:15-4:05

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 (Daetz) 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 en-
engineering students. Prerequisite: 240 and Computer Science 111.

3 units, Win (Di Giulio) by arrangement, alternate years, given 1973–74

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 1972–73

MATERIALS SCIENCE and ENGINEERING

Emeriti: Welton J. Crook, O. Cutler Shepard (Professors)
Chairman: John C. Shyne
Associate Professors: Craig R. Barrett. Consulting: Farid Abraham
Assistant Professors: David M. Barnett. Visiting: Richard A. Wallace
Lecturer: Claus G. Goettel

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 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 course work and to obtain training in research. Graduate programs lead to the degrees of Master of Science, Engineer, and Doctor of Philosophy.

FACILITIES FOR INSTRUCTION AND RESEARCH

The Materials Science and Engineering Department occupies an area of 30,000 square feet in the Thomas F. Peterson Engineering Laboratory building. The laboratory includes modern facilities for teaching and research in physical metallurgy and materials science. Ordinary melting and heat treating furnaces are included as well as furnaces for vacuum melting, zone refining, and crystal growing. Mechanical testing equipment includes hardness measuring devices, variable strain rate machines for mechanical deformation studies, creep machines and equipment for dynamic elastic modulus and internal friction measurements. For studying the structure of solids, there are optical and electron microscopes as well as X-ray and electron diffraction machines, X-ray fluorescent equipment, gamma ray spectrometer, electron probe microanalyzer, nuclear magnetic resonance spectrometer, and equipment for standard electrical, magnetic, and optical measurements.

The Department, together with Physics, Chemistry, and Solid State Electronics, participates in an interdisciplinary Center for Materials Research that has been established at Stanford by funds from the Advanced Research Projects Agency. The Center, with a budget of a million dollars a year, provides equipment, service facilities, and funds for faculty and student research. In addition the Center provides 35,000 square feet of space for materials research in the McCullough Building.
PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The undergraduate Materials Science and Engineering program provides training in solid state fundamentals and in physical metallurgy. Students desiring to specialize in this field during their undergraduate period may do so by following the curriculum outlined earlier under School of Engineering. The University's basic requirements for the Bachelor's degree are discussed in the section "Degrees" in this bulletin. Electives are available so that students with broad interests can combine Materials Science and Engineering with work in another science or engineering department.

ADVANCED DEGREES

Graduate students can specialize in any of the areas of Materials Science and Engineering. In collaboration with other departments of the University, additional special programs are available. For example:

Materials Science and Engineering—
   Electronic Materials
Materials Science and Engineering—
   Applied Mechanics and Structures

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 Departmental requirements:

1. Completion of the equivalent of the requirements for the B.S. degree in Materials Science and Engineering. Deficiencies in previous training should be made up.

2. Completion of 45 units of an approved program. A minimum grade point average of 2.75 for course work is expected. The program should contain the following:
   a) All courses in the 180 series (18 units) except for students who have had equivalent courses at other universities.
   b) A minimum of 15 units of advanced course work (beyond the 180 series) in the Department (excluding attendance-only seminars and research and special problems).
   c) The entire 45 units Masters 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.
   d) 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.

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 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

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 (Barrett) 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 (Shyne) MWF 10


3 units, Win (Staff) 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 (Geballe) MWF 10

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 behav-
ior, 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 prostheses 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

203. Computer Simulation in Materials Science—The objective is to provide the graduate student with the techniques and attitudes required for the synthesis of several disciplines of knowledge so that he may be able to effectively resolve the “systems” problems which populate the Materials field. Prerequisite: Mathematics 131.

2 units, Win (Barnett) TTh 9

204. Wave Mechanics—Concepts and mathematical formalisms for treating waves, with specific applications to lattice vibrations, electromagnetic waves and optical properties of solids, and elementary quantum mechanics.

3 units, Win (Bube) MWF 1:15

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 (Nix) MWF 8

207. Metal Refining Processes—(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

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 (Goetzel) 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 1972–73

220. Phase Transformations in Solids — Thermodynamic, kinetic, and crystallographic aspects of phase transformations in metals and alloys, with particular attention to martensitic transformations. Prerequisite: 152.

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, Spr (Stevenson) 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 1973–74

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, Spr (Staff) TTh 10:00–11:30, given 1972–73

225. Surfaces and Interfaces — (Enroll in Applied Earth Sciences 225.)

226. Corrosion and Electro metallurgy — 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 1972–73

230. Materials Science Colloquium. 1 unit, Aut (Sherby) M 4:15

Win (Stevenson) M 4:15
Spr (Bube) 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 (Bube) 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 levels 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—Seminlar on selected topics in photoelectronic properties of solids, including photoconductivity, luminescence, photovoltaic effects, and methods of photoelectronic analysis of ordered and disordered materials. Prerequisite: 233 or Electrical Engineering 322B.

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

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, Aut (Staff) TTh 9, given 1972–73
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: 237.

3 units, Win (Nix) MWF 8, alternate years, given 1973–74

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 1972–73


3 units, Win (Pound) TTh 1:15–2:45, given 1973–74

256. The Science of Crystallization I — Analysis of the factors involved in predicting distribution coefficients for solutes between two phases. Analysis of solute redis...
tribution 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. Prerequisite: 201 or 240, and Mathematics 131.

3 units, Aut (Tiller) TTh 3:15-4:30 alternate years, given 1972-73

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 1972-73

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

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 (Tiller) TTh 2:15-3:30
Design Division Affiliated Faculty: William J. Bowman (Art), Matthew S. Kahn (Art), Bruce B. Lusignan (Systems Design), David A. Thompson (Biotechnology and Computer Graphics), Douglass J. Wilde (Optimization)

Offerings and Facilities

The courses and degrees offered in Mechanical Engineering provide a background for careers in research, development, design, and manufacture in a wide variety of industries concerned with the handling of mechanical, thermal and nuclear energy (generation, transmission, conversion, metering, control, utilization), the handling of fluids, the construction of mechanical devices (tools, mechanisms, machines, mechanical instruments, control systems), and the conception of systems involving mechanical and thermal components together with electrical, chemical, and human components. Graduates at all degree levels typically go into the product manufacturing industries, aerospace industries (especially in propulsion systems), nuclear power industry, gas turbine and internal combustion systems industries, and to a lesser extent into the chemical and petroleum process, and transportation.

The Department is organized into three divisions: Thermosciences, Design, and Nuclear, each of which maintains its own laboratory, shops, and secretarial services. The Thermosciences Division offers courses and specialized work in the areas of thermodynamics, thermal power systems, pollution control, energy conversion, fluid mechanics, and heat transfer. The Design Division is concerned with systems design, product design, mechanical analysis and design, component design, and the design process. The Design Division also offers an undergraduate program in architecture and advises undergraduates interested in Urban Design. The Nuclear Division offers work in reactor physics and all aspects of nuclear reactor technology. It should be noted that this Department does not offer specialized work in the areas of engineering mechanics, and students interested in concentrating in engineering mechanics should consult the Department of Applied Mechanics section of this bulletin. However, students studying for any of the degrees offered by the Department will ordinarily take courses in Applied Mechanics, as well as in several other departments of the University.

Facilities

All three Divisions of the Department maintain modern laboratories which are used for both undergraduate and graduate instruction and graduate research work.

The Thermosciences Division Laboratories are equipped with representative power, fluid handling, refrigeration and heat and mass transfer equipment, a magneto-hydrodynamic power conversion system, shock tube, gasdynamics facility, and extensive special facilities for convective heat transfer and boundary layer research. A wide variety of instrumentation, extensive shop facilities, utilities, and research space are all available within the laboratories.

The Design Division maintains shops and laboratory space for both student instruction and construction of research apparatus, drafting rooms, and instrumentation and space for instruction and graduate research work in stress analysis, dynamics, mechanics, and control systems.

The Nuclear Division laboratories include a 10 KW pool-type research reactor, a neutron accelerator, a sub-critical assembly, a radiochemistry laboratory, a reactor heat transfer laboratory, an analog computer, and a machine shop.

In addition each Division maintains its own small library and reading room, and office space for a substantial number of graduate research students.

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.

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 graduate student in the Department a student must have received a B.S. degree in engineering, physics, or some comparable science program. His undergraduate record and personal recommendations must demonstrate that he is capable of handling graduate level work and will be able 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 esthetic aspects of design, to highly technical scientific research. The discipline areas of interest to mechanical engineers include applied mechanics, materials, fluid mechanics, thermodynamics, heat transfer, nuclear reactor physics, magnetohydrodynamics, 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 (and 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 should ordinarily 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, 175, 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 175, 201A,B,C, 206, 242A, 242B, 247, 273, 274, 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: Industrial 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 78 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>
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<tr>
<td>*M.E. 299A, B, C. Master's Project</td>
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<tr>
<td>*Art 341D. Master's Project</td>
<td>12</td>
<td></td>
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<tr>
<td>Art 261. Graphic and Product Design</td>
<td>4</td>
<td></td>
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<tr>
<td>Indus. Engr. 208. Biotechnology</td>
<td>6</td>
<td></td>
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<tr>
<td>Indus. Engr. 263. The Engineering and</td>
<td>3</td>
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<tr>
<td>Organization of Small Businesses</td>
<td>3</td>
<td></td>
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<tr>
<td>Approved electives</td>
<td>12</td>
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<tr>
<td>Free electives</td>
<td>5</td>
<td></td>
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<td><strong>Total</strong></td>
<td>45</td>
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* 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 he 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 himself during his 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 he holds a fellowship that precludes such payment.

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 82 (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, he 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 his research prior to admission, his adviser will assist him in making such an arrangement. However, the Department cannot guarantee research supervision, as this involves a personal arrangement between the student and the individual faculty member, and such an arrangement is entirely the responsibility of the student. Once a student has obtained a research supervisor, this supervisor becomes thereafter his academic adviser. Research supervisors may require that the student pass the Departmental Oral examination before starting on research work and before awarding 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 five oral interviews, one of which must be in mathematics, and the other four are chosen from the areas of controls, mechanical engineering design, fluid mechanics, heat transfer, elastic body mechanics, dynamics, physics, nuclear reactor theory, or thermodynamics. Additionally the student must complete certain minimum course requirements in a sixth optional area, but need not take an examination. A student must have the approval of his adviser, and at least a tentative arrangement for research supervision, in order to take the examination. The examination is offered during the winter 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. 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 (of 135 units of graduate work), 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.

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 he holds a fellowship that precludes such payment.

**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 teaching 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.

Applicants for all three forms of assistance may obtain the necessary application forms from the University Admissions Office. How-
ever, post-Master's degree applicants for re-
search assistantships are advised to contact
directly the faculty member under whom
they would like to work, because of the in-
dividual nature of these awards, and if they
are successful they need not apply to the
Department for assistance. Formal applica-
tions to the Department for research assis-
tantships 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. Inso-
far as the laboratory schedule permits, stu-
dents will be allowed, with due regard to
priority of application, to arrange their own
sections and laboratory periods. Enrollment
with the instructor concerned, on registra-
tion day or the first day of University in-
struction, is essential in order that the lab-
oratory schedule may be prepared. Enrollment
later than the first week will not be
permitted under any circumstances.

33. **Introductory Fluids Engineering**—Ele-
ments of fluid mechanics, introduction to the
use of the momentum principle, together
with the fundamentals of thermodynamics,
in the solution of fluids engineering prob-
lems. 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 exer-
cised in context of solving design problems.
Exercises for the mind's eye. Quickly exe-
duted diagrammatic, orthographic, perspec-
tive and three-dimensional sketching. Rela-
tion of visual thinking to creative process.
Emphasis upon fluent and flexible idea pro-
duction.

3 units, Aut (McKim, Verplank) lec. and
lab.
Sec 1 MW 1:15–3:05
Sec 2 MW 3:15–5:05

102. **Optimization**—(Enroll in Engineering
102.)

103. **Manufacturing Technology**—The ca-
pabilities and limitations of common manu-
facturing processes. Selection and specifica-
tion of metallic and non-metallic engineer-
ing materials. Properties of materials as they
affect and are affected by manufacturing
processes. Engineering shop drawings—the
interrelation of part description, dimension-
ing, tolerances, and process of manufacture.
Laboratory experience in machining, cast-
ing, and welding. Various aspects of the
course will be developed in a project to be
designed, described in engineering draw-
ings, 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 Engi-
neering 104.)

105. **Control System Analysis and Design**—
(Enroll in Engineering 105.)

107. **Mechanical Systems**—An investigation
of the techniques used in design and de-
velopment of complex mechanical systems.
The relative role of test, cut-and-try de-
development, intuition and analysis will be in-
vestigated. Critical parameters of mechan-
ical system elements and transmission of force
and motion through systems will be dis-
cussed. 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.). Pre-
requisites: Engineering 11 and 12 or equiva-
 lent.

3 units, Win (Piziali) lec. TTh 10;
lab. Th 2:15–5:05

111. **Failure Prevention**—Modes of me-
chanical failure. Effects of loads, load his-
tory, environment. Strength criteria. Prop-
erties of materials and their measurement.
Description and forecasting of load histories.
Probability of survival. Structural similarity
and optimization. Characteristics of struc-
tures to resist deformation, fracture, loosen-
ing, corrosion, wear. Analysis of typical ex-
amples from a variety of fields. Familiarity
with elementary statics and strength of ma-
terials is assumed.

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, Win, Spr (J. Manning) TTh 2:15–5:05

115A. **Introduction to Product Design**—Active encounter with human values in design. Lectures survey central philosophy of product design program, with emphasis upon the relation between technical and human values, the creative process, and design methodology. Laboratory exercises include the development of simple product concepts visualized in rapidly executed three-dimensional mockups. Prerequisite: 101.

3 units, Win (McKim) MW 1:15–4:05

115B. **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 (Staff) TTh 12:00–2:05

116B. **Advanced Product Design**—New product innovation via need-finding. Prerequisite: 116A.

3 units, Win (Verplank) 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 thermosciences 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 (Staff) MWF 10; lab. one afternoon by arrangement

131B. **Thermosciences**—Continuation of 131A.

5 units, Win (Staff) MWF 10; lab. one afternoon by arrangement

131C. **Thermosciences**—Continuation of 131B.

4 units, Spr (Staff) 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 engineering and science students and a limited number of 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


3 units, Win (Piziali) MWF 11

150. **Energy and Society**—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: junior standing or consent of instructor. Student may register for 3 or 5 units, the latter requiring a term paper.

3 or 5 units, Spr (Connolly)
T 9 and Th 9 and 10

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

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.

3 units, Aut (Staff) Th 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

MEZZANINE LEVEL COURSES

Although described elsewhere, the following courses are especially suitable both for advanced undergraduates and for graduates, and may be used to satisfy the M.S. requirement, item 3, 15 units of approved electives.

Course No. Subject
M.E. 105. Control System Analysis and Design
(Enroll in Engineering 105)
M.E. 113. Engineering Design
M.E. 137. Air Pollution
M.E. 138. Noise Pollution
M.E. 161. Engineering Vibration
M.E. 206. Control System Analysis and Design
(Enroll in Engineering 205)
M.E. 230. Heat Transmission
M.E. 232. Advanced Fluids Engineering
M.E. 236. Gasdynamics

COURSES PRIMARILY FOR GRADUATES

ENGINEERING DESIGN

201A,B,C. Engineering Design — An intensive treatment of engineering design. The package will consist 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 environ-
ments, design aesthetics, and man-machine integration. The course will be team-taught and will involve all Design Division faculty members. These three courses constitute an integrated series. Students wishing to enroll in a portion of the series must obtain the consent of the instructor. Prerequisite: graduate standing.

201A. 6 units, Aut (Staff) TTh 1:15-4:05
201B. 6 units, Win (Staff) TTh 3:15-5:05
   plus 1 hour by arrangement
201C. 6 units, Spr (Staff) MW 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 (McKim) T or Th 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, given 1973-74

222. Kinematic Synthesis of Mechanisms—The rational design of linkages is the central theme of this course. The problem of determining linkage proportions to fulfill various design requirements is treated analytically. Topics include: three- and two-dimensional displacements and motions, the theory of higher plane curves, higher-order path-curvature analysis, circle and center-point theory. Prerequisite: 107.

3 units, Spr (Roth) MWF 12, given 1973-74

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, given 1973-74


3 units, Spr (J. Manning) MWF 9,
   alternate years, given 1972-73

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


2 units, Spr (Fuchs) MW 2:15

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

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, he prepares a design
program, develops concepts, performs necessary experiments, and carries project to the stage of a working prototype. In the third quarter, he 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.)

230. Heat Transmission — A one-quarter course open to all graduate students and to undergraduates outside of Mechanical Engineering covering conduction, convection, and radiation. This course is intended primarily for students who want an appreciation of the principles of heat transfer to support their major engineering objectives, but who do not wish to devote a full year to the subject. The course should not be taken by students who have had a previous undergraduate heat transfer course or by students who plan to take 231A,B,C. Prerequisite: elementary ordinary differential equations.

3 units, Aut (Staff) MWF 9


3 units, Aut (Staff) MWF 9

231B. Heat Transmission—Boundary layer theory, including heat, mass, and momentum transfer, laminar and turbulent flows inside tubes and external boundary layers; the high velocity compressible boundary layer; design of heat and mass transfer systems. Prerequisite: 231A or consent of instructor.

3 units, Win (Staff) MWF 9

231C. Heat Transmission—Continuation of 231B: Prerequisite: 231B.

3 units, Spr (Staff) MWF 8

232. Advanced Fluids Engineering—A one-quarter course in continuum fluid mechanics, and engineering design and optimization of internal flow systems, e.g. nozzles, diffusers, turbomachines. Brief development of equations of continuity and motion for viscous, compressible, and incompressible substances. Introduction to boundary layer and potential flow methods, dimensional analysis, modeling and analogues, flow visualization. This course should not be taken by students who plan to take 238A,B,C. Prerequisites: elementarv vectors, ordinary differential equations, and calculus of functions of several variables; 131A,B,C or equivalent.

3 units, Win (Johnston) 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) TTh 11:00–12:15

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, flame propagation theories, design of combustion chambers. Production of pollutants in combustion systems. Kinetics of reactions, particularly with regard to emissions of oxides of nitrogen. Reduction of pollutant emissions by modification of combustion parameters. Applications to combustion systems includ-
ing gas turbines, rockets, and industrial systems.

3 units, Aut (Eustis, 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, Win (London) MWF 10; 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. Continuum Fluid Mechanics — Development of the basic mathematical models for the kinematics and dynamics of the fluid continuum. Integral theorems for mass, momentum and energy. The Newtonian fluid and Navier-Stokes equations. Fractional analysis of basic equations and boundary conditions to obtain simplified models: one-dimensional flow, two-dimensional potential flow of an incompressible fluid, the boundary layer. Applications to engineering problems by exact and approximate methods. Prerequisite: graduate standing.

3 units, Aut (Staff) MWF 8

238B. Continuum Fluid Mechanics — Continuation of 238A: Exact solutions to Navier-Stokes equations. Low Reynolds number flows. Introduction to lubrication. The laminar boundary and free shear layers (wakes and jets). Concepts of stability of fluid flows and introduction to hydrodynamic stability theory. Prerequisite: 238A.

3 units, Win (Staff) MWF 11


3 units, Spr (Reynolds) MWF 9

239A. 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. Prerequisite: graduate standing. Recommended: 238A or 232.

3 units, Win (Johnston) MWF 3:15, alternate years, given 1973-74

239B. Hydrodynamic Stability—(Enroll in Chemical Engineering 211.)

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 layers. 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


3 units, Sum (Moffat) MWF 10; one 2-hour lab. by arrangement

247. Experimental Plasma Physics Laboratory—(Enroll in Engineering 215.)
251. Introduction to Partially Ionized Gases—(Enroll in Aeronautics and Astronautics 284.)

252. Magnetofluidmechanics—Interaction of conducting fluids with electric and magnetic fields. MHD one-dimensional channel flow, boundary layers, power generation and fluid acceleration. Calculations of electrical conductivity of equilibrium and nonequilibrium partially ionized gases.

3 units, Spr (Staff) MWF 1:15

253. Kinetic Theory of Partially Ionized Gases—Collisions between charged particles, Debye shielding. The Fokker-Planck equation and its relation to the Boltzmann equation. Application of the spherical harmonic expansion to the calculation of electrical and thermal conductivities and thermal-diffusion coefficients of partially ionized gases in a magnetic field. The effect of strong electric fields on the electron velocity distribution 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. Nonequilibrium as a result of relaxation and radiation escape. Prerequisites: 251 and 211A, or consent of instructor.

3 units, Spr (C. Kruger) MWF 1:15, alternate years, given 1972–73

254. Physics of Atomic and Radiative Processes in Partially Ionized Gases—This course will be primarily concerned with providing an introduction to fundamental concepts in the electromagnetic theory of radiation and in quantum mechanics. Topics to be covered will include radiation from an accelerated charge, bremsstrahlung, blackbody radiation, deficiencies of classical theory, de Broglie waves, the uncertainty principle, Schrödinger’s equation and its solutions, scattering theory, Ramsauer effect. Emphasis will be placed on atomic collision processes of interest in high temperature gasdynamics. Prerequisite: familiarity with partial differential equations.

3 units, Spr (C. Kruger) MWF 3:15, alternate years, given 1973–74


3 units, Spr (Ferziger) MWF 11

260A. Mathematical Methods in the Thermosciences—Advanced topics in the analytical, asymptotic, and numerical solution of ordinary and partial differential equations with application in a variety of physical problems, including fluid mechanics and heat transfer. Prerequisites: Mathematics 106 and 132, or equivalent. Computer programming capability desirable.

3 units, Aut (Leonard) MWF 9

260B. Mathematical Methods in the Thermosciences—Continuation of 260A. Prerequisite: 260A.

3 units, Win (Leonard) MWF 9

298. Seminar in Fluid Mechanics—(Enroll in Engineering 298.)
OFFERINGS AND FACILITIES

The Division provides graduate instruction in nuclear reactor theory and experimentation, in nuclear reactor design and control, and in particle and radiation transport theory and experimentation. In addition, a wide range of courses in mathematics, physics, and various engineering sciences is available to the student. The program is intended for those students who plan a career of research, teaching, design, or management in the field of nuclear energy processes or systems. Each student works out a program of study with his adviser.

The Nuclear Engineering Laboratory has among its facilities a pool-type research reactor, an accelerator-type neutron generator with pulsing capability, a subcritical assembly, extensive nuclear counting and spectrometry equipment, and a radiochemistry laboratory. These facilities are used for instruction and graduate student research.

An active program of research is carried on in the Division of Nuclear Engineering under the sponsorship of various agencies. These projects include experimental and theoretical investigations relating to nuclear reactor theory, neutron transport and thermalization, and neutron cross sections. Research programs are also conducted in heat transfer, fluid mechanics, and radiochemistry. Qualified students participate in these projects as research assistants, engaged in thesis research, in close working association with a faculty research supervisor and fellow students.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The Division operates exclusively at the graduate level and requires the B.S. degree for admission.

MASTER OF SCIENCE

Admission and Registration — The basic University requirements for the Master's degree are discussed in the section “Degrees” in this bulletin. The Division of Nuclear Engineering is administered within the Department of Mechanical Engineering. A prospective student may apply for admission either in this Department (Nuclear Engineering — Mechanical Engineering) or in the Engineering Science program (Nuclear Engineering — Engineering Science). In either case, to be eligible for registration as a graduate student an applicant must have received a B.S. degree in engineering, physics, or some comparable science program. His undergraduate record and personal recommendations must demonstrate that he is capable of handling graduate level work and will complete the requirements for the M.S. degree. The graduate program leading to the M.S. degree under the rules of the Department of Mechanical Engineering is described in the preceding section. A student who wishes to follow a more specialized program of study in nuclear engineering than would conform with the requirements of the Department of Mechanical Engineering may do so under the Engineering Science program. This program is described under School of Engineering graduate programs in this bulletin.

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.

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, where 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 Division of Nuclear Engineering is administered within the Department of Me-
mechanical Engineering; a Ph.D. candidate is enrolled in this Department. A student may elect a minor field of study if he wishes, but it is not required that he do so. A Ph.D. program should, however, show some breadth of training outside of a student's research field.

A student studying for the Ph.D. degree ordinarily will not take an Engineer degree, although this is not precluded. Although a Master's degree is not technically required, a student will usually have fulfilled M.S. degree requirements before becoming a candidate for the Ph.D.

Prior to being formally admitted to candidacy for the Ph.D. degree the student must demonstrate his knowledge of the fundamentals of nuclear engineering by passing a qualifying oral examination. The examination covers the subjects of mathematics, physics, nuclear reactor theory, and two other engineering science subjects (e.g., control theory, heat transfer) selected from a list of seven. The academic level of this examination corresponds to the M.S. degree program. A student must have the approval of his adviser, and at least a tentative arrangement for research supervision, in order to take the examination. The examination is offered during the winter 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.

FINANCIAL ASSISTANCE

A number of fellowships and research assistantships are awarded annually to graduate students. The fellowships are usually awarded to first-year graduate students, with the assistantship used primarily for post-Master's degree students. Research assistantships are awarded by the individual faculty research supervisors and not by the Division as a whole.

Applicants for all forms of assistance may obtain the necessary application forms from the University Admissions Office. However, post-Master's degree applicants for research assistantships, because of the individual nature of these awards, are advised to contact directly the faculty member under whom they would like to work. Formal applications to the Division for research assistantships will be referred to the individual faculty research supervisors.

Research assistants can, and normally do, carry out their thesis work and write their thesis as an integral part of the commitments of their assistantship.

COURSES

174. Nuclear Science—(Enroll in Engineering 174.)

175. Radiation Measurements Laboratory—(Enroll in Engineering 175.)

176. Nuclear Energy—(Enroll in Engineering 176.)

177. Radioactivation Analysis—(Enroll in Engineering 177.)

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—Neutron cross sections, the fission process. Infinite medium criticality calculations; the four-factor formula. Neutron diffusion and slowing down theory. Age theory. Criticality calculations for the bare homogeneous reactor. Elementary reactor kinetics.

3 units, Aut (Staff) MWF 10


3 units, Win (Staff) MWF 10


3 units, Spr (Staff) 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, stellerator, Tokamak. Concepts of fusion reactors and
fusion-electric generators. Prerequisite: consent of instructor.

3 units, Win (Staff) MWF 8

273. Reactor Physics Laboratory — Measurements of: reactor criticality, periods, control rod worth, danger coefficients, reactor flux and power. Prerequisite: 271A.

3 units, Win (Staff); one afternoon by arrangement

274. Reactor Physics Laboratory — Measurements of: buckling and other parameters of subcritical assembly, void coefficients in pool reactor, neutron age and diffusion length in various media. Prerequisite: 271B.

3 units, Spr (Staff); one afternoon by arrangement

276. Neutron Transport Theory — Exact solutions of the one-speed neutron transport equation: escape probabilities, reciprocity theorems, infinite medium Green’s function, albedo problem, Milne problem, half-space Green’s function; approximate solutions of other problems; applications to kinetic theory of gases and radiative transfer. Extensions to the energy-dependent case will be treated briefly. Prerequisites: 271B and Mathematics 106.

3 units, Spr (Staff) by arrangement

277. Neutron Thermalization — Calculation of thermal neutron spectra; space-dependent spectra in reactors, time-dependent spectra in pulse systems. Calculation of scattering kernels from the dynamics of the scattering system: the Zemach-Glauber and Van Hove formalisms, application to scattering from an ideal gas, Einstein and Debye crystals, and molecules; approximate treatments of liquids, real gases and crystals. Prerequisites: 271C and Physics 132.

3 units, Spr (Ferziger) by arrangement

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 (Staff) TTh 11:00–12:15


3 units, Spr (Sher) TTh 10, alternate years, given 1973–74


3 units, Win (Staff) MWF 1:15

OPERATIONS RESEARCH

Chairman: Gerald J. Lieberman


Associate Professors: Richard W. Cottle, B. Curtis Eaves

Assistant Professor: 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 Professor: Charles P. Bonini

Assistant Professors: 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>
<tr>
<td>Op. Res. 240</td>
<td>Linear Programming</td>
<td>3</td>
</tr>
<tr>
<td>Electives from the offerings of the Department of Operations Research or from authorized courses in other departments</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Total.</td>
<td>45</td>
<td></td>
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</tbody>
</table>

No thesis is required. A minimum grade point average of 2.75 is expected.

**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 com-
munication 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, optimal control theory, structure and identification of dynamical systems, stochastic processes, optimal prediction and filtering, 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 his adviser may make adjustments in his program to reflect his 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 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 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, given 1973–74

150. Models and Applications of Operations Research in Society—Lectures same as 50, but a term paper is required.

3 units, given 1973–74

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) MW 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) MW 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
3 units, Sum (——) TTh 1:15–3:00

241. Economics of Industry — (Lectures same as Economics 254.) 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, Aut (Manne) TTh 11–1

3 units, Spr (Eaves) TTh 2:45–4:00

250. Deterministic Models in Operations Research—Formulation, solution, and analysis of mathematical programming models in operations research, including those of integer programming, nonlinear programming, network flow theory, dynamic programming, and game theory. Prerequisite: 240.
3 units, Win (——) 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 (Lieberman) MW 4:15–5:30
Sum (——) MW 1:15–3:00

252. Operations Research — For graduate students who have not had the equivalent of 152 and 153. Prerequisites: calculus and Statistics 40, or 110, or 116. May be taken concurrently.
4 units, Aut (Jacobs) MW 3:15–5:05
Win (Eaves) MW 4:15–6:05
Sum (——) TTh 3:15–5:30

257. Data Processing in Operations Research—Seminar in selected topics in the application of electronic computers to operations research activities. Emphasis on the use of simulation techniques. Prerequisites: Computer Science 106 or equivalent and at least two courses in Operations Research. May be taken concurrently.
3 units, Win (Hillier) MW 4:15–5:30

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 (Manne) W 1:15–3:05
290B. 3 units, Spr (Manne) 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 argu-
ment. Prerequisites: Mathematics 102 or 113, and consent of instructor.

314A. 3 units, Win (Cottle, Olkin)
314B. 3 units, Spr (Cottle, Olkin)

340A. Mathematical Programming — Formulation of standard linear programming models. The simplex method and lexicographic resolution of degeneracy. Linear inequality theory, alternative theorems, and duality. Variants of the simplex method including the dual simplex method, the revised simplex method with product form of the inverse, the primal dual method, and parametric linear programming. Matrix games. Theory of polyhedral convex sets. Prerequisite: Mathematics 113 or consent of instructor.

3 units, Aut (Eaves) TTh 1:15-2:30


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

340C. Mathematical Programming — Further study of nonlinear programming including convexity, duality theory, and optimality criteria for constrained optimization problems. Convergent solution methods such as feasible directions, nonlinear decomposition, cutting plane, penalty function, differential gradient. Unconstrained optimization and search techniques. Prerequisites: 340B and Mathematics 116, or consent of the instructor.

3 units, Spr (Cottle) TTh 1:15-2:30

341. Large Scale Systems in Mathematical Programming — Specializes the methods of 340. Development of efficient solution methods for optimizing special large-scale linear inequality systems such as those encountered in control theory, programming in a Markov chain, investment and economic planning, multi-commodity network flows, multi-item production and distribution models; and those that arise as a solution procedure for non-linear, integer, and stochastic programming problems. The decomposition principle, partitioning proposals, compact inverse schemes will be developed and applied to various special structures. The role of flexible computer languages to assist in the experimental development will be discussed. Prerequisite: 340B.

3 units, Spr (Dantzig) by arrangement


3 units, Spr (Wilde) MWF11


3 units, Win (——) TTh 9-11


3 units, Spr (Porteus) TTh 9-11


3 units, Win (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 (Iglehart) TTh 8-10

358. Queueing Theory — Introduction to queueing systems, Markov queues, ballot theorems and applications, random walks and applications, multiple channel queues in heavy traffic. Prerequisite: 359.

3 units, Win (Hillier) TTh 3:15-4:30


3 units, Aut (Iglehart) TTh 3:15-4:30

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 (Jacobs) TTh 10:30-11:45

370. Seminar in Mathematical Programming—Complementarity. Prerequisite: 340B.

3 units, Aut (——) by arrangement

371. Seminar in Combinatorial Analysis and Integer Programming—Advanced topics. Prerequisite: 341.

3 units, given 1973–74

372. Seminar in Nonlinear Programming—Advanced topics. Prerequisite: 340C.

3 units, given 1973–74

375. Seminar in Network Theory — Advanced topics. Prerequisite: 345.

3 units, given 1973–74


3 units, given 1973–74

377. Seminar in Game Theory—Advanced topics.

3 units, Win (Eaves) by arrangement

381. Seminar in Dynamic Programming — Advanced topics. Prerequisite: 351 and Mathematics 205A.

3 units, given 1973–74

385. Seminar in Reliability Theory — Advanced topics. Prerequisite: 355.

3 units, given 1973–74

386. Seminar in Inventory Theory — Advanced topics.

3 units, given 1973–74

387. Seminar in Probability Models—Topic for 1972–73 will be point processes.

3 units, Win (Jacobs) by arrangement

388. Seminar in Queueing Theory — Advanced topics. Prerequisite: 358.

3 units, given 1973–74

389. Seminar in Applied Probability—Advanced topics. Prerequisites: 359 and Mathematics 230A.

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. The topic for 1972–73 will be integer programming: branch-and-bound methods, heuristic procedures, special formulations, and socio-economic applications.

4 units, Spr (Hillier) TTh 4:10-5:45
SCHOOL of HUMANITIES and SCIENCES

Dean: Albert H. Hastorf
Associate Deans: Calvin F. Quate, Claude M. Simpson, Jr., Gordon J. Wright
Assistant Deans: Sydney G. Burkhart, Arnice Streit


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, Military Science, Music, Naval Science, Philosophy, Physics, Political Science, Psychology, Slavic Languages and Literatures, Sociology, Spanish and Portuguese, and Statistics, together with appointees to the Faculty at Large.

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, David Abernethy, Frank Bonilla, Henry Breitrose, Francesca Caniclan, William Chace, Cedric Clark, Elizabeth Cohen, N. Gregson Davis, Carl Degler, Peter Duignan, James Gibbs, Joseph Greenberg, Barbara Hatton, Kennell Jackson, Tetteh Kofi

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. Freshmen contemplating a possible future major are advised to enroll in the first term of the core-seminar of the Program. 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 units will be in "core" courses, including 6 in the core-seminar. Twenty-five units are to be presented as "collateral" courses; and, normally, the majority of these units will be earned in one department with which the student will choose 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 is affiliated and who is also a member of the Committee in Charge of the Program. In the senior year each student will write a substantial research paper or carry out a comparable project in consultation with his adviser.

CORE COURSES

(See course descriptions under Departmental listings)

A two-term core-seminar will be offered each year. Additional courses may be selected from the following regular departmental offerings as well as from other courses on African and New World black populations that may be listed in the quarterly time schedules.

ANTHROPOLOGY

104. Race and Culture Contact in the Caribbean.
109. Peoples of Africa.

110. Urbanization in African Societies.
136. Comparative Urbanism.
   Given 1973-74

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.

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.

HOOVER INSTITUTION

131. History of Southern Africa.

POLITICAL SCIENCE

113B. Latin American Politics: Selected Country Analyses.
182A,B. Research on Racism and Law Enforcement.
SCHOOL OF HUMANITIES AND SCIENCES

223. Seminar in Comparative Politics: Latin America.

PSYCHOLOGY
235A. Seminar in African Psychology I.
235B. Seminar in African Psychology II.
235C. Seminar in African Psychology III.

SOCIOLOGY
60. Racism and Prejudice.
132. Black Communities in the United States.

COLLATERAL COURSES
(To be selected by the student and the advisor from Departmental listings.)

ANTHROPOLOGY
Chairman: Joseph H. Greenberg
Associate Professors: Harumi Befu (on leave 1972–73), A. Richard Diebold, Jr., Arthur P. Wolf
Assistant Professors: George A. Collier, Jane F. Collier, Michelle Z. Rosaldo, Renato I. Rosaldo, Jr., Ezra B. W. Zubrow. Acting: M. Bridget O’Laughlin
Lecturers: Peggy J. Golde, Suzanne Chevalier-Skolnikoff (winter quarter, 1973), Louise S. Spindler
Research Associate: Gene McN. Sterling

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 degree with a concentration in Anthropology. General requirements for all majors are as follows:

Students wishing to declare a major in Anthropology should apply to the Department’s Committee on Undergraduate Studies. The Committee will appoint an advisor with whom the student may 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 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 or 1A, and one of the following: Anthropology 5, 170, 172, or 175 (or newly offered equivalent). Advanced majors are invited to seek admission to one of the undergraduate seminars (Anthropology 192) and to 200-level courses of interest. Students may also take part in field work on local archaeological sites, and they may obtain training in museum methods by doing directed research relating to the Stanford anthropological collections (Anthropology 180, 182).

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 and must include Anthropology 1 or 1A; one of the following: Anthropology 5, 170, 172, or 175 (or newly offered equivalent); at least one quarter of Anthropology 195. Once admitted to the Honors Program, the student may take as many as fifteen units (but at least five units) of Anthropology 195.

Major in Social Sciences (Anthropology). The Major in Anthropology who is interested in pursuing a 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 in Anthropology and must include Anthropology 1 or 1A. 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 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.
DOCTOR OF PHILOSOPHY

The Doctor of Philosophy degree is earned by fulfilling the following requirements:

1. Demonstrate a reading knowledge of one foreign language in which there exists a substantial body of literature relevant to the student's program of study.

2. Pass during the first year, at an acceptable graduate level, courses 283 and 290, and at least 3 of the following: 233, 243, 245, and 255. Students with inadequate backgrounds may, in consultation with their adviser and the department, delay some or all of these courses to the second year. Students wishing to take Chinese, Japanese, or Korean may, using the same procedures, delay two of these courses until their second year.

3. Gain experience by serving as a teaching apprentice during one quarter of graduate work, normally during the second year, enrolling in Anthropology 308 for this purpose.

4. By the end of the second year pass, at a satisfactory graduate level, four courses distributed across at least two of the following fields: Statistics, Linguistics, Archaeology, Biological Anthropology. Students who submit satisfactory evidence of previous training in any of these fields will be exempted from part of the requirement.

5. As part of their course requirements, students may register for a maximum of 15 credits of directed reading.

6. Pass a Special Examination, normally given during the autumn quarter of the third year, covering the candidate's major topic of specialization and one major ethnological area of the world.

7. Pass the University Oral Examination, normally given in defense of the dissertation proposal.

8. Present an approved dissertation based upon independent research.

FINANCIAL SUPPORT

The Department endeavors to provide financial support, when needed, to anyone admitted as a graduate student and maintaining a satisfactory level of graduate work. For most of its graduate students the Department provides (a) tuition, fellowship, and dependency support in the form of NIMH and NICMS traineeships, as well as NDPL fellowships; or (b) tuition and stipends in the form of University fellowships; or (c) teaching assistanceships (salary and tuition).

COURSES PRIMARILY FOR UNDERGRADUATES

1. Cultural Anthropology — An introduction to social and cultural anthropology, including the assumptions underlying various approaches, the interaction between man's institutions and his biological characteristics, and the relation of language to culture.

2. 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.

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

102. Natives of North America — History, cultural background, and contemporary situation of major tribes in North America.

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 105AB.

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.

105A,B. Peoples of Latin America—Survey of cultural development culminating in high preconquest civilizations of Mesoamerica and South America. Tracing postconquest continuities and changes in indigenous cultures. Consideration of broader contexts of Latin American society since Spanish con-
quest and significance of regional variations. Credit offered only for two-quarter continuous enrollment.

10 units (G. Collier, R. Rosaldo) given 1973–74

109. Peoples of Africa — A survey of social structure and process in rural sub-Saharan Africa, with emphasis on the political, social, and economic organization of descent groups in both acephalous and state societies.

5 units (Drake) MWF 1:15

110. Urbanization in African Societies — 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, Win (O’Laughlin) MWF 9

111. Belief Systems of Sub-Saharan Africa — 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. Limited enrollment. Prerequisite: consent of instructor.

5 units, Win (Wolf) MTWTh 11

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, Win (O’Laughlin) MWF 9

115. Peoples of Island Southeast Asia — A survey of history and the contemporary situation of ethnic peoples in Indonesia, the Philippines, Madagascar, and portions of Malaysia. Among topics discussed are: prehistory, the process and impact of colonization, the contrast between hill and valley peoples, subsistence modes, social organization, and religion.

5 units, Win (M. and R. Rosaldo) MWF 10

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 1A or consent of instructor.

5 units (Befu) given 1973–74

117. Traditional Chinese Society — Course of lectures which analyzes the society, polity, and economy of late traditional China as a total system. Secondary attention is given to the nature of premodern social change. Prerequisite: 1 or 1A or Sociology 1 or consent of instructor.

5 units (Skinner) given 1973–74

118. Communist Chinese Society — An examination of social and cultural change and political and economic development in the People’s Republic of China in light of current social science theory. Prerequisite: 1 or 1A or Sociology 1A, 1B, 1C, or 1D.

5 units, Aut (Skinner) MTWTh 11

119. Peoples of the Pacific — Ethnology of the Malayo-Polynesian speaking world focusing on linguistics, ecology, social structure, and cultural history. Emphasis on the importance of this area to a variety of general problems in anthropological theory. Prerequisite: 1 or 1A or consent of instructor.

5 units, Win (Frake) MWF 11

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 1A or consent of instructor.

5 units, Win (O’Laughlin) MWF 9

124. Ethno-Art — A Seminar on the anthropology of art concerned with questions of universals in plastic and graphic art, ways to study cross-cultural differences in objects and behavior and their symbolic meaning. Limited enrollment. Prerequisite: consent of instructor.

5 units, Win (Befu) given 1973–74

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 1A or consent of instructor.

5 units, Win (Befu) given 1973–74

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 1A or consent of instructor.

5 units, Win (O’Laughlin) MWF 10
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 1A or consent of instructor.

5 units, Spr (Barnett) MW 3:15-5:05

131. Comparative Social Systems—Analysis of social structure, including kinship, community, and other principles of organizing social life; comparison of non-Western with Western societies. Prerequisite: 1 or 1A or Sociology 1 or consent of instructor.

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, Spr (R. Rosaldo) MWF 11

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 (Drake) given 1973-74

138. Women in Cross-Cultural Perspective —A collective research seminar 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 1:15-3:05

142. Symbolic Anthropology — (Same as Modern Thought and Literature 242.) The course will concern the content and organization of systems of symbols and belief. Readings will include Freud, Durkheim, and modern anthropologists who have written about myth, magic, pollution, rites of passage, and other aspects of symbolic organization.

5 units, Spr (M. Rosaldo) MWF 10

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 (R. Rosaldo) given 1973-74

144. Mythology and Folklore—Anthropological contributions to understanding these fields of human activity; comparisons with Western literature.

5 units (Gerow) given 1973-74

146. Anthropology of Law — Theories of law, social control and conflict resolution set in ethnographic perspective. Prerequisite: consent of instructor.

5 units, Feb. 1-May 18 (J. Collier)

ThF 12:50-2:05

151. Economic Anthropology—A course of lectures on 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, Spr (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) MW 3:15-5:05

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 1A or consent of instructor.

5 units, Spr (Zubrow) MWF 9

155. Psychological Anthropology—Adaptations in different cultural settings. The problem of what is "normal" and "abnormal" in
human behavior. Relationship of socializa-
tion and cultural transmission to develop-
ment 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 con-
sciousness. Prerequisite: 1 or 1A or Psychol-
ogy 1.

5 units, Win (G. and L. Spindler)
MWF 2:15

158. Personality in Culture—Anthropologi-
cal contributions to psychological and psy-
chiatric theories of personality formation.
Cross-cultural comparative studies leading
to hypotheses about cultural determinants of
personality structure. Cross-cultural perspec-
tive on the notion of “normal” vs. “abnormal”
adjustment. Prerequisite: 1 or 1A or Psychol-
ogy 1, or consent of instructor.

5 units, Spr (Diebold) MWF 2:15

164. Typology and Universals of Language
— (Same as Linguistics 214.) The methodol-
y of structural comparisons of languages;
the connection between typological analyses
and generalizations about language; univer-
sals of language in phonology, grammar, and
semantics; problems concerning deductive
explanation of universals. Limited enroll-
ment. Prerequisite: elementary linguistic
course or consent of instructor.

5 units, Win (Greenberg) TTh 2:15–4:05

167. Language and Culture— (Same as Lin-
guistics 312.) The relevance of linguistic the-
ory, semantic analysis, and the study of
speech as social behavior to problems of an-
thropology, sociology, and psychology. Pre-
requisite: consent of instructor.

5 units, Aut (Frase) MWF 2:15

168. Introduction to General Linguistics—
(Same as Linguistics 100.) Linguistics and
the study of language and verbal behavior.
Speech contrasted with nonverbal communi-
cative behavior. Principles of descriptive
analysis. Grammatical theory as exemplified
by transformational generative grammar.
Linguistic universals and language typology.
Speech surrogates and the history of writing.
Brief introduction to historical linguistics.

5 units, Aut (Diebold) MWF 1:15

170. Prehistoric Archaeology — Methods,
findings in this field; correlations of prehis-
tory of Europe and Near East with that of
other zones over the world. Prerequisite: 1
or 1A or consent of instructor.

5 units, Spr (Gerow) MWF 11

172. Prehistoric Archaeology of the New
World—This course is a survey of the known
prehistoric cultural record in terms of both
time-space systematics and models for cul-
tural change and growth. It will attempt to
assess the adequacy of the models in terms of
comparative data from various cultural areas
in both North and South America.

5 units, Aut (Zubrow) MWF 9

173. Development of Civilization — This
course considers the archaeological evidence
for the development of civilization. Limited
enrollment. Prerequisite: consent of instruc-
tor.

5 units, Win (Zubrow) MWF 9

175. Evolution of Primate Behavior — In-
troduction to evolutionary theory, including
such concepts as population, variation, ge-
netics, the forces of evolution and adapta-
tion, and the process of speciation. Brief
survey of the fossil record. Classification,
distribution, and general behavioral adap-
tations of the major groups of contempo-
rary primates. Primate dispersal patterns
and their relevance to the evolution of hu-
man behavior.

5 units, Win (Skolnikoff) MW 1:15–3:05

177. Medical Anthropology—Seminar, ana-
lyzing theories of disease and therapy in
selected societies, the relation of medical
beliefs to other areas of culture, and similar
problems of medical anthropological inter-
est. Limited enrollment. Prerequisite: gradu-
ate standing or consent of instructor.

5 units, Aut (Barnett) MW 3:15–5:05

180. Archaeological Field Methods—Stud-
ies, excavations of local archaeological sites,
and related work in the Department archae-
ological laboratory. Prerequisite: 5 or con-
sent of instructor.

4 units (Gerow) by arrangement

182. Museum Methods—Directed work on
anthropological collections. Can be taken for
one or two quarters with consent of instruc-
tor.

1 to 4 units (Gerow) by arrangement

184. Design of Field Research—A seminar,
primarily for graduate students, on basic
issues in research design, with special atten-
tion to problems of preparing dissertation
proposals and applications for research
grants. Limited enrollment. Prerequisite: con-
sent of instructor.

5 units, Spr (Cancian) T 9:00–11:50
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 1973-74

187. Data Analysis — Training in computer applications and other formal methods of data analysis in anthropology. Limited enrollment. Prerequisite: consent of instructor.

5 units, Win (G. Collier) TTh 3:15-5:05

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 1973-74

190. Directed Individual Study — For undergraduate students with special needs, and showing capacity to do independent work. Prerequisite: 1 or 1A or consent of instructor.

Any quarter (Staff) by arrangement

192. Seminar on Selected Topics in Anthropology — Normally open to anthropology majors.

5 units (——) given 1973-74

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 — Presentations 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 (R. Rosaldo) MW 3:15-5:05

COURSES PRIMARILY FOR GRADUATE STUDENTS

(Undergraduates who are anthropology majors are invited to seek instructor’s consent to register for 200-level courses and seminars.)

207. Latin American Peasantry — Seminar treating selected topics in the study of agrarian-based societies of Latin America. Emphasis is on plantation systems, socioeconomic adaptations, and relations between local communities and larger political units. Prerequisite: consent of instructor.

5 units, Aut (Siegel) by arrangement

217. Social Change in Chinese Society — Seminar treating social structure in late Imperial, Republican, and Communist China. Special attention is given to social change and problems of cultural and structural continuity. Prerequisite: 112, 117, or 118, or course work on China in other social sciences, including history.

5 units, Spr (Skinner) MW 1:15-3:05

226. Advanced Culture Change in Mesoamerica — Seminar on selected topics and problems, with primary or comparative focus on historical and contemporary changes in the culture of communities in southern Mexico and highland Guatemala. Prerequisite: graduate standing in the Department or consent of instructor.

5 units, Spr (Paul) Th 9:00-11:50

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 — A seminar on systems of structured social and economic inequality in small communities in comparative perspective. Attention will be given to egalitarian societies. Prerequisite: consent of instructor.

5 units, Win (Cancian) T 3:15-6:05

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 (Frake) TTh 9:00-10:50
234. Comparative Peasant Societies—Seminar treating selected topics in the comparative analysis of traditional agrarian societies. The focus in 1972–73 is on urbanization and regional systems, in particular the manner in which the mode and extent of peasant integration and cultural variation reflect the structure of city-centered regions. Prerequisite: consent of instructor.
5 units, Spr (Skinner) TTh 1:15–3:05

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 sects, worship, rites of passage, magic, shamanism, and dreaming. Prerequisite: consent of instructor.
5 units, Aut (R. Rosaldo) TTh 9:00–10:50

244. Structural Studies of Myth—The purpose of this seminar will be to develop a critical language for discussing, evaluating, and applying Levi-Strauss' theories to the study of mythology. The first sessions will involve a discussion of theory; in the last weeks, structural methods will be applied to a body of related myths. Limited enrollment. Prerequisite: consent of instructor.
5 units, Win (M. Rosaldo) TTh 1:15–3:05

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, Spr (G. and J. Collier) MW 1:15–3:05

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.

260. Languages of the Pacific—(Same as Linguistics 322.) Comparative Austronesian linguistics, structural characteristics of Oceanic languages, sociolinguistics in the Pacific and Insular Southeast Asia.
5 units, Aut (Frake) T 2:15–5:05

265. Seminar in Historical Linguistics: Linguistic Change—(Same as Linguistics 239.) 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, Spr (Greenberg) MW 3:15–5:05

269. Languages of Africa—(Same as 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) given 1973–74

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, Aut (Zubrow) M 2:15–5:05

276. Family Ecology—(Same as Pediatrics 276 and Preventive Medicine 12.) Arrangements are made through the Department of Pediatrics for students to observe children and their families in the Clinic and at home. The course is designed to help students understand interrelationships of patients, families, and communities as they affect health and disease. Prerequisite: graduate students, other than medical students, must have consent of instructor.
5 units, Win (Barnett) T 4:15–6:05

278. Psychopathology in Cross-Cultural Perspective—Cross-cultural epidemiology of mental disorders. Native vs. Western categories of psychopathology, both medical and forensic. Devereux's concept of "eth-
nic psychosis.” Discussion of selected non-Western psychotherapeutic practices. Prerequisites: introductory course in both anthropology and psychology and/or consent of instructor.

5 units, Spr (Diebold) Th 3:15-6:05

279. The Hospital as a Socio-Cultural System—Students will carry out field studies of the structure and functioning of the Stanford University Medical Center after review of the relevant literature and demonstration of research interviewing and participant observation techniques. Open to Year I and II medical students, graduate students in Anthropology and Sociology, and advanced nursing students.

3 units (Barnett) given 1973-74

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) T 9:00-11:50

286. Anthropological Research Methods with Implications for Education—(Same as Education 452.) 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 structures 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.

3 to 5 units, Win (Textor) by arrangement

288. Field Training in Cultural Anthropology—Instruction and practice in data gathering methods and analyses in native or ethnographic settings. Prerequisites: graduate standing in Department and consent of instructor.

3 to 12 units, Sum (Staff)

290. History of Anthropological Theory—A historical treatment of the chief theoretical trends in anthropology. Prerequisite: consent of instructor.

5 units, Aut (Greenberg) MWThF 10

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.

APPLIED PHYSICS

Chairman: Calvin F. Quate

Professors: Arthur Bienenstock, Marvin Chodorow, Sebastian Doniach, Theodore Geballe, Walter A. Harrison, Hubert Helfner, Calvin F. Quate, Peter A. Sturrock (Space Science and Astrophysics)

Associate Professors: Vahe Petrosian (Astrophysics), Mitchel Weissbluth

Assistant Professors: Robert L. Byer, W. Andrew Phillips

Visiting Professor: Oliver Penrose
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, 1973. 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 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 351, 357, 359, 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 351, 357, 359, 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. In cases where performance on courses during the first year of graduate study is inadequate, a special departmental oral exam will be held during the autumn of the second year to determine if the candidate may continue toward the doctorate. The exam will last two hours and will cover undergraduate and graduate physics. 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, 1973.

COURSES

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

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 acoustoelectric 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

252. Fundamentals of Acoustics — Basic elasticity, plane wave propagation in isotropic and anisotropic media, dispersion relations, piezoelectricity, scattering at plane boundaries. Prerequisite: consent of instructor.

3 units, Spr (Auld) alternate years, given 1972–73

261. High Energy Astronomy — Introduction to nonthermal phenomena of astrophysics: radio and X-ray radiation and the production of high-energy particles by the sun, neutron stars (pulsars), galaxies, and quasars. Discussion of cosmic rays, microwave background and cosmology. Prerequisites: Physics 122 and 131, or equivalents; Aeronautics and Astronautics 226 desirable.

3 units, Spr (Petrosian) MWF 1:15

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

350. Applied Physics Measurements I — Lecture course which, together with 351, is intended to introduce fundamental measurement methods useful in applied physics. Wherever possible, microwave techniques will be utilized to explore the experimental phenomena under investigation. Theory of the properties of waves at microwave frequencies and the related laboratory techniques for measuring these properties. Selected topics from the following: waveguiding systems for electromagnetic waves, measurement of impedance and discontinuities, resonant cavity modes and field configurations, and the attenuation of acoustic waves at microwave frequencies. Prerequisite: concurrent registration in Electrical Engineering 243 or equivalent.

2 units, Aut (Quate) TTh 8, alternate years, given 1972–73


2 units, Aut (Quate) by arrangement, alternate years, given 1972–73

356. Superconductivity and Low Temperature Physics — Lecture course which concurrently with 357 discusses important concepts in superconductivity including phase transitions, heat capacity, magnetic properties, type I and II superconductors, tunneling and Josephson effect. Possible experiments include thermometry and transitions measurements, magnetization measurements, solenoid design, superconducting cavity design, levitation, power transmission line measurements, two fluid viscosity, and ac Josephson effect.

2 units, Win (Byer) MW 9

357. Superconductivity and Low Temperature Physics Laboratory — Experimental work concurrent with 356.

2 units, Win (Byer) by arrangement

358. Quantum Electronics — Lecture course which concurrently with 359 discusses laser devices and their application in experiments. The topics discussed include properties of lasers, gaussian beams, anisotropic crystals, second harmonic and parametric generation, Raman and Brillouin scattering, and acousto-optics processes. Experiments include work with HeNe, argon ion, CO₂, GaAs, Ruby, and Nd:YAG lasers. Prerequisites: Electrical Engineering 231 and 232 or consent of instructor.

2 units, Spr (Byer) MW 9

359. Quantum Electronics Laboratory — Laboratory course concurrent with 358.

2 units, Spr (Byer) 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) MW 9, alternate years, given 1972–73

361. The Sun and Solar Activity — Photosphere, chromosphere, and corona. Fraunhofer spectrum. The solar cycle. Active phe-
nomina: 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 1972–73

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 1972–73

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 (Petrosian) by arrangement Spr (Sturrock) by arrangement


3 units, Aut (Sturrock), 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. Analysis of isotropic, homogeneous Friedmann universes and comparison with observations. Discussion of inhomogeneities and anisotropies with special reference to the microwave background radiation. Prerequisite: Physics 221 or equivalent. (Concurrent enrollment acceptable.)

3 units, Aut (Petrosian), alternate years, given 1973–74

366. High-Energy Astrophysics — Observational properties and theoretical models of selected astrophysical phenomena involving nonthermal electromagnetic processes, such as pulsars, quasars, radio galaxies, Seyfert-type galaxies, and cosmic rays. Prerequisite: Physics 221 or equivalent. Recommended: Applied Physics 364.

3 units, Win (Petrosian), alternate years, given 1973–74


3 units, Spr (Sturrock) MWF 11, alternate years, given 1973–74

373. Nonequilibrium Statistical Thermodynamics—The first part of the course will deal with fundamentals of nonequilibrium thermodynamics, discussing generalized flow in terms of thermodynamic forces and the Onsager relations. The second part will be concerned with statistical mechanical treatments of transport (Boltzmann equation, etc.). Finally, recent efforts to understand the thermal properties of metastable systems (e.g., glass) will be described. Prerequisites: Physics 171 or Physics 231 or Electrical Engineering 322B or Materials Science 222.

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

376. 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 (Staff) alternate years, given 1972–73

377, 378, 379. Theory of Solids—Basic meth-
ods and concepts of solid-state physics, including metals, semiconductors and insulators, crystal symmetry, band theory, the pseudopotential method, classical and quantum theories of the electron gas, optical properties, tunnelling in solids, properties of crystal defects and liquids, lattice vibrations, magnetism, and the theory of superconductivity. Prerequisite: Physics 231 or Electrical Engineering 322B.

377. 3 units, Aut (Harrison) MWF 10
378. 3 units, Win (Harrison) MWF 10
379. 3 units, Spr (Harrison) MWF 10

385. Physics and Chemistry of Solids—Patterns in the properties of real solids. Both the periodic system of the elements and the concepts of modern microscopic theory will be used to discuss the properties of metals, semiconductors, and insulators. Superconductivity, magnetism, localized states in dilute alloys, and associated transport phenomena such as electrical and thermal conductivity will be considered. Prerequisites: 377, 378, and 379, or equivalents; 379 may be taken concurrently.

2 units, Spr (Geballe) 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 resistance; 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 379 and Physics 232, 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) T 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
man or sophomore intending to major in one of these areas should consult with an adviser appointed by the Department in order to plan his 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 teaching assistants, research assistants, or in other capacities, 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:

3 units—Art 1
3 units—Bibliography and Library Methods
30 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. Provisional enrollment may be permitted, however, in cases in which previous training has been deficient, with the understanding that the deficiency will be remedied in advance of Departmental approval of candidacy.

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 historical bibliography in the first quarter.
3. Reading knowledge of two foreign languages, preferably German and French or Italian. For oriental art history, reading knowledge of at least one far eastern language and either German or French.
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. Completion of a comprehensive written examination covering three main areas in the history of art (the student may choose from the following: Ancient, Medieval, Renaissance, Baroque, Modern, and two areas in Oriental Art). The other requirements must be met before this examination can be taken. It can be taken in the middle of any quarter.

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 has fully satisfied all the requirements which govern the A.M. program in the history of art (see above), and has been accepted as a candidate by the University Committee on Graduate Studies. Immediately upon acceptance of a student into the Doctoral program, a committee of at least three art historians shall be formed which shall take responsibility for advising and evaluating that student through the obtaining of the degree. It shall be left to the discretion of the committee whether or not the student will take examinations to test competence in the 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 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 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 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 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 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.

The student is required to formulate his program in careful consultation with his adviser. 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 140, 145, 150 (Intermediate Fine Arts)
3. 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, and product or graphic design.

The Graduate Program in Painting, Sculpture, and Lithography 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 partnership 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

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. 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 and lithography 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 four areas of concentration: (a) Drawing and Painting, (b) Sculpture, (c) Design, or (d) Printmaking.
   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, and lithographs in exhibitions serving the interests of the Graduate Program.

**ART EDUCATION**

**MASTER OF ARTS IN TEACHING**

The degree of Master of Arts in Teaching is offered by this Department and the School of Education for teachers who wish further to strengthen their academic preparation. The candidate must have a teaching credential. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements are outlined in the section "School of Education" in this bulletin.

**DOCTOR OF EDUCATION AND DOCTOR OF PHILOSOPHY IN EDUCATION**

In cooperation with the School of Education the Department offers work leading to the Ed.D. and Ph.D. degrees with a concentration in Art Education. Consult the section on "Graduate Degrees" listed in the "School of Education" section in this bulletin. Complete information concerning these degrees may be secured from the Office of the Dean of the School of Education.

**TEACHING CREDENTIAL (SECONDARY)**

A program leading to a Master of Arts degree with a specialization in art education
and/or including a California Teaching Credential in art is offered in art education by the School of Education. This program is available to students who have majored in art at the undergraduate level, who have had no teaching experience, and who wish to become teachers of art at the elementary or secondary levels. For details with respect to this program consult the “Teaching Credential Program” listed in the “School of Education” section in this bulletin.

COURSES IN HISTORY OF ART

BASIC COURSES

1. Introduction to Art—A topical introduction to the history and appreciation of architecture, sculpture, and painting.
   4 units, Spr (Elsen)

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.
   3 units, Aut (Michels)

10. Survey II—Main currents in the history of Western art from the Renaissance to the present.
    3 units, Win (Michels)

INTERMEDIATE COURSES

100A. Ancient Art I—The Pre-Hellenic Cultures: Egypt, Mesopotamia, Crete, Mycene.
    3 to 4 units, Aut (Raubitschek)

100B. Ancient Art II—Greece from the Geometric period to the Hellenistic, with emphasis on sculpture and painting.
    3 to 4 units, Win (Raubitschek)

100C. Ancient Art III—Rome from the Prehistoric and Etruscan periods to the early Christian.
    3 to 4 units, Spr (Raubitschek)

103. Greek Architecture—From its origins to the Hellenistic Age, with emphasis on the Classical period.
    3 units, Spr (Raubitschek) alternate years, given 1973-74

105A. Medieval Art I—Aspects of iconography and style in the pictorial arts 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.
    3 units, Aut (Lewis) given 1973-74

105B. Medieval Art II—Art and architecture 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.
    3 units, Win (Lewis) given 1973-74

105C. Medieval Art III—Art and architecture 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.
    3 units, Spr (Lewis) given 1973-74

110A. Renaissance Art I—Italian architecture, sculpture, and painting of the fourteenth century.
    3 units, Win (Eisenberg)

110B. Renaissance Art II—Italian architecture, sculpture, and painting of the fifteenth century.
    3 units, Spr (Eisenberg)

110C. Renaissance Art III—Italian architecture, sculpture, and painting of the sixteenth century, from Michelangelo to Giovanni Bologna.
    3 units (Forster, Staff)

111A. 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.
    3 units (Forster, Staff)

111B. Northern Renaissance Art II—Art and architecture in France during the sixteenth century with emphasis on the First School of Fontainebleau.
    3 units (Forster, Staff)

111C. Art in the Lowlands During the Fifteenth and Sixteenth Centuries.
    3 units (Staff)

112. The Renaissance City—Urban planning, expansion, and renewal in Italy, 1200–1600.
    3 units, Spr (Forster)

115A. Baroque Painting in Italy—Important developments in painting with emphasis on Bologna and Rome; major trends of style and iconography.
    3 units, Aut (Miller) given 1973-74
115B. Painting in the Low Countries and France During the Seventeenth Century—Rubens, Rembrandt, Vermeer, and Poussin.
3 units, Win (Miller) given 1973–74

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.
3 units, Win (Eitner)

120B. Modern Art II — Romanticism and Naturalism. Main currents in European art in the time of the Napoleonic Wars, the Restoration, and the era of middle class dominance. The later work of David, Goya, and Blake; the German Romantics; Ingres, Gericault, Delacroix, Daumier, Courbet, Millet, Manet, and Degas; the landscape art of Turner, Constable, and the Barbizon painters.
3 units, Aut (Eitner)

3 units (Elsen) given 1973–74

121A. Modern Art IV—Twentieth Century Painting I, 1900–1920 — Fauvism, Matisse, German and Austrian Expressionism, Cubism, Orphism, Futurism.
3 units (Elsen) given 1973–74

3 units (Elsen) given 1973–74

3 units, Spr (Elsen) given 1973–74

3 units, Aut (Elsen)

123B. Modern Sculpture II — Sculpture since World War I. Tatlin, Malevich, Gabo, Pevsner, Duchamp, Arp, Giacometti, Ernst, Moore, Lipchitz, Picasso, Gonzales, and American Sculpture since World War II.
3 units, Win (Elsen)

125A. Oriental Art I — The arts of India, China, and Japan from the Neolithic through the sixth century A.D.
4 units, Aut (LaPlante)

125B. Oriental Art II — The arts of India, China, and Japan from the seventh century A.D. to the Mongol Invasion (thirteenth century).
4 units, Win (LaPlante)

125C. Oriental Art III—The arts of India, China, and Japan after the thirteenth century.
4 units, Spr (LaPlante)

126A. Introduction to Chinese Art.
4 units, Aut (Sullivan)

126C. The Art of Japan.
4 units, Win (Sullivan)

126D. The Art of Southeast Asia.
4 units, Spr (Sullivan)

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, Spr (Sullivan)

130. Art and Architecture in Nineteenth Century America—Major developments and personalities in painting, sculpture, and architecture in 19th century America with an especial concern for evidence of a developing national consciousness in the arts.
3 units, Aut (Miller) given 1973–74

150. Rodin — An intensive examination of the life, art, and times of a great sculptor. Students will have assignments on his sculpture in the Museum and the California Palace of the Legion of Honor.
3 units (Elsen) given 1973–74

155. Picasso — Picasso’s work in painting, sculpture, drawing, and prints.
3 units, Win (Elsen)

167. Art Historical Bibliography and Library Methods.
3 units, Win (Finch)

175. Modern Architecture I: The Nineteenth Century—Major trends, with atten-
tion to the impact of new materials and structural systems, as exemplified in the work of selected European and American architects.

3 units, Aut (Michels)

176. Modern Architecture II: The Twentieth Century—Major trends and technological developments as exemplified in the work of selected architects in the western world and Japan.

3 units, Win (Michels)

ADVANCED UNDERGRADUATE AND GRADUATE COURSES


3 to 4 units, Aut, Win, Spr (Raubitschek)

203. Studies in Greek Architecture.

3 units, Spr (Raubitschek) alternate years, given 1973-74


3 units, Aut, Win, Spr (Lewis) given 1973-74

206. Seminar in Medieval Art.

4 units, any quarter (Lewis, Staff)

208. Seminar in Medieval Architecture.

4 units, any quarter (Lewis, Staff)

210A,B. Studies in Renaissance Art.

3 units, Aut, Win (Eisenberg)

211A,B. Studies in Northern Renaissance Art.

3 units (Forster, Staff)

211C. Studies in Art in the Lowlands During the Fifteenth and Sixteenth Centuries.

3 units (Staff)

212. Studies in the Renaissance City.

3 units, Spr (Forster)

214B. Seminar in Renaissance Art—Giulio Romano and North Italian architecture of the sixteenth century.

4 units, Spr (Forster)


3 units, Aut, Win (Miller) given 1973-74

216A. Seminar on the Carracci Family and Painting in Bologna of Their Period.

4 units, Win (Miller) given 1973-74

216B. Seminar on Painting in Bologna of the Post-Carracci Period.

4 units, Spr (Miller) given 1973-74

217. Seminar in European Art and Architecture During the Eighteenth Century.

4 units, Spr (Miller), given 1973-74


3 units, Aut, Win, Spr (Eitner, Elsen)

221. Seminar in Nineteenth Century Art—Rodin (offered in autumn only). Artist in spring undetermined.

4 units, Aut (Elsen)

221A. Studies in Modern Painting from 1900-1920.

3 units (Elsen) given 1973-74

221B. Studies in Modern Painting from 1920-1960.

3 units (Elsen) given 1973-74


3 units, Spr (Elsen) given 1973-74

223. Seminar in Twentieth Century Art.

4 units, any quarter (Elsen, Forster)

223A,B. Studies in Modern Sculpture.

3 units, Aut, Win (Elsen)


4 units, Aut, Win, Spr (LaPlante)


4 units, Aut, Win (Sullivan)

226D. Studies of the Art of Southeast Asia.

4 units, Spr (Sullivan)

226E. Studies of Meeting of Eastern and Western Art.

4 units, Spr (Sullivan)


4 units, Aut (Sullivan)


4 units, Win, Spr (Sullivan)

228A. Seminar in Japanese Ceramics.

4 units, Aut (LaPlante)

228B. Seminar in Architecture of India and Farther India.

4 units, Win (LaPlante)

228C. Seminar in Indian Painting.

4 units, Spr (LaPlante)

229A. Seminar in Nineteenth Century German Art.

4 units, Win (Forster-Hahn)
229B. Seminar in Political, Social Caricatures and Satires in England During the Eighteenth Century.
4 units, Spr (Forster-Hahn)

3 units, Aut (Miller) given 1973–74

4 units, Aut (Forster-Hahn)

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: 1 or 5 and 10.
4 units, Spr (Elsen)

Any quarter (Staff) by arrangement

250. Studies on Rodin.
3 units (Elsen) given 1973–74

255. Studies on Picasso.
3 units, Win (Elsen)

3 units, Win (Finch)

3 units, any quarter (Finch)

275. Studies in Modern Architecture I.
3 units, Aut (Michels)

276. Studies in Modern Architecture II.
3 units, Win (Michels)

277. Seminar in Urban Development of Selected American Cities.
4 units (Turner) given 1973–74

278. Seminar in Architectural Theory and Criticism—The examination of different concepts and philosophies of architecture, principally from selected readings of various periods, but concentrating on the 19th and 20th centuries.
4 units (Turner) given 1973–74

279. Seminar: Frank Lloyd Wright.
4 units, Spr (Michels)

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 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 and Painting—Basic drawing and painting 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)

145. 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. Prerequisite: at least two quarters of painting.

3 or more units, Aut, Win, Spr (Lobdell)

148. Lithography—Introduction to lithography. Prerequisite: 140 or equivalent. May be repeated for credit.

3 units, Win (Oliveira)

150. Sculpture I—Introduction to woodcarving and wood construction. Prerequisite: 50.

3 units, Aut, Win, Spr (Randell)

151. Sculpture II—Introduction to sculpture in metal. Gas and arc welding are principal techniques used. Prerequisite: 150.

3 units, Aut, Win, Spr (Randell)

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 units, Aut, Win, Spr (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: 161.

4 or more units, Aut (Kahn)

167. Metalsmithing—Design problems in jewelry and small utilitarian objects. Emphasis on craftsmanship in metal construction and lost wax casting. Prerequisite: 162.

4 or more units, Spr (Kahn) alternate years, given 1972-73

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 1973-74

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—Graduate students only.

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)
   Aut, Win, Spr (Holub) by arrangement
   Any quarter (Staff) by arrangement
341. Master's Project (Studio).
   Any quarter (Staff) by arrangement
341D. Master's Projects: Design (Seminar).
   Any quarter (Kahn) by arrangement
342. M.F.A. Project (Studio).
   Any quarter (Staff) by arrangement
369. Advanced Creative Studies Seminar—Intensive emphasis in areas of personal specialization, with comparative analysis.
   Aut, Win, Spr (Kahn) by arrangement

RELATED COURSE
Philosophy of Design—See Mechanical Engineering 214.

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 spring quarter, 1973), Makoto Ueda

Associate Professors: William A. Lyell, John C. Y. Wang (on leave autumn quarter, 1972)

Assistant Professors: Kung-yi Kao (on leave autumn and winter quarters, 1972–73), Susan K. Matisoff, Dana B. Young

Lecturers: Frederick P. Brandauer, Yin Chuang, Hiroyasu Kubota, Norman Masuda, Kimie Nebrig, Hiroshi Sakamoto, Dorothy Shou

Chinese-Japanese Language and Area Center
Director: Albert E. Dien


COURSES IN ART EDUCATION
213. Foundations of Aesthetic Education—(Enroll in Education 213.)
Lecturers: Frederick P. Brandauer, Yin Chuang, Hiroyasu Kubota, Norman Masuda, Kimie Nebrig, Hiroshi Sakamoto, Dorothy Shou

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. Undergraduate work need not necessarily have been in Chinese or Japanese, or in an East Asian area of specialization. For admission, an applicant must, however, satisfy the Department that he has an aptitude for language work, and that he has a command of English written style adequate for the pursuit of graduate study. While it is possible for an applicant to be admitted to graduate study in the Department with no previous knowledge of an East Asian language, such an applicant is warned that he will not be able to complete the requirements for the A.M. in the minimum time.

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. 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 should normally be able, after spending a year at the overseas center, to return to Stanford and complete his 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 his graduate adviser and the departmental chairman. 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 257 and 297; and two courses in such fields as Japanese anthropology, history, politics, and religion, as approved by his graduate adviser and the departmental chairman. 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 must complete all the requirements for the Master of Arts degree in this Department or equivalent work at another university.

2. He must demonstrate a reading knowledge of French or German by the end of his first year after completing the A.M. degree.

3. He must complete two seminars at the 300 level. These seminars must be in different subjects.

4. He must pass an examination in the supporting Asian language. If the candidate's field is Chinese, he will be examined on his ability to read modern Japanese works relevant to his field of study. This requirement may be met by completing Japanese 103. If the candidate's field is Japanese, he will be examined on his ability to read Classical Chinese works relevant to his field of study. This requirement may be met by completing Chinese 103.

5. He 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 his graduate adviser and the departmental chairman, from the following: Chinese literature, Chinese history, Chinese philosophy, Chinese linguistics, Japanese literature, Japanese history, Japanese religion.

**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 dissertation, after acceptable parts thereof have been completed in draft form.

**Dissertation**—The candidate will write a dissertation demonstrating his 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 must elect either Chinese 201-202 or Japanese 201-202 unless he satisfies the Department that work done elsewhere has given him similar training. He 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 Lan-
guages, preferably before the end of the preceding autumn quarter.

**Courses Not Requiring a 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

81, 82, 83. First Year Cantonese—Conversational and grammar.

81. 5 units, Aut (Staff) MTWThF 9
82. 5 units, Win (Staff) MTWThF 9
83. 5 units, Spr (Staff) MTWThF 9

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, Spr (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 Prose 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 (Young) MWF 1:15

137. Japanese Literature in Translation—The Middle Period—An introduction to the major works in prose, poetry, and the theater from the Muromachi through the Tokugawa periods (1330–1868).

4 units, Win (Matisoff) MWF 1:15

138. Modern Japanese Literature in Translation—An introductory course in Japanese poetry, drama, and fiction since 1868. Authors considered will include Tanizaki, Kawabata, Mishima, and many others. Knowledge of pre-modern Japanese literature not required.

4 units, Spr (Ueda) MWF 1:15

143. The Philosophy of Wang Yang-ming (1472–1529)—(Same as Philosophy 123.)

4 units, Win (Nivison) MWF 2:15

150 (250). Seminar: The Ironic Muse in the Classics of East and West—(Same as Classics 150 and Comparative Literature 150.) Graduate students may register under 250, in which case they will be expected to do additional work.

4 units, Spr (Moore, Young) by arrangement

151. Chinese Historical Literature in Translation—A survey of the various modes of historical literature from earliest times, the development of historical consciousness and comparisons with other traditions.

4 units, Aut (Dien) MWF 1:15

152. Central Asia in the Pre-Modern Period—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

166. The Tale of Genji—A reading of Waley’s translation together with a general study of Heian society and culture.

4 units, Win (Young) MWF 10


4 units, Win (Wang) MWF 10

195. Modern Intellectuals in Japanese Literature—Reading and discussion of Japanese literary works that portray a modern intellectual facing philosophical, social, or moral problems characteristic of our time.

4 units, Win (Ueda) given 1973–74

197. Images of Woman in Modern Japanese Literature—The study of various types of ideal woman as envisioned by modern Japanese writers.

4 units, Aut (Ueda) W 2:15–4:05

255. The Nature of Literature: Japanese and Western Views—(Same as Comparative Literature 255.) An attempt to study different attitudes toward literature in Japan and
in the West. Seminar with limited enrollment.

5 units, Aut (Ueda) M 2:15-4:05

See also History 91 and 92, History of East Asian Civilizations.

I. COURSES IN CHINESE

1, 2, 3. First-Year Modern Chinese — Conversation, grammar, reading, elementary composition.

1. 5 units, Aut (Chuang, Masuda, Shou)
   Section 1 MTWThF 9
   Section 2 MTWThF 2:15

2. 5 units, Win (Chuang, Masuda, Shou)
   Section 1 MTWThF 9
   Section 2 MTWThF 2:15

3. 5 units, Spr (Kao, Masuda, Shou)
   Section 1 MTWThF 9
   Section 2 MTWThF 2:15

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.

41. 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

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) MW 2:15-3:30; F 2:15

ADVANCED

101, 102, 103. Introduction to Classical Chinese — Reading, syntax, composition. Prerequisite: 23 or equivalent.

101. 5 units, Aut (Staff) MTWThF 11

102. 5 units, Win (Staff) 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.

201. 5 units, Aut (Dien) T 2:15-4:05

202. 5 units, Win (Dien) T 2:15-4:05

211, 212, 213. Modern Expository Chinese — Scholarly and journalistic writings in Chinese. The materials read in these courses cover two years. By consent of the instructor, the courses may be repeated for credit in a
consecutive year. Prerequisite: 103 or consent of instructor.

211. 5 units, Aut (Lyell) MWF 9
212. 5 units, Win (Lyell) MWF 9
213. 5 units, Spr (Lyell) MWF 9

215. Modern Expository Chinese—Journalistic, legal, scholarly and other types of writings in modern Chinese prose, excluding belles lettres. The materials read cover half of those of the two-year sequence of 211, 212, and 213. Prerequisite: 103 or consent of instructor.

15 units, Sum (——) MTWThF 9–12

221, 222, 223. Advanced Classical Chinese—Prerequisite: 103 or equivalent.

221. 4 units, Aut (Nivison) MWF 9
222. 4 units, Win (Wang) MWF 9
223. 4 units, Spr (Wang) MWF 9

231T, 232T, 233T. Advanced Modern Chinese—A basic training course in the art of translation; in addition there will be sections with specific areas of focus. Written reports and exercises will develop translational skills. Prerequisite: 213 or consent of instructor.

231T. 5 units, Aut (Brandauer) by arrangement
232T. 5 units, Win (Brandauer) by arrangement
233T. 5 units, Spr (Brandauer) by arrangement

241. Chinese Philosophical Texts—Readings in the works of Wang Yang-ming. Prerequisite: 223 or consent of instructor.

4 units, Aut (Nivison) given 1973–74

243. The Philosophy of Wang Yang-ming—(Same as 143 with additional work requiring the knowledge of the language.)

4 units, Win (Nivison) MWF 2:15

253. Local Histories—History of Chinese local historiography; survey of types of histories available; reading of sample texts of different kinds found in local histories. Prerequisite: 223 or consent of instructor.

4 units, Spr (Nivison) given 1973–74

254. Chinese Historical Texts—A practicum in the reading of narrative historical texts. Prerequisite: 223 or consent of instructor.

4 units, Win (Dien) given 1973–74

261. Chinese Poetry—Selected Readings of 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) MW 2:15–4:05

262. Chinese Poetry—Selected Readings of 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) MW 2:15–4:05

271, 272. Vernacular Chinese Fiction—Prerequisite: 103 or consent of instructor.

271. 4 units, Aut (Wang) given 1973–74
272. 4 units, Win (Wang) given 1973–74

281, 282. Modern Chinese Literature—Prerequisite: 213 or consent of instructor.

281. 4 units, Aut (Lyell) given 1973–74
282. 4 units, Win (Lyell) given 1973–74

291. The Structure of Modern Chinese—Prerequisite: 23 or equivalent. Recommended: a general introductory course in linguistics.

4 units, Spr (Kao) given 1973–74

292. The Chinese Language and Current Linguistic Theories—Prerequisite: 103 or equivalent. Recommended: a general introductory course in linguistics.

4 units, Spr (Kao) TTh 2:15–4:05

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) given 1973–74

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) by arrangement

371. Seminar in Chinese Fiction—May be repeated for credit.

5 units, Spr (Wang) given 1973–74

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 and Nebrig)**  
   Section 1 MTWThF 9  
   Section 2 MTWThF 2:15

2. **5 units, Win (Sakamoto and Nebrig)**  
   Section 1 MTWThF 9  
   Section 2 MTWThF 2:15

3. **5 units, Spr (Sakamoto and 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 l:15**
   28. **2 units, Win (Sakamoto) TTh l: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, 202. **Proseminar**—Research methods in Japanese studies. Prerequisite: 103 or equivalent.

   201. **5 units, Aut (Staff) given 1973–74**
   202. **5 units, Win (Staff) given 1973–74**

211, 212, 213. **Modern Expository Japanese**—Scholarly and journalistic writings in Japanese. Prerequisite: 103 or equivalent.

   211. **4 units, Aut (Matisoff) MWF 9**
   212. **4 units, Win (Matisoff) MWF 9**
   213. **4 units, Spr (Matisoff) MWF 9**

214, 215, 216. **Modern Expository Japanese**—Scholarly and journalistic writings in Japanese. Prerequisite: 103 or equivalent.

   **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 Helian grammar, while the subsequent quarters deal with later developments in style. Prerequisite: 103 or equivalent.

   246. **4 units, Aut (Young) TTh 2:15–4:05**
   247. **4 units, Win (Young) TTh 2:15–4:05**
   248. **4 units, Spr (Young) TTh 2:15–4:05**

257. **Major Tanka Poets**—Reading and discussion of selected tanka by Hitomaro, Sai-gyō, Shiki, and others. Prerequisite: 246 or equivalent. May be repeated for credit.

   **4 units, Win (Ueda) by arrangement**

258. **Major Haiku Poets**—Reading and dis-
cussion of selected haiku by Bashō, Buson, Issa, and others. May be repeated for credit.

4 units, Win (Ueda) given 1973-74

266. The Tale of Genji—(Same as 166 with additional work requiring knowledge of the language.) Prerequisite: 243 or equivalent.

4 units, Win (Young) MWF 10

276, 277. Readings in Medieval Prose—Readings from the major prose texts of the Kamakura-Muromachi periods. Prerequisite: 243 or equivalent.

4 units, Win and Spr (Young) given 1973-74

279. Classical Japanese Drama — Reading and discussion of selected plays from the nō, the kyōgen, the puppet theatre, and the kabuki. Prerequisite: 246 or equivalent. May be repeated for credit.

4 units, Spr (Ueda) by arrangement

295. Modern Intellectuals in Japanese Literature—(Same as 195 with additional work requiring knowledge of modern Japanese.)

4 units, Win (Ueda) given 1973-74

296. Readings in Modern Japanese Literature—Poetry, prose, and drama after 1868. Prerequisite: 103 or equivalent. May be repeated for credit.

4 units, Win (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) W 2:15-4:05

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 Early Prose Literature—Students intending to enroll in the seminar are required to consult the instructor at the beginning of the preceding quarter.

5 units, Spr (Young) given 1973-74

396. Seminar in Modern Japanese Literature—May be repeated for credit. Students intending to enroll in the seminar are required to consult the instructor at the beginning of the preceding winter quarter.

5 units, Spr (Ueda) given 1973-74

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


Senior Research Associate: Donald H. Perkel

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)

Research Associates: Isabella A. Abbott, Virginia M. Page
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

- A group of specified core courses in biology or their equivalents.
  - Biology 1 5
  - Biology 21 4
  - Biology 22 3
  - Biology 23 3
  - Biology 24ABC or 24YZ (see note 1) 9 or 6

Total 24 or 21

Notel. 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.

Not more than 10 units in a single specialized field from "in-depth" courses, such as 169, 175H, 176H, 178, 198, 199, 199H, 199B, 222H, 245, 251, 253, may be applied toward the total number (40) of required biology units.

(2) Elective Courses

- Electives 16 or 10

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.

Not more than 10 units in a single specialized field from "in-depth" courses, such as 169, 175H, 176H, 178, 198, 199, 199H, 199B, 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 (see note 2)
- Mathematics 5, 6, 7 or 10, 11, 21 or 41, 42
- Physics 21, 23 or 51, 53, 55

Note 2. Of the Chemistry courses listed, Chem. 31, 33, 35, and 36 will be offered for the first time 1972-73. Chem. 131, 132, and 135 will not be offered until 1973-74. Students who have taken Chem. 1, 2, and 3 (no longer offered) can complete their Chemistry requirements by taking 121 and 123 (offered for the last time 1972-73).

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>
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<tbody>
<tr>
<td>Chem. 31, 33, 35, 36. Introductory Chemistry</td>
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<tr>
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<td>Math. 5, 6, 7. Calculus and Probability</td>
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**Second Year**

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<td>Biology 23. Principles of Biology</td>
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<td>Biology 24. Experimental Biology</td>
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<td>Chem. 131, 132, 135. Organic &amp; Physical Chemistry</td>
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**Third Year**

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**Fourth Year**

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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 section 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—Applications for admission and for financial aid are mailed (upon request to the Department) between September 1 and February 1. The deadline for receipt of applications with all supporting materials is March 1. Notification of decision is mailed by April 1. Information concerning advanced courses, research, and facilities offered by the Department is contained in the brochure Graduate Study in the Biological Sciences at Stanford University which, together with current "Information to Applicants" is sent with the application forms. The publication Hopkins Marine Station Bulletin, which describes the activities and facilities of the Marine Station, is also sent if appropriate to the applicant’s interest.

An applicant must file a report of his scores on the aptitude tests of the Graduate Record Examination as part of his application. The advanced biology test is recommended but not required. This examination may be taken at most American colleges (see your Registrar for further information). It is recommended that the October or December examination be taken. Scores for tests taken later than January will not be received before the March 1 application deadline.

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 sup-

port. A limited number of Biology Fellowships, National Institutes of Health Traineeships, and Graduate Research Assistantships is available each year. Such awards are for one year and are renewable as funds permit. Qualified applicants are urged to take the initiative in applying for predoctoral national fellowships in open competition, especially those from the National Science Foundation, and to consult their Financial Aid Officers for information and applications.

Students who have had their undergraduate training in biology at Stanford are ordinarily encouraged to undertake graduate study elsewhere to ensure breadth of experience. Printed information regarding choice of a graduate school can be obtained from the 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 as a graduate under each of four or more Stanford faculty members. Course work to be taken in preparation for the qualifying examination will be determined in consultation with the graduate adviser or the Director of Graduate Studies.

As soon as possible after successful completion of the qualifying examination the student should meet with his major professor to determine what (if any) further course requirements are to be met. Additional requirements may be specified by the major professor at any time during the student’s first nine quarters.

Teaching Experience and Training are part of the graduate curriculum. Each student assists in teaching eight sections. This normally involves two afternoons a week for four quarters and assignments are made in consultation with the student.

Graduate Seminars, devoted to the discus-
sion 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 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—Proficiency in reading scientific literature in one foreign language is normally required by the Department. Where appropriate, additional foreign languages may be required by the major professor. If, in the opinion of the major professor, a foreign language is not appropriate to a student's training, the student may petition the Department for a waiver of the requirement.

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, the proposed methods of procedure, an agreed terminal point for the work in general and a realistic probable completion date. 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 should be appointed as soon after the filing of the application to candidacy as is deemed appropriate by the major professor and the student.

The committee will consist of at least (1) the principal dissertation adviser, (2) a second member from within the major department, and (3) a third member chosen from the major or another department. When this third member is from another institution a fourth member must be chosen from the major department. The principal adviser and at least one of the other committee members must be Academic Council members.

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 forty minute formal seminar open to the public, followed by a twenty minute public discussion. After the seminar the candidate and examiners go into a closed session which will not exceed one hour. The seminar should place the candidate's work into the broader context of his field of specialization. Examiners may question in the area of specialization beyond the specific dissertation topic. This examination is taken after the dissertation is completed in draft form and approved by all members of the Reading Committee, or after the dissertation is completed and submitted to the University.

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.


2. **Biology and Social Responsibility** — Contemporary problems viewed in a framework of evolutionary biology.

   3 units, Win (Ehrlich, Holm) TTh 11

3. **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) 12 hours per week by arrangement

4. **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.

   24Y. 3 units, Win (Staff) labs and discussion (1) T 1:15-3:05, Th 1:15-5:05; (2) T 1:15-5:05, Th 1:15-3:05; (3) W 1:15-5:05, F 1:15-3:05; (4) W 1:15-3:05, F 1:15-5:05

5. **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 instructor. Prerequisites: SCUBA certification, SCUBA equipment, ocean experience, and consent of instructor.

   3 units, Aut (Baxter) 12 hours per week by arrangement

**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) TTh 10

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 (Green) MWF 11

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 (1) T 1:15–5:05; (2) T 1:15–5:05; (3) Th 1:15–5:05; (4) Th 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) by arrangement

128. Systematics and Ecology of Vascular Plants—Lectures, laboratory, field studies. Prerequisite: 1, Human Biology 1, or consent of instructor.

4 or 5 units, Spr (Thomas) WF 1:15; lab. WF 2:15–5:05; field trips by arrangement

130. Algae and Fungi—The major groups of algae and fungi are studied in the context of field identification, structure, and utility in the investigation of major biological phenomena. Lectures, laboratory, field trips. Prerequisites: 22 and 23.

5 units, Win (Green) MWF 10; lab. W 1:15–4:05

131. Mosses and Ferns—Structure, development, evolutionary relationships of mosses and ferns. Lectures, laboratories, and field trips. Prerequisite: 22.

5 units, Aut (Thomas) WF 2:15–5:05

132. Seed Plants—Structure, development, evolutionary relationships of seed plants. Lectures, laboratories, and field trips. Prerequisite: consent of instructor.

5 units, Spr (Holm) TTh 1:15–5:05

134. Seminar on Replication of Nucleic Acids—Modes of replication and their con-
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trol in prokaryotic and eukaryotic systems. Critical review of current literature. Prerequisite: 21 and/or consent of instructor.
3 units, Spr (Hanawalt) by arrangement

135. Seminar on Developmental Genetics—
Genetic expression and its developmental basis, especially in such representative organisms as Drosophila, mice and men. Prerequisites: 1; and 22 or consent of instructor.
3 units, Spr (Center) by arrangement

137. 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.
3 units, Win (Perkel) by arrangement

138. Topics in Mathematical Biology —
Levels of mathematical modeling in biology. Readings and discussion of selected areas, including growth equations, population interactions, models of neural systems, and the uses and abuses of computers. Term projects in students' fields of special interest. Prerequisites: calculus, either probability or statistics, and consent of instructor.
3 units, Win (Perkel) by arrangement

141. Biostatistics — An introduction to the statistical analysis of biological data. Lectures, discussion and student exercises.
3 units, Win (Feldman) by arrangement

146. Cell Differentiation—Lectures and discussions for graduate and advanced undergraduate students covering the original literature of selected problems in the cellular and molecular biology of cell differentiation. Prerequisites: 21, and 22 or consent of instructor.
3 units, Spr (Stockdale) by arrangement

151. Evolutionary Genetics—Application of genetics to study of evolution. Prerequisite: a knowledge of basic genetics.
3 units, Spr (Regnery) TTh 10, alternate years, given 1973–74

153. 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.
3 units, Win (Kennedy) MWF 1:15,
given 1973–74

154. Animal Behavior—A comparative sur-
vey of patterns of animal behavior stressing their evolution and adaptive significance. Emphasis will be placed on vertebrates. Lecture and discussion. Prerequisites: 22 and 23. Recommended: 153.
3 units, Spr (Heller) TTh 8:30–10:00

156. Plant Physiology—Principal functions of green plants, including photosynthesis, gas exchange, water and nutrient transport, mineral metabolism, growth, and environmental responses. Prerequisites: 21 and 22 or equivalent, and Chemistry 121 and 123 or Biochemistry 200 and 201 or equivalent.
3 units, Aut (Ray) MWF 10

158. Introduction to Behavior Genetics —
(Same as Psychology 158.) Designed for students of anthropology, biology, and psychology. Principles and methods of animal and human behavior genetics research. Discussion of the social implications of gene-behavior relationships. Prerequisites: Psychology 1 and Genetics 201 or Human Biology 130 or their equivalents.
4 units, Win (Kessler) TTh 1:15

162. Biogeography—Survey of major principles of ecological and historical geography of plants and animals. Prerequisite: 23.
3 units, Aut (Holm) TTh 11, alternate years, given 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

169. Advanced Cellular and Molecular Bi-
ology 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: 24A or 24Y.

175H. Problems in Marine Biology — See Hopkins Marine Station.

176H. Problems in Biological Oceanography—See Hopkins Marine Station.

178. Biology of Natural Populations—An introduction to the study of natural populations: lectures, laboratory, and field studies with emphasis on individual projects. Designed primarily for undergraduates. See unit limitation under “Bachelor of Science Course Requirements.” Prerequisites: 22 and 23, and consent of instructor.

179. Plant Ecology — Lectures and field problems in plant ecology with emphasis on the experimental approach. Prerequisites: 22 and 23, or consent of instructor.

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.

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.

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. Prerequisites: 21 and 22; 24A and 24B (or 24Y instead of A and B); high school physics.

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. Prerequisite: consent of instructor.

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.

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. See unit limitation under “Bachelor of Science Course Requirements.”

(Staff) by arrangement

199H. Special Problems—See Hopkins Marine Station.

199R. Special Problems in Fields Related to Biology — Directed reading or research in subjects not strictly within the biological sciences. This course provides credit for biologically related studies, such as medicine, which are not within the compass of another undergraduate department. Frequently directed by instructors who are not members of the Department of Biological Sciences.

2 to 4 units, Aut, Win, Spr, by arrangement

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 (Stocker) MWF 1:15, alternate years, given 1973–74

213. Viruses — Principles of virus growth, genetics, architecture and assembly. Relation of temperate viruses and other episomes to the host cell. Prerequisite: 21.

3 units, Aut (Campbell) MWF 11

215. Advanced Topics in Evolution—Current methods of approach to such evolutionary subjects as tempo and mode, origin of major categories, cytogenetics, hybridization. Prerequisites: 22, 23.

3 units, Aut (Holm) TTh 11, alternate years, given 1972–73

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 2:15–3:30

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

248. Genetic Recombination—Emphasis on meiotic recombination and chromosome organization in eukaryotes. Prerequisite: 166 and 167 or consent of instructor.

2 units, Aut (Perkins) M 2:15–4:05

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. Prerequ-
sites: 21, 22, and 23; knowledge of genetics and biochemistry.

3 units, Aut (Ganesan) MWF 10

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 7:15-9:00 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 4:15

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, given 1973-74

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 1973-74

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 11, alternate years, given 1972-73

258. Physiological Basis of Adaptation — Lectures, reading, and discussion on recent research concerning biochemical and physiological bases of evolutionary adaptations to environment. Subjects covered will include invertebrate and vertebrate thermal biology, biochemical population genetics, respiratory physiology, and other topics. Prerequisites: biology core and cognates.

3 units, Aut (Watt, Heller) TTh 8:30-10:00, alternate years, given 1972-73

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) by arrangement

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 ex-
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) MWF 11

281. Mathematical Population Biology — The course will, in alternate years, respectively deal with theoretical population genetics and with mathematical ecology.

3 units, Spr (Feldman) by arrangement

300. Research.
(Staff) by arrangement

300H. Research—See Hopkins Marine Station.

351. Seminar in Neurobiology—Prerequisite: consent of instructor.

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

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

355. Seminar in the Teaching of College Biology—Primarily designed for graduate students who are actively teaching in laboratories. Prerequisite: consent of instructor.

1 to 3 units, Aut, Win, Spr (Spivack)
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; two student members 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 12 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 de-
fining the research to be undertaken, including methods of procedure. This proposal should be submitted by the end 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 his 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.
- 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)

**Director:** John H. Phillips, Jr.

**Associate Director:** Donald P. Abbott

**Professors:** Donald P. Abbott, Malvern Gilmartin, John H. Phillips, Jr.

**Assistant Professors:** Welton Lee. Acting: John H. Martin

**Research Associate:** Isabella A. 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 seven and a half 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 Leob Laboratory. The 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.

15 units, Spr (D. Abbott, Gilmartin, Lee, 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.

(Abbott)

Physiology — Problems on physiology of invertebrate animals; photobiology, especially effects of ultraviolet light.

(Giese)

Biological Oceanography.

(Gilmartin)

Comparative Biochemistry and Immunology—As exemplified in marine animals.

(Phillips)

Marine Ecology, Physiological Ecology.

(Lee)

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 20 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 protocoelomates. 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 (Lee)

199H. Special Problems — (See above, autumn, winter, and spring quarters.)

222H. Biological Oceanography—An intensive introduction to the organisms and environment of the open sea—to the concepts, problems, and methods of biological oceanography; involves extensive work at sea aboard an oceanographic research vessel. Open to matriculated graduate students in biology.

6 units (Gilmartin, Staff)

209H. Ecological Physiology — Physiological responses of animals to variations in environmental factors and to organisms. Most of the work will deal with marine invertebrates. Prerequisites: general zoology and elementary chemistry.

6 units (Giese) MTW

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

117H. Zooplankton — Lectures and laboratory work designed to provide a working knowledge of zooplankton at the organism and population level, stressing the role of zooplankton in oceanic environments from
surface waters to the deep sea. Prerequisite: Invertebrate Zoology.

6 units (——) MWF

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 (Lee)

176H. Problems in Biological Oceanography — The course is designed primarily to give students an opportunity to engage in research at sea aboard an oceanographic research vessel. Prerequisite: 222H, or consent of instructor.

10 units (Gilmartin)

199H. Special Problems — (See above, autumn, winter, and spring quarters.)

261H. Comparative Biochemistry of Marine Microorganisms—Emphasis is placed on the biogeochemical cycles and the biochemical effects of pollutants. Prerequisite: elementary biology and organic chemistry.

6 units (Phillips) MWF

300H. Research—(See above, autumn, winter, and spring quarters.)

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


bert S. Loring, David M. Mason, Harden M. McConnell, Harry S. Mosher, Linus C. Pauling, Douglas A. Skoog, Henry Taube, Eugene E. van Tamelen. (By Courtesy): Michel J. Boudart

Associate Professor: Robert Pecora

Assistant Professors: Hans C. Andersen, Leonard M. Stephenson, Frank A. Weinhold

Lecturer: Karen P. Long

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.

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, 135, 153, 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, 153, 171, 173, 174, 175, 176. In addition, a reading knowledge of scientific German is strongly recommended. Premedical students majoring in chemistry may substitute Physics 21, 23, 29 for Physics 51–58 provided they also complete Biology 1, 21,
Students interested in attending overseas campuses should consult their advisers as early as possible in order to avoid scheduling problems. Note that it is particularly convenient to attend an overseas campus during spring and summer of the second year, since the courses listed in these quarters may be delayed to subsequent years without disadvantage. No required course may be taken on a pass/no credit basis.

**American Chemical Society Certification**

Students who wish to be certified as having met the minimum requirements of the American Chemical Society for professional training must complete, in addition to the above requirements, at least six units from Chemistry 136, 145, or 190; and at least three additional units from one of the following: Chemistry 136, 143, 145; any chemistry course numbered above 200 for which permission to register has been granted by the instructor; Biochemistry 101; 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, 241, 251, 253, 255, 271, 273, 275, Biochemistry 101, 102, Mathematics 130, 131, 132, physics lecture courses numbered 100 and higher, or other advanced courses approved by the student's adviser and by the supervisor of his work in Chemistry 190.

Students who wish to be admitted to the Honors Program but who do not meet all of the above formal requirements, may petition the Department for admission.

**Typical Schedule for Four-Year Program**

(Class of 1975 and earlier)

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
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<tbody>
<tr>
<td>A W Sp</td>
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<tr>
<td>Chem. 1, 2, 3. General Chemistry</td>
<td>4 4 5</td>
</tr>
<tr>
<td>Writing Requirement</td>
<td>3 3 3</td>
</tr>
<tr>
<td>German 1, 2, 3. First-Year German</td>
<td>4 4 5</td>
</tr>
<tr>
<td>Math. 10, 11, 21. Analytic Geometry and Calculus</td>
<td>3 3 3</td>
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Totals: 14 14 16

**Second Year**

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<td>Chem. 121, 123, 125. Organic Chemistry</td>
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<td>Chem. 122, 124. Organic Laboratory</td>
<td>3 3</td>
</tr>
<tr>
<td>Math. 22, 23. Analytic Geometry and Calculus</td>
<td>3 3</td>
</tr>
<tr>
<td>Physics 51, 53, 54. Mechanics, Sound, Electricity</td>
<td>3 3</td>
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<tr>
<td>Electives (see Note 1)</td>
<td>8 3 4</td>
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**Third Year**

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<td>Physics 55, 56, 57, 58. Light and Heat, Atomic Physics</td>
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<tr>
<td>Chem. 153. Inorganic Chemistry</td>
<td>3 3</td>
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<td>15 12 15</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. 128, 130A, 130B, 150, 204; Econ. 1; English 102; Math. 44, 106, 113, 130, 131, 132; Physics 61, 110, 111, 132; Statistics 27, 100, 118; Geology 1, 25; Engr. 50; Appl. Earth Sci. 105; Mat. Sci. and Engr. 107; Med. Microbiology 101; Biol. Sci. 1, 21, 22, 23, 116; Biochem. 101, 102; Comp.Sci. 106, 127; Civil Engr. 171, 175, 278.

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(Class of 1976 and later)

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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 by consulting the section on credentials under "School of Education" in this bulletin and the Credential Secretary of the School of Education.

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.
be given during the period September 22, 23, 1972, and all must be taken at this time.

MASTER OF SCIENCE
All applicants for the degree of Master of Science in Chemistry are required to complete, in addition to the requirements for the Bachelor's degree, a minimum of 39 units of work. Of the 39 units approximately two-thirds must be in the Department and must include at least 12 units of advanced course work in chemistry exclusive of the thesis. Of the 12 units, at least three units must be from Chemistry 221, 223, 225, 251, 253, 255, 271, 273, or 275.

MASTER OF ARTS IN TEACHING (CHEMISTRY)
In cooperation with the School of Education, the Department offers a program leading to a degree, Master of Arts in Teaching (Chemistry). This degree is intended for candidates who have a teaching credential and who wish to strengthen further their academic preparation. Detailed requirements are outlined in this bulletin under "School of Education, the Master of Arts in Teaching."

DOCTOR OF PHILOSOPHY
The graduate student does not become a formal candidate for the Ph.D. degree until he has passed the Department qualifying and language examinations and has been admitted to candidacy by the University Committee on the Graduate Division. Doctorate candidates will be considered responsible for an integrated knowledge of their field of specialization, which will not be limited to the content of related advanced courses offered by the Department. Normally they will register for at least 30 units of advanced lecture courses, exclusive of research. The foreign language requirement for the Ph.D. in organic chemistry ordinarily will be met in German and in French or Russian. The foreign language requirement in physical or inorganic chemistry ordinarily will be met in either German or Russian. Proposals to substitute for French or Russian another language or a program of course work will be considered by the Department on petition by the candidate. Candidates for the Ph.D. degree are required to participate continually in the Department seminar (Chemistry 300), and in the division seminar of the major 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, 235, and 237 in the second year; (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, chemical physics, or inorganic chemistry; (3) Chemistry 221, or 223, or 225; (4) six additional units of advanced lecture courses outside of the fields of chemical physics, physical chemistry, and inorganic chemistry.

Students majoring in biochemistry in the Chemistry Department are required to take (1) Biochemistry 101 and 102 (eight units) unless an equivalent course in general biochemistry was satisfactorily completed previously; (2) nine units of advanced biochemistry chosen from Chemistry 241, Biochemistry 203, 211, 212, 213, 214, 215 or allied courses as approved by the Department of Chemistry, and (3) six units of advanced lecture courses in organic, inorganic, or physical chemistry chosen from Chemistry 221, 223, 225, 251, 253, 255, and 273.

The chemical physics program is designed
solely as a convenience to the unusual chemistry graduate student with an exceptionally strong mathematics and physics background. A student may carry out graduate studies in chemical physics equally well majoring either in physical chemistry or in chemical physics. Students majoring in chemical physics are required to take (1) Chemistry 271, 273, and 275 (or be exempted therefrom by passing special examinations given by the professors in charge of these courses); (2) Chemistry 281, 283, and 285; (3) such other courses as may be recommended by the student's adviser.

Before a candidate may request scheduling of the University oral examination, clearance must be obtained from his 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. McNair 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 Gard 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 aspects of chemistry. Primarily for engineering and science majors with advanced mathematical background including trigonometry and calculus. Some prior knowledge of physics, e.g. the properties of gases, the laws of motion, and some knowledge of elementary chemistry, is assumed. Properties of solutions; chemical equilibrium; electrolyte solutions; galvanic cells, oxidation-reduction; chemical thermodynamics.

4 units, Aut (Hutchinson) lec. TWTh 8; lab. T or W 2:15-5:05

5. General Chemistry—Continuation of 4. Chemical kinetics; atomic structure; molecular structure and bonding; molecular spectra; introduction to organic chemistry.

4 units, Win (Hutchinson) lec. TWTh 8; lab. T or W 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 (Staff) lec. (1) MWF 8, (2) and (3) MWF 9, (4) MWF 10; one recitation by arrangement

32. Structure and Reactivity — Organic chemistry, functional groups, hydrocarbons, oxygenated compounds, chemical equilibria. Prerequisite: 4 or 31.

4 units, Win (Staff) 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 (Staff) 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.

2 units, Spr (Staff) lecture sections same as 31

111. Quantitative Analysis — Primarily for premedical students. Not for Chemistry or Chemical Engineering majors. Chemical principles underlying quantitative analyses for common inorganic ions by gravimetric, volumetric, potentiometric and colorimetric procedures: Concurrent enrollment in 112 required. Given for the last time in 1972-73. Prerequisite: 3 or 5. It is recommended that 121 and 123 be completed previous to enrollment in 111.

2 units, Spr (Loring) TTh 11
Sum (Staff) MWF 1:15-4:05

112. Quantitative Analysis Laboratory — Concurrent enrollment in 111 required. Quantitative analyses are required of a series of unknowns involving the chemical principles covered in 111. Given for the last time in 1972-73.

3 units, Spr (Loring) MWF 1:15-4:05 or TTh 1:15-4:05 and S 9-12
Sum (Staff) MWF 1:15-5:05


4 units, Aut (Skoog) lec. (1) TThS 10; lab. (2) MWF 10; lec. (3) MWF 11; one recitation by arrangement

116. Instrumental Analysis — Fundamentals of modern analytical techniques, especially spectrometric methods, electrochemical methods and those of separation. Theory and techniques of absorption spectrometry, polarimetry, refractometry, flame photometry, conductometric, amperometric, potentiometric and coulometric titrations, chromatography and electrophoresis. Given for the last time in 1972-73. Prerequisites: 113, 114, 171 and previous or concurrent enrollment in both 173 and Physics 29 or 57.

4 units, Win (Skoog) lec. TTh 10; lab. TTh 1:15-4:05 or WF 1:15-4:05

119. Organic Chemistry — Aliphatic, aromatic compounds. For students other than Chemistry or Chemical Engineering majors. Prerequisite: 3 or 5.

5 units, Sum (Staff) MTWTThFS 9

120. Organic Chemistry Laboratory — Prerequisite: concurrent enrollment in 119. Given summer only.

1 unit, Sum (Staff) M or W 1:15-5:05

121. Organic Chemistry — A systematic introduction to the chemistry of carbon compounds. Aliphatic and aromatic hydrocarbons, alcohols, halides, ethers, aldehydes and ketones, reaction mechanisms, and stereochemistry. Given for the last time in 1972-73. Prerequisite: 3 or 5.

4 units, Aut (Staff) lec. (1) TThS 10; lec. (2) MWF 10; lec. (3) MWF 11; one recitation by arrangement

122. Organic Preparations — Laboratory course. About twenty organic compounds will be synthesized. Experiments will be designed to introduce the techniques and manipulations common to many research labs. Some emphasis will be placed on methods of analytical separations. After 1972-73, given summer only. Prerequisite: 119, or previous or concurrent enrollment in 123.

3 units, Win (Staff) MWF 1:15-5:05 or TTh 1:15-5:05
Sum (Staff) MWF 1:15-5:05


3 units, Win (Staff) lec. (1) TThS 10; (Staff) lec. (2) MWF 10; lec. (3) MWF 11

124. Qualitative Organic Analysis Laboratory — Techniques and theory, including both spectroscopic and "wet chemical," in the identification of organic compounds and mixtures in the 0.1 to 1 gram range. Assigned reading and problems. Given for the last time in 1972-73. Prerequisite: 122.

3 units, Spr (Staff) MWF 1:15-4:05

3 units, Spr (Staff) MWF 11

130. Biosocial Aspects of Birth Control — (Same as Human Biology 150.) The problems of introducing a new, practical birth control agent or procedure are enormously complicated and 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 using the development of oral contraceptives and intrauterine devices as historical examples. Prerequisite: Human Biology 3A, 4A desirable.

4 units, Win (Djerassi) T 2:15-4:05, alternate years, given 1973-74

131. Chemical Synthesis and Properties—Polymers, heterocyclic compounds, natural products, dyes, purines, pyrimidines, DNA, RNA. Prerequisite: 35.

3 units, Aut (Staff) lec. (1) MWF 11, lec. (2) TThS 10, given 1973-74 for the first time

132. 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 identification of compounds. Chemistry majors are required to enroll for 4 units.

3 units, Aut (Staff) lec. TTh 10 or TTh 11, lab. MWF 1:15-4:05, given 1973-74

4 units, Aut (Staff) lec. TTh 10 or TTh 11, lab. TTh 1:15-4:05, given 1973-74


3 units, Win (Staff) 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.

4 units, Win (Staff) lec. TTh 11, lab. MW or TTh 1:15-4:05, given 1973-74 for the first time

135. Physical Chemical Principles — Terminal physical chemistry for non-chemistry majors. Prerequisite: 131 and calculus.

3 units, Win (Staff) MWF 10, given 1973-74


3 units, Spr (Staff) by arrangement, given 1973-74

143. Nuclear Chemistry — (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; radiation chemistry; applications in chemistry and engineering. Prerequisite: Physics 57 or equivalent.

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

145. Radioactivation Analysis — (Same as Engineering 177.) The use of radioactivation as a research tool: radioactivation, properties of radioisotopes, sources of irradiations, activation analysis practices and uses in biology, chemistry, and engineering.

3 units, Win (P. Kruger) TTh 11; one lab. by arrangement

153. Inorganic Chemistry — Intended for undergraduates. Survey of the chemistry of transition metal compounds. Bonding, stereochemistry, and structural patterns among transition metal complexes. Emphasis will be given to the synthesis and reactions of organometallic compounds. Prerequisite: 171 or 131.

3 units, Win (Taube) TTh 11

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 (Pecora) MWF 11

173. Physical Chemistry—Quantum Chemistry, molecular structure and spectroscopy including atomic spectroscopy, molecular rotation and microwave spectroscopy, molecular vibration and infrared spectroscopy, electronic states of molecules and magnetic resonance spectroscopy. Prerequisite: 171.

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

221. Advanced Organic Chemistry—Introduction to physical organic chemistry. Rasic 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 (Stephenson) 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 (Staff) MWF 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 (Johnson) MWF 9

227. Selected Topics in Organic Chemistry — May be repeated for credit. Possible topics include synthetic organic chemistry, photochemistry, inorganic-organic chemistry, bioorganic 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

2 units, Spr (Stephenson, Brauman) by arrangement

233. Creativity in Organic Chemistry—The art of formulating, writing, and orally defending a research progress report will be practiced and criticized with the student using his own research as a vehicle. Required of all 2nd year Ph.D. candidates. Winter and Spring: The art of formulating, writing, and orally defending an original research proposal will be practiced and criticized.

1 unit, Aut, Win, Spr (Eastman, Djerassi, Bonner) 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 (Taube) 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 (Weinhold) MWF 11

273. Advanced Physical Chemistry—Molecular spectroscopy and molecular structure. Examination of the experimental and theoretical basis for various models of molecular structure: review of quantum theory of atomic and molecular structure, Born-Oppenheimer approximation, molecular energy levels, interaction of radiation with matter, microwave, infrared, and ultraviolet spectroscopy of molecules. Also, special topics to be chosen according to the interests of the students and instructor; for example, scattering of light by fluids, correlation function methods, spectra of molecules in solution, Mossbauer spectroscopy, magnetic resonance, Raman spectroscopy. Prerequisite: 271.

3 units, Win (Andersen) 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 (Pecora) 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

281. Chemical Physics—Lectures. Prerequisite: 175 or consent of instructor.

3 units, Aut (McConnell) MWF 9, alternate years, given 1973-74

283. Chemical Physics—Continuation of 281: Prerequisite: 281 or consent of instructor.

3 units, Win (McConnell) MWF 9, alternate years, given 1973-74

285. Chemical Physics— Continuation of 283: Prerequisite: 283 or consent of instructor.

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—Introduction to Theory and Experimental Techniques. Seminars, directed reading, and individual instruction. Open to qualified graduate students with consent of instructor. May be re-
peated for credit. Registration required of all graduate students who have passed the qualifying examination.

3 units, Aut, Win, Spr (Staff) sections 1 through 24, 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

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 biochemistry and organic chemistry: previous or concurrent registration in 124.

(Staff) by arrangement

CLASSICS

Emeriti: Hermann F. Fränkel, Raymond D. Harriman (Professors)
Chairman: Mark W. Edwards
Professors: Mark W. Edwards, Edwin M. Good (Religion and, by courtesy, Classics), Lionel Pearson, Antony E. Raubitschek, T. B. L. Webster
Associate Professors: Andrew Devine, Michael Wigodsky
Assistant Professors: William Berg, N. Gregson Davis, Ronald Mellor, John D. Moore
Lecturer: Edward Spofford

The Department of Classics offers work in the Greek and Latin languages and literatures (both in the original languages and in translations), in Greek and Roman History, and in Classical Art and Archaeology. It affords an opportunity for the student to develop three things: a competence in the classical languages, an appreciation, comprehension, and enjoyment of classical literature, and an understanding of the history and culture of the ancient world. The Department is interested both in students who wish to do their major work in Classics and in students who wish to relate Classics to work in such other departments as English, Philosophy, History, and the Modern Languages.

Study of the Classics is a very important part of a liberal education and should be undertaken with that thought in mind. The Department hopes that some students who make it their major subject will devote themselves to teaching Latin and Greek in high schools or colleges. In such cases a Combined Major (see below) is recommended.

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 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.

PROGRAMS OF STUDY

BACHELOR OF ARTS IN CLASSICS

The Degree of Bachelor of Arts in Classics may be taken either in 1: Classics (Latin and Greek), 2: Latin or Greek, 3: Latin or Greek with a related minor, 4: Classical Studies.

A student's program of study should be prepared in advance after consultation with his Departmental adviser. The program will be planned to follow the interests of the individual student, and will normally include study of most of the major authors in the language or languages of concentration; a list can be obtained from the Departmental adviser. A student interested in obtaining certification for teaching Latin in the State of California should consult the Chairman of the Department or his adviser.

1. Latin and Greek. 50 units in Latin and Greek courses at the 100 level or higher. If recommended by the student's adviser, some work in Latin or Greek composition
should be included. (This major is recommended for students who are interested in graduate work in Classics or in related fields such as Ancient History, Medieval History, Ancient and Medieval Philosophy, etc.)

2. Latin or Greek
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.

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.

3. Latin or Greek with related minor. As in 2. above for (a) Latin or (b) Greek, with an additional minor program of 20 units in any field acceptable to the department.


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 Ancient 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.

**COMBINED MAJORS**

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 English, Classics and Philosophy, Classics and one or more modern languages, Classics and History. Other combinations are possible. Students interested in such a major should consult the Chairman of each of the departments concerned. Combined Majors are particularly recommended for students who may enter high school teaching.

**MINORS**

The Department recommends for an undergraduate minor in Classics (Latin or Greek) the following: 20 units of Latin or Greek of which at least 16 shall be on the 100 level or above, and 4 units in related courses (Greek or Roman 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.

**ROME CLASSICAL CENTER**

Classics majors are strongly urged to attend the Intercollegiate Classical Center at Rome. The program in Rome is specially designed for classical undergraduates. The Center is managed by Stanford University for 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.

ADVANCED DEGREES

MASTER OF ARTS

Students may, under very exceptional circumstances, be accepted as candidates for the degree of Master of Arts who have completed an undergraduate major in Classics (Latin and/or Greek) or its equivalent. 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 his undergraduate major has been Latin) or one Latin course at the 100 level (if his 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 degree. At least 72 approved units in graduate courses or seminars at 200 level or above must be completed in addition to the doctoral dissertation. At least three consecutive quarters of graduate work and the final units of credit in the program must be taken at Stanford. More detailed information on the Advanced Degree Program is available in mimeographed form in the Classics Department Office.

2. Candidates will be required to pass examinations as follows:
   a) Reading examinations in French and German. In some circumstances Italian may be substituted for French.
   b) Examinations in translation into English from Greek and Latin authors included in an approved list (drawn up by the Department and available from the Departmental secretary).
   c) Final written examinations in two classical authors (one Greek and one Latin) and in two fields, one of which must be historical. Each student must submit a syllabus for each author and each field. The examinations will be drawn up on the basis of this syllabus after it has been approved by the Department.
   d) A colloquium on the candidate's dissertation and an oral examination 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 dissertation colloquium and 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 expect-
ed 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 he takes his final written examination) must submit to the Chairman of the Department a statement of his dissertation topic as approved by his dissertation committee. This committee will normally be appointed (for each candidate) by the Chairman of the Department at least one quarter before his 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 (Devine)

2. First-Year Greek—Continuation of 1. 4 units, Win (Devine)

3. First-Year Greek—Continuation of 2. 4 units, Spr (—)

51. First-Year Greek—Accelerated course. 5 units, Win (Moore)

52. First-Year Greek—Continuation of 51. 5 units, Spr (Moore)

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. Hesiod.
   3 to 4 units, Aut (——) given 1973–74

152. Aristophanes.
   3 to 4 units, Win (Wigodsky) given 1973–74

   3 to 4 units, Spr (——) given 1973–74

160. Individual Work.
   By arrangement

161. Plato.
   3 to 4 units, Aut (Moore)

162. Aeschylus.
   3 to 4 units, Win (——)

163. Herodotus.
   3 to 4 units, Spr (Raubitschek)

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)

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 1971–72 there were courses in the following authors or topics: Greek Metrics, Thucydides, Menander, Greek Terracottas, The Iliad and the Epic Cycle, Lyric Themes. The following courses will be offered in 1972–73.

211. Hellenistic Poetry.
   4 units, Spr (Webster)

218. Demosthenes.
   4 units, Aut (Pearson)

222. Topics in Greek Philosophy.
   4 units, Spr (Moore)

228. Archaic Greek Figured Pottery.
   4 units, Win (Webster)

260. Directed Reading.
   By arrangement

261. Plato.
   4 units, Aut (Moore)

263. Herodotus.
   4 units, Spr (Raubitschek)

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 (Spofford)
2. First-Year Latin—Continuation of 1.
   4 units, Win (Spofford)
3. First-Year Latin—Continuation of 2.
   4 units, Spr (Spofford)
51. Accelerated Beginners' Course.
   5 units, Win (Devin)
52. Accelerated Beginners' Course — Continuation of 51.
   5 units, Spr (Devin)

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.)—Reading in Latin prose. Cicero, Sallust, Caesar.
   4 units, Aut (Pearson)
   4 units, Win (Pearson)
103. Second-Year Latin (Continuation of 102.)—Latin Poetry. Virgil, Aeneid. One or more books will be studied.
   4 units, Spr (Pearson)
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 (Davis)
112. Third-Year Latin (Continuation of 111.)—The Augustan Age. Virgil, Eclogues and Georgics.
   4 units, Win (Pearson)
113. Third-Year Latin (Continuation of 112.)—The Augustan Age. Livy and the elegiac poets, a selection.
   4 units, Spr (Pearson)

**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) given 1973–74
152. Cicero, Oratory.
   3 to 4 units, Win (Mellor) given 1973–74
153. Roman Satire.
   3 to 4 units, Spr (Wigodsky) given 1973–74
160. Individual Work.
   By arrangement
161. Tacitus.
   3 to 4 units, Aut (Pearson)
   3 to 4 units, Win (Davis)
163. Lucretius.
   3 to 4 units, Spr (Wigodsky)

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)

**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 1971-72 there were courses in the following authors or topics: Cicero, Vulgar Latin Inscriptions, Ancient Pastoral Poetry, Art and Monuments of the Romans, Post-Classical Latin. The following courses will be offered in 1972-73.

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)

210. Ancient Dialects of Italy.
4 units, Win (Devine)

218. Virgil, Aeneid.
4 units, Aut (Wigodsky)

260. Directed Reading.
By arrangement

262. Topics in Roman Elegy.
4 units, Win (Davis)

263. Lucretius.
4 units, Spr (Wigodsky)

270. Latin Prose or Verse Composition.
By arrangement

Note: Some of the above courses may be continued in the following quarter by arrangement with the instructor. This will usually require the writing of a research paper based on work directly related to the course.


COURSES IN HEBREW
For courses in Hebrew, see Humanities Special Programs: Religious Studies.

COURSES IN CLASSICAL STUDIES
No knowledge of Greek or Latin is required for these courses.

COURSES FOR FRESHMEN
Topics in Classical Civilization
In this program a number of courses are offered specifically intended to acquaint first-year students with certain ways of looking at the ancient world which will be of use to them in their general educational experience in the university. They introduce the student to the value of classical learning as a means of rapidly widening one’s knowledge and experience, and as an opportunity to observe how the universal problems of human nature, human society, and the circumstances of human life were viewed and grappled with by the brilliant civilizations of Greece and Rome.

1. The Men Who Made Rome Great—Studies in the personality and actions of those who contributed most to making Rome the Eternal City and the center of western civilization.
2 to 3 units, Aut (Raubitschek)

2. The World of Greece and Rome—Contrasts and comparisons in literature, history, and ideas.
2 to 3 units, Aut (Webster)

3. New Democracy and New Imperialism—Examination of the lessons that can be learned from the few years that embraced Athens’ experiments with democracy, her imperialistic expansion, and her fall from power.
2 to 3 units, Win (Edwards)

4. Ancient Poets and Philosophers on the World and Society—A study of some poets and philosophers with emphasis on their understanding of their own abilities; their attention to gods, justice, and work; and their sense of the wholeness of the world of which men are part.
2 to 3 units, Win (Spofford)

GENERAL COURSES

Literature

121. Latin Literature in Translation—A study of some Latin poets, with particular stress on their relevance to English poetry.
3 to 4 units, Aut (Spofford)

150, 250. Seminar: The Ironic Muse in the Classics of East and West—(Same as Asian Languages 150 and Comparative Literature 150.) Graduate students may register under 250, in which case they will be expected to do additional work.
4 units, Spr (Moore, Young) by arrangement

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, Spr (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 history in selected Renaissance and later writers; parallel readings from ancient literature.

3 to 4 units, Win (Wigodsky) given 1973-74

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) given 1973-74

173. Classical Political Theory—Ancient political ideas (Plato, Aristotle, Polybius, Cicero) and their impact on modern theory.

3 to 4 units, Win (Raubitschek) given 1973-74

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 (Raubitschek)

MORE SPECIALIZED COURSES

112. Alexander and the Hellenistic World—Open to all students, designed as a sequel to 102.

4 units, Spr (Pearson)

113. The Roman Empire in the Second Century—Open to all students, designed as a sequel to 103.

4 units, Aut (Mellor) given 1973-74

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 1973-74

261. Individual Work in Greek History.
By arrangement

262. Individual Work in Roman History.
By arrangement

Religion and Mythology

117. Myth and Religion in Greek Art—
(Same as Humanities Special Programs 117.)

3 units, Spr (Webster) TTh 1:15

163. Comparative Mythology: Topics from Greek and Roman, Near-Eastern and African Culture—(Same as Comparative Literature 163.)

3 to 4 units, Aut (Davis)

Art and Archaeology

101. Archaic Greek Sculpture and Painting.
2 to 3 units, Aut (Webster)

102. Classical Greek Sculpture and Painting.
2 to 3 units, Win (Webster)

103. Hellenistic Greek Sculpture and Painting.
2 to 3 units, Spr (Webster)

105. Athenian Everyday Life.
2 to 3 units, Aut (Webster) given 1973-74

106. Art and Monuments of the Romans.
4 units, Spr (Wigodsky) given 1973-74

107. Greek Theatre Production.
2 to 3 units, Win (Webster) given 1973-74

See Greek 228.
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 1973-74

232. Introduction to Indo-European Linguistics—(Same as Linguistics 232.) 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) given 1973-74  

COMMUNICATION  

Emeriti: Chilton R. Bush, 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, Don C. Dodson, David L. Grey, Donald F. Roberts. Acting: Emile McAnany  

The Department of Communication engages in research in communication and offers curricula leading to the A.B., A.M. and Ph.D. degrees in Communication. The Master of Arts degree prepares students for careers in journalism or documentary film. The Ph.D. degree is for careers in teaching and research or other research specialities.  
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 program.  

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 his 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: Chairman, Department of Communication, Redwood Hall, 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 literature, social sciences, and sciences. Most commonly, majors take elective courses in psychology, sociology or anthropology, political science, history, economics, speech and drama, 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 designed to provide flexibility 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 close consultation with his adviser.

Requirements for the degree are as follows:

1. A total of at least 25 and not more than 35 units in Communication Department courses, which must include:
   a) Two survey courses, Communication 1 and 142 or 220;
   b) Two courses, either Communication 100–102, and 150 or 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.

While 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) normally takes four or five quarters depending on the nature of the project. Tuition usually is charged only for the three or four 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 his individual needs, normally most Film and Broadcasting students will take 200, 208A,B,C, 215, and 223A. The rest of his curriculum will be worked out in consultation with his 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, 207, 220, two quarters of 225, 230 or 240, 249 or Law 104, 309, and an internship with a media organization. Students without adequate prior course work in the behavioral sciences are required to take Communication 203 or 215. 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. No special sequence in broadcast journalism is offered at this time, but students interested in this field can take several broadcast courses.

**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 Systems Research. 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 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 a written examination in the subjects required of all candidates and in the area of specialization of the particular candidate.

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 if they are doctoral candidates in Public Affairs Communication, or, if they are doctoral candidates in Communication Research, 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 are examples of standard Ph.D. programs in Communication Theory and Research:

1. **Communication Theory**
   - Comm. 211A. Theory of Communication I
   - Comm. 211B. Theory of Communication II
   - Comm. 211C. Theory of Communication III

2. **Methodology**
   - Comm. 218. Communication Research Methods I
   - Comm. 219. Communication Research Methods II
   - C.S. 105. Introduction to Computing
   - 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. **Experimental Psychology** (at least two of the following: Psych. 103A and Psych. 103E are strongly recommended)
   - Psych. 103A. Experimental Psychology: Higher Mental Processes
   - Psych. 103B. Experimental Psychology: Perception
   - Psych. 103C. Experimental Psychology: Learning
   - Psych. 103D. Experimental Psychology: Social Processes
   - Psych. 103E. Experimental Psychology: Social Psychology

5. **Psychology** (at least two courses in social psychology, at least one in learning theory, and at least one in personality or motivation). Example courses are:
   - Psych. 210. Advanced Learning
   - 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. 261. Seminar in Social Psychology
Psych. 262. Seminar in Verbal Behavior
Psych. 264. Seminar in Learning Theory
Psych. 267. Seminar in Person Perception

6. Sociology (at least two graduate level courses in Sociology)
Example courses are:
Sociol. 104. Interpersonal Behavior
Sociol. 131. Advanced Social Psychology
Sociol. 217. Problems in Theoretical Analysis
Sociol. 250. Basic Problems in Sociological Theory
Sociol. 253. Theory Construction
Sociol. 264. Seminar in Socialization and Social Control
Sociol. 268. Concepts and Operations in Sociological Analysis
Sociol. 279. Problems in Study of Social Influence
Sociol. 285. Problems in the Analysis of Social Stratification

The following is an example of the Ph.D. program required in Public Affairs Communication:

1. Communication Theory
   Comm. 211A,B,C. Sequence in Communication Theory

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
   And at least two among the following:
   Comm. 240. Seminar in Mass Media History
   Comm. 245. Economics of the Mass Media
   Comm. 249. Mass Media Law (or Law 104, Courts and the Legal Processes, or both.)
   Comm. 256. Communication in Economic and Social Development
   Comm. 257. Educational Technology in Developing Countries

3. Methodology and Statistics
   Comm. 218, 219. Sequence in Research Methods
   Comm. 227. Analysis of Documentary Evidence
   Comm. 309. First-Year Research Project
   Comm. 319. Pre-dissertation Research Project
   Psych. 60. Statistical Methods, or Stat. 50. Elementary Statistics
   At least one other course in statistics or advanced research methods.

4. Political Science, Law, History, Economics — a unified program of six courses in one or two of these fields. Examples of subject areas and courses:
   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. Modern Political Thought
   Pol.Sci. 158. Theory, Power, and Social Science
   Public Law:
   Law 104. Courts and the Legal Process
   Pol.Sci. 170 (270). The Supreme Court and the Constitution
   Pol.Sci. 173 (273). Civil Liberties in the U.S.
   Modern European History:
   Hist. 32. Twentieth Century Europe
   Hist. 121, 122A,B. Russia
   Graduate Seminars in European History
   United States History:
   Hist. 166, 167. 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. Developing Economies
   Econ. 158. 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.)

5. At least two courses from the above or other departments (including Communication) chosen in consultation with an adviser, in preparation for the degree examinations, the dissertation, and a teaching and research career. This requirement is designed especially for students who have not concentrated in the behavioral sciences as undergraduates or as graduate students in other programs.

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. Such programs are individually planned for unusually well-qualified students.

One example would be an Information Science program involving communication and computer science. Applicants for such special programs must first be admitted to a Stanford department. Inquiries about programs involving communication should be directed to the Communication Department.

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 between communication theory, methods, and applications courses will be determined by the candidate and his senior adviser. Communication 211A, B, C, together with Communication 218 and 219 are most 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 about the Institute write to the Director.

COURSES OPEN TO UNDERGRADUATES AND GRADUATES

GENERAL


5 units, Win (Maccoby) MTW 10 and section

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.

3 units, Aut (Rivers) TTh 11
Win (Grey) TTh 10
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 (Grey) 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

140. History of Anglo-American Journalism — Open to non-majors.
Given 1973-74

150. Magazine Writing—Practice in writing magazine articles, with emphasis on marketing manuscripts. Conferences. Prerequisites: 100 and 102.

3 units, Win (Rivers) TTh 11

152. Magazine Editing — Planning, writing, production studied with local magazine editors, correspondents; industrial editing. Prerequisite: 150.

3 units, Spr (Rivers, Sellers) 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 (Grey) MWF 10

178. Mass Communication in Developing Nations—Structure and roles of the mass media in Africa, Asia, Latin America, and the Middle East. Prerequisite: any other Communication course.

4 units, Win (Dodson) TTh 9 and sections

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.

3 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, Aut (Grey) T 2:15-4:05

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 (Breitrose) 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 (Breitrose) MWF 9;
evening screenings by arrangement

142. Broadcast Communication — The de-
velopment of American broadcasting and its contemporary problems. (Graduate students register for 242.)

4 units, Aut (Dundes) TTh 1:15

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 (Breitrose) MWF11

189. Uses of Ethnographic Film — Critical examination of the problems of validity and reliability involved in reporting and interpreting aspects of a culture using essentially non-verbal forms. Evaluation of the uses of ethnographic films as research reports, as research instruments and as instructional materials. Students will prepare a series of written exercises and a term paper. Prerequisite: Anthropology 1 and consent of instructor.

4 to 5 units, Spr (Breitrose) MW10; lab. Th 7:30-10:00 p.m.

200. Visual and Aural Communication Techniques — An investigation of the techniques of cinematography and sound from the standpoint of the communication of ideas. Students will produce short 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 quarter.)

5 units, Aut, Win, Spr (Alexander) MW 1:15-3:05

205A. Television Production I — Production and direction of news and documentary television programs. Prerequisites: 200, 223A or consent of instructor.

4 units, Sum (——)

205B. Television Production II — Prerequisite: 205A.

3 units (——) by arrangement, given 1973-74

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. Prerequisite: 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

216. The Broadcast Editorial — Analyses of radio and television editorials. Students will research, write, deliver and direct their own editorials.

3 units, Win (Dundes) MW 1:15-3:05

221. Film and Television Directing — Theory and technique of directing actors and non-actors for film and television. Prerequisites: 200, 205A,B, 223A.

3 units, Spr (——) by arrangement

223A. Writing for Film and Broadcasting I — Techniques of research and writing for the visual media. To be taken concurrently with 223A. Prerequisite: consent of instructor. (Open only to graduate students in autumn quarter.)

4 units, Aut, Win, Spr (——) TTh 10-12

223B. Writing for Broadcasting and Film II — Structure and style in the construction of factual film and television scripts. To be taken concurrently with 206A. Prerequisite: 223A.

4 units, Win (——) 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 (——) TTh 10-12

242. Broadcast Communication. (See 142.)

243. Seminar in Broadcast Management — An advanced examination of the managerial aspects of commercial and public broadcasting from the standpoint of legal, financial,
and ethical obligations. Prerequisites: 142 or 242 or concurrent registration in the School of Law or the Graduate School of Business and consent of the instructor.

4 units, Win (Dundes) W 3:15

Summer Film and Broadcasting Institute

(See the 1973 Summer Session Bulletin, available in February, 1973.)

COURSES FOR GRADUATES


3 units, Aut (—) MW 2:15-4:05

207. Survey of Communication Research Methods — Research designs, sampling, data collection, and data analysis. For Journalism A.M. students.

4 units, Win (—) MW 4:15-6:05

211A. Theory of Communication I — Seminar and tutorial meetings, extensive readings and papers. For doctoral candidates planning to continue with the sequence on theory.

4 to 6 units, Aut, Win, Spr (—)

TTh 3:15-5:05

211B. Theory of Communication II — Continuation of 211A.

4 to 6 units, Win (—) TTh 3:15-5:05

211C. Theory of Communication III — Continuation of 211B.

4 to 6 units, Spr (—) 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 beyond the first year. Prerequisites: 211A,B,C, 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


4 units, Aut (Maccoby, Breitrose) by arrangement

218. Communication Research Methods I — Methods of research in mass and interpersonal communication. Application of scientific method to communication research. Sample surveys, laboratory and field experiments, historical analyses. Conceptualization of variables, sampling, data collection, data processing and analysis. Prerequisite: elementary statistics.

4 units, Win (Staff) MW 3:15-5:05


4 units, Spr (Staff) 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 (Breitrose) by arrangement


4 units, Aut (Grey) by arrangement

230. Mass Media and Government — Study of the interaction between the government and the press. Role of the press in the governmental process as a disseminator, opinionmaker and adversary. Open to Communication graduate students only.

4 units, Win (Rivers) TTh 2:15

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.

4 units, Aut (—) by arrangement

232. Developmental Communication II — Continuation of 231.

4 units, Win (—) by arrangement
4 units, Spr (—) by arrangement

235A. Seminar in African Psychology I—(Same as Psychology 235A.) 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 7–10 p.m.

235B. Seminar in African Psychology II—(Same as Psychology 235B.) 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) African conception of space and time. Prerequisite: 235A.
3 to 4 units, Win (C. Clark, McGee) TTh 7–10 p.m.

235C. Seminar in African Psychology III—(Same as Psychology 235C.) 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 7–10 p.m.

240. Mass Media History—Review of the literature and research in the historical development of newspapers, magazines, broadcasting and film.
4 units, Spr (Grey) by arrangement

242. Broadcast Communication—See 142.

243. 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) W 1:15–3:05

245. Economics of the Mass Media—Analysis of the literature in mass media economics and intensive research projects. Primarily for doctoral students in Public Affairs Communication.
4 units, Spr (Grey) by arrangement

251. Teaching Seminar—Discussions of effective teaching methods led by Stanford teachers from several departments. Communication Ph.D. candidates only.
1 unit, Aut (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

257. Educational Technology in Developing Countries—(Same as Education 214.) Seminar in problems in research design related to evaluating educational technology in developing areas. The focus will be both substantive and methodological. Areas that are most relevant to education broadly considered and that are affected by the application of technology (television, radio, etc.) will be examined with special reference to Africa and Latin America.
3 to 5 units, Spr (McAnany, Staff) by arrangement

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 (Parker, 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 (Paisley) M 12:00–2:05, alternate years, given 1973–74
262. **Flow of Scientific and Technical Information to the Public**—Exposure of the public to scientific and technical information (emphases: science, medicine). Public knowledge levels. The interplay of media and personal networks.

3 units, Win (Paisley) M 12:00-2:05, alternate years, given 1972-73

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

270. **Advanced Communication Theory and Method Seminar I** — May be repeated for credit. Topic and instructor change each year. Prerequisites: 211C 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: 211C 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: 211C 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**—Continuation of analysis topics covered in 219: Students may choose individual analysis projects.

4 units, Aut (Paisley) M 2:15-4:05

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

309. **First-Year Research Project**—Individual research, in lieu of Master's thesis.

3 to 6 units (Staff) by arrangement

319. **Pre-Dissertation Research Project**—Advanced research for Ph.D. candidates.

(Staff) by arrangement

330. **Public Affairs Thesis Seminar**—For Public Affairs Ph.D. candidates only.

1 to 6 units, Aut, Win, Spr (Rivers) W12

331. **Public Affairs Comprehensive Review**—For Public Affairs Ph.D. candidates only.

1 to 6 units, Aut, Win, Spr (Rivers) T12

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**COMPARATIVE LITERATURE**

*Committee in Charge: Herbert Lindenberg, Chairman; Edward J. Brown, W. B. Carnochan, Robert G. Cohn, N. Gregson Davis, Jean Franco, David G. Halliburton, James J. Y. Liu, Edgar Lohner*

*Professors: Jean Franco (Spanish and Comparative Literature), Herbert Lindenger (Comparative Literature and English), N. Scott Momaday (English and Comparative Literature) (on leave 1972-73), Makoto Ueda (Japanese and Comparative Literature)*

*Associate Professor: David G. Halliburton (English and Comparative Literature)*
Assistant Professors: N. Gregson Davis (Classics and Comparative Literature). Acting: John B. Foster (English and Comparative Literature), Josué Harari (French 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 major, or the equivalent of a major, in a single national literature. Requirements are as follows:

1. Western Thought and Literature — Humanities 61 or 62. Completion of the full Humanities 61, 62, 63 series is strongly recommended.
2. Two seminars drawn from the series Humanities 191–196, of which one must be Humanities 194.
3. At least three literature courses in a foreign language and at least one advanced course—preferably a literature course—in a second foreign language.
4. One literature course—not necessarily in the original language—drawn from a cultural tradition distant from that of the student's main areas of interest.
5. Two additional literature courses drawn from the following:
   a) Courses listed under Comparative Literature.
   b) Courses offered in translation by the foreign language departments in languages outside the student's two languages.
   c) Advanced literature courses offered at the overseas campuses.
6. Honors essay—an essay in literary criticism (2 units, spring, junior year; 5 units, autumn, 5 units, winter, senior year). A grade of at least B is required on the essay for graduation with Honors in Humanities.
7. Two courses related to the student's total program, but drawn from disciplines outside literature.
8. Course distribution should be designed in such a way that students develop an extensive background (about six courses covering a large range of periods) in a single national literature read in the original language. Students may fulfill this requirement through work either in the English Department or in one of the language departments.

**Graduate Program**

The Ph.D. program is designed for a small group of students whose linguistic background, breadth of interest in literature, and curiosity about the problems of literary scholarship 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 will draw up his 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
will normally complete the program in four years.

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 Roman- tic period. 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 are as follows:

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.

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 parts:

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. On the basis of this examination and the student’s total record, the examining committee will recommend whether the student is qualified to proceed toward the Ph.D.

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. Students may elect to take this section of the examination before the genre section, in which case it must be taken no later than the first quarter of the second year.

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 of graduate work, will serve as the University Oral Examination, which will also include a short section on the student’s plans for the dissertation.

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 twofold: to present the novel as a significant, distinct genre of literature, and by encouraging close, sympathetic reading to increase the student's appreciation of the individual novels.

5 units, Win (Foster)

40. Drama—(Same as English 40.) Principal dramatic forms; development of dramatic art, masterpieces of the theater from various periods, countries.

5 units, Spr (Lindenberger)

45. The Tragic—(Same as English 45.) The articulation of tragic forms in English and European literature. The course will attempt to define various insights and tendencies we connect with the term tragedy by studying the works of major writers in drama, the novel, and poetry. Authors will include Shakespeare, Racine, Webster, Dickens, Stendhal, Ibsen, Becket, Yeats, and Faulkner.

5 units, Win (Friedlander)

50. Poetry—(Same as English 50.) An introduction, through the study of language, technique, and critical theory, through writing, and through the slow reading of poems.

5 units, Spr (Felstiner)

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) MWF 11; two hours by arrangement


5 units, Win (Ryan, Staff) MWF 11; two hours by arrangement

63. From the Enlightenment to the Present—Rousseau, Goethe, Stendhal, Büchner, Flaubert, Dostoevsky, Nietzsche, Lawrence, Kafka, Beckett.

5 units, Spr (Sokel, Staff) MWF 11; two hours by arrangement

113. Problems of Narrative in Eighteenth Century Fiction—(Same as French and Italian 113.) A study of the concepts of time and space, system and structure, in order to explain the logic and the organization of narrative discourse. Readings from Defoe, Fielding, Richardson, Smollett, Sterne, Diderot, Prévost, Voltaire, Sade, and Laclos.

4 units, Spr (Harari)

114. Myth and Violence in Literature—(Same as French and Italian 114.) An analysis of Greek, French, and English theater in conjunction with anthropological material. Readings from Sophocles, Aeschylus, Euripides, Shakespeare, Racine, Sade, Artaud, Malinowski, and Lévi-Strauss.

4 units, Aut (Harari) MW 9; one hour by arrangement

116. The Fate of Modern Fiction—(Same as French and Italian 116.) Literature or criticism.

3 to 4 units (Harari) given 1973-74
117. Literary Criticism and Structural Analysis—(Same as French and Italian 117.)
3 to 4 units (Harari) given 1973–74

118A, B. Russian Intellectual History—(Same as History 118A, B and Slavic Languages and Literatures 118A, B.)
8 units, Aut, Win (Brown, Emmons) given 1973–74

147. Contemporary Drama—(Same as English 147.)
5 units, given alternate years

150. Seminar: The Ironic Muse in the Classics of East and West—(Same as Asian Languages 150 and Classics 150.) Graduate students may register under 250, in which case they will be expected to do additional work.
4 units, Spr (Moore, Young)
by arrangement

163. Comparative Mythology: Topics from Greek and Roman, Near-Eastern and African Culture—(Same as Classics 163.)
3 to 4 units, Aut (Davis)

164. Neo-African Literature of the Caribbean—With focus on the literature of the former French and British islands.
5 units, Win (Davis)

174. The Concepts of Chaos, Cosmos and Metamorphosis in Literature—(Same as French and Italian 174.) An experimental approach to the history of ideas tracing the concepts of chaos, cosmos, and metamorphosis in ancient literature, in the Renaissance, and in such later writers as Melville, Pirandello, Kafka, Buzzati, and Betti. In English.
4 units, Spr (Braghieri)

188. Three Forms of Drama—(Same as French and Italian 188.) Dramatic form as perceived during three of the major periods of literary history: ancient Greece, the 16th and 17th centuries, the modern period. In English.
4 units, Win (Braghieri)

194. Literature and the Humanities—(Same as Humanities Special Programs 194.) The critical study of major texts; theory and practice of criticism.
5 units, Win (Foster) by arrangement

208. Post-Classical Latin—(Same as Classics 208 and English 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)

218A. The Culture of England, 1890–1914—(Same as English 218A, History 244, and Modern Thought and Literature 218A.) History, literature, and art as expressing and influencing the period in related ways. Limited to 30 students, who should have taken a course in nineteenth century English literature or history.
5 units, Win (Felstiner, Stansky)

230. Aspects of Intrinsic Criticism—(Same as Slavic Languages and Literatures 230.)
4 units, Spr (Brown) given 1973–74

235. The Impressionist and Experimental Novel—(Same as English 235.)
5 units (Guerard) alternate years, given 1973–74

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) M 2:15–4:05

257. The “New Novel” in Europe and Latin America—(Same as Spanish and Portuguese 257.)
4 units, Spr (Franco)

258. Modern European and Latin American Poetry: Avant Garde and Vanguard—(Same as Spanish and Portuguese 258.) Studies in the relationship of European movements such as Symbolism, Dada, and Surrealism with contemporary Latin American poetry.
4 units, Win (Franco)

260. The History of Literary Theory—(Same as English 260.)
5 units, alternate years, given 1973–74

262. Nietzsche and the Modern Novel—(Same as English 262 and Modern Thought and Literature 262.) Nietzsche as a philosopher of culture; the force of his ideas in the novels of D. H. Lawrence, Thomas Mann, Malraux, and Belyj. Reading knowledge of French or German or Russian desirable.
5 units, Spr (Foster)

263A. Existential and Visionary Literature
263B. The Existential Hero in Modern Literature—(Same as English 263B and Modern Thought and Literature 263B.) Forms of existential commitment in the protagonists of writers like Sartre, Joyce, Woolf, Ellison, and Malamud.

5 units, Spr (Ruotulo)

266. Romantic Historical Literature—(Same as English 266.) The rise of Romantic historical drama and fiction in Europe and America: Goethe, Scott, Cooper, Hawthorne, Pushkin, Tolstoy, Stendhal, and Büchner.

5 units, Aut (Dekker)

269A. Toward an Understanding of Romanticism—(Same as English 269A and Modern Thought and Literature 269A.) Study of such major developments in Romantic thought and literature as concepts of the self, historicism, and visionary poetry. Reading knowledge of French or German desirable.

5 units, Spr (Lindenberger)

269B. Toward an Understanding of Modernism—(Same as English 269B and Modern Thought and Literature 269B.)

5 units (Lindenberger) alternate years, given 1973-74

270. Modern Critical Thought: The Symbolist Heritage — (Same as Modern Thought and Literature 270 and French 270.) The development of the main stream of modern French (and allied) philosophico-critical thinking, from Baudelaire through Mallarmé, Valéry, Bergson, Proust, Edmund Wilson, Mauron, Blanchot, Richard, Northrop Frye, Benjamin, and Derrida. Readings in French and English. Discussions in English.

5 units, Spr (Cohn) M 2:15-4:05

289B. Yeats, Eliot, Neruda—(Same as English 289B. Introduction by way of Yeats, followed by intensive reading of two long poems, *Four Quartets* and *Alturas de Macchu Picchu*. Students should have done some work in modern poetry, and have a reading knowledge of a Romance language.

5 units, Win (Felstiner)

302. Seminar in Medieval Drama—(Same as Drama 302.)

4 units, Aut (Prosser) MW 2:15-4:05

306. Seminar in Modern Drama—(Same as Drama 306.) The “Isms” in Modern Drama.

4 units, Spr (Chioles) TTh 10-12

307. Seminar in Tragedy—(Same as Drama 307.)

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

311. Seminar: Methods and Materials for the Study of Medieval Literature—(Same as English 311.) An examination of the major medieval works of mythography, hagiography, Biblical exegesis, beast lore, numerology, astrology, and the like, and with modern aids to their use, followed by individual research projects making use of such materials.

5 units, Win (E. Brown)

315F. Seminar: The Enlightenment and Its Literary Traditions — (Same as English 315F.)

5 units, given alternate years

335. Seminar: The Modern Novel—(Same as English 335.)

5 units (Guerard) alternate years, given 1973-74

342. Colloquium: Modern Lyric Poetry from Baudelaire to Benn—(Same as German Studies 342.) Discussions of the theory and poetry of Baudelaire, Mallarmé, Rimbaud, Poe, Whitman, Pound, Stevens, Yeats, Dario, Alberti, Nietzsche, Trakl, Benn. Discussions will be in English.

4 units, Win (Lohner) Th 4:15-6:05

342B. Colloquium—Continuation of 342.

4 units, Spr (Lohner) Th 4:15-6:05

343. Realism in Nineteenth-Century European Fiction—(Same as German Studies 343.)

4 units, Win (Sokel) given 1973-74

349. Methodenlehre der Literaturwissenschaft—(Same as German Studies 349.)

4 units (Mueller-Vollmer) given 1973-74

350C. Seminar: Kafka—(Same as German Studies 350C.) A study of Kafka in a larger European perspective, with special reference to existentialism.

4 units, Win (Sokel) Th 2:15-4:05

360A. Seminar: History of Literary Theory: Ancient—(Same as English 360A.) 360A may be taken independently of 360B.

5 units, Win (W. Trimpi)

360B. Seminar: History of Literary Theory:
Medieval/Renaissance — (Same as English 360B.) Prerequisite: 360A.
5 units, Spr (W. Trimpi)

5 units, Aut (Guerard)

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, Spr (Moser)

368A. Seminar: Literature and the Visual Arts—(Same as English 368A.) The relationship between leading English writers or schools and the movements in European painting, architecture, and sculpture to which they most closely correspond.
5 units, Spr (Roston)

368B. Seminar: American Critics—(Same as English 368B.) Study of influential theorists and critics such as Poe, James, Kenneth Burke, Lovejoy, Yvor Winters, and J. Hillis Miller and movements such as the Chicago school and hermeneutics.
5 units, Aut (Halliburton)

369. Seminar: Major Modern Critics — (Same as English 369.) Study of such central figures as Auerbach, Spitzer, Frye, and Combrich.
5 units, Win (Lindenberger)

380. The Poetic Revolution of the Latter Eighteenth Century: Sturm and Drang in Its European Context—(Same as German Studies 380.)
4 units (Sokel) given 1973–74

393. Workshop in Verse Translation—(Same as English 393.)
5 units (Davie) alternate years, given 1973–74

400B. Seminar: Humboldt and Structuralism—(Same as German Studies 400B.)
4 units (Mueller-Vollmer) given 1973–74

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.

COMPUTER SCIENCE

Acting Chairman: John G. Herriot


Associate Professors: Jerome A. Feldman, Harold S. Stone. Visiting: George E. Collins, Donald D.Cowen

Assistant Professors: Forest Baskett III, Vinton Cerf, C. Cordell Green. Acting: 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, Charles T. Zahn, Jr.


Affiliated Faculty:
Assistant Professors: Thomas H. Bredt (Electrical Engineering), Edward S. Davidson (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 Computation Center. See the section “Computation Center” in this bulletin. For use in research and teaching, the Department has an HP-2116 computer and a PDP-11 computer.

The Artificial Intelligence Laboratory is located in the D. C. Power Building. Its research is in artificial intelligence, mathematical theory of computation, time sharing, human higher mental functions, semantics of natural languages, symbolic computation, and related topics. It operates a time-sharing system with PDP-6 and PDP-10 computers, 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 1971-72 the members were Thomas H. Brede, Edward S. Davidson, Jerome A. Feldman, Gene H. Golub, and Edward J. McCluskey, Chairman.

A student who wishes to enter the Computer Engineering program should indicate his preference for this degree when he applies 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 individual objectives and how his 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. His adviser has the 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 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.

Applicants for assistantships are expected to have a background in computing at least as deep as that achieved in course 106, together with some knowledge of a machine language. A deeper background is preferable. An applicant’s major field may be computer science, mathematics, statistics, operations research, physics, psychology, electrical engineering, or other discipline in which there is significant research involving the use of automatic digital computers. Preference will generally be given to students of computer science.

Further information may be obtained from the Chairman of the Computer Science Department. Applications for assistantships should be made to the Financial Aids Office, together with an application for admission to graduate study in some department. Unless the applicant is also applying for admission to the Computer Science Department, he should at the same time write to the Chairman of the Computer Science Department of his desire to have an assistantship in computing and stating his desired major 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. The applications are selected from problem areas in which no detailed knowledge of mathematics is required. Some discussion sections are limited to freshmen and sophomores. Not intended for students with substantial mathematical training or with a previous knowledge of programming. Alternates: 104, 106. Prerequisite: Mathematics 1 or equivalent.

*3 or 4 units, Aut (——) MWF 10,
(——) MWF 2:15
Win (Floyd) MWF 2:15,
(——) TTh 2:13-3:30
Spr (——) MWF 11
Sum (——) MTWTh 10

106. Introduction to Computing — Design and construction of computer programs; use of a specific programming language to solve problems over a wide range of applications on a digital computer. This course is essentially the same as 105 except that some of the applications are mathematical in nature. Intended for students with some mathematical training. Not intended for students with a previous knowledge of programming. Alternates: 104, 105. Prerequisite: Mathematics 21 or 42 or equivalent.

*3 or 4 units, Aut (——) MWF 11,
(——) MWF 1:15
Win (——) MWF 10
Spr (——) TTh 11:00-12:15
Sum (——) MTWTh 9 or 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 (——) MWF 11
Win (Baskett) MWF 1:15
Spr (——) MWF 1:15
Sum (——) MTWTh 10


3 units, Aut (Staff) MWF 9
Win (Davidson) MWF 9

125. Nonnumerical Methods — This survey course is designed to acquaint students in the humanities, social sciences, and behavioral sciences with methods and techniques for solving scientific problems of a nonmathematical type on digital computers. Emphasis is given to practical problems and pragmatics. Program libraries are studied and used. Problems to be discussed include text processing, information retrieval, system simulation, graphics, elementary statistical calculations. Prerequisite: 105 or 106 or equivalent.

3 units, Win (——) TTh 11:00-12:15

127. Computer Models of Social Behavior —(Same as Education 218, Political Science 180M, Psychology 154, and Sociology 179.) Models of human behavior in social situations. Particular attention is given to the problems involved in specifying simulation
models, determining their properties, and testing them. Enrollment limited to 20. Pre-
requisites: knowledge of at least one pro-
grramming language; advanced courses in so-
cial science; consent of instructors.

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

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.
Familiarity with automatic computation and their
remedies are discussed. Not intended for
students with further interests in Numerical
Analysis. Alternate: 135A, 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 prob-
lems on digital computers. 137A is primarily
concerned with functions of a single vari-
able. Problems discussed include solution
of nonlinear equations, interpolation and ap-
proximation of functions, numerical differen-
tiation 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 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

140A, B. Systems Programming — (Same as
Electrical Engineering 286A, B, which is of-
fered winter and spring quarters, 1972–73.)
Structure of assemblers, linkage editors, load-
ers, macro facilities, interpreters, and com-
pliers. Introduction to operating systems. Not
recommended for students with background
in systems programming. Alternate: 240A, B.
Prerequisite: 111 or equivalent.

140A. 3 units, Aut (——) TTh 1:15–2:30
140B. 3 units, Win (——) TTh 1:15–2:30

144A, B. Data Structures—This two-quarter
sequence is intended for those who wish to
study computer programming techniques inten-
sively. Topics include basic concepts of
data and its representation inside a com-
puter; linear lists, strings; arrays, orthogonal
lists; tree structures; data structures in pro-
gramming languages. Detailed study of
different techniques for sorting and search-
ing; 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; Mathe-
matics 11 or 41; or equivalents. Course 155
is recommended but not required.

144A. 3 units, Win (McCreight)
MWF 3:15
144B. 3 units, Spr (McCreight)
MWF 3:15

150. Introduction to Combinatorial Theory
— Permutations, combinations, partitions,
generating functions. Principle of inclusion
and exclusion, and more general Möbius in-
version. Redfield–Pólya–de Bruijn theory of
counting. Elementary theory of graphs and
trees. Latin squares, block designs, and finite
geometries. Prerequisite: Mathematics 44 or
equivalent.

3 units, Win (Dantzig) MWF 2:15

155. Concrete Mathematics — Finite differ-
ence calculus; manipulation of sums and pro-
ducts; properties of binomial coefficients,
Stirling numbers, harmonic numbers, Fibon-
acci numbers; use of generating functions to
solve complex recurrence relations; asymp-
totic expansions; analysis of computing al-
grithms. An emphasis on obtaining simple
closed-form answers to problems when it is
possible to do so. Prerequisites: Mathematics
22, 42, or equivalent.

3 units, Aut (Klarner) MWF 3:15

156. Introduction to the Mathematical The-
ory of Computation—Mathematical logic,
including propositional calculus and the
first-order predicate calculus. Computability, recursive functions, undecidable problems.

3 units, Aut (Green) MWF 10

191. Computer Systems Laboratory—(Enroll in Electrical Engineering 288.) Individual and group projects on the design and implementation of computer systems consisting of programs and/or logic circuits. Emphasis is on the design process and design evaluation. 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: 140B, 144A,B, 212, 240B, or 246.

3 units, Spr (Bredt) F 1:15 and by arrangement

199. Independent Work.
Any quarter (Staff) by arrangement

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS

204. Problem Seminar—Solution of various problems, numeric and symbolic, on a computer, using various languages. Emphasis on efficiency of programming, proofs of correctness, and clarity of documentation. Presentation of solutions by students. Limited to degree candidates in Computer Science. Recommended for entering students in the Computer Science Ph.D. program.

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 (——) TTh 11:00–12:15
Spr (Green) MWF 11

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, Win (McCluskey) MWF 11 and (Peterson) MWF 1:15
Spr (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) MWF 2:15

225. Artificial Intelligence Research — Intermediate-level examination of problems of artificial intelligence research. Generality in problem-solving systems; theorem proving by computer; semantic information processing; problem representation; perceptual and effector processes; scientific reasoning processes. Not recommended for first-year graduate students. Research project involving computer program will be required. Prerequisites: 206 and 224 or equivalents.

3 units, Aut (Feigenbaum) by arrangement

226. The Representation Problem in Artificial Intelligence—Formalisms for 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 and Binford) TTh 11:00–12:15

229. Topics in Artificial Intelligence—Given only when a suitable faculty member is available.

By arrangement

234. Numerical Methods of Optimization—Introduction to the numerical analysis, data processing; and software problems associated with decision problems, which form a significant proportion of all scientific computation. Unconstrained and constrained minimization, gradient methods with special metrics, pivotal optimization techniques, solving large-scale systems, partitioning methods, combinatorial search procedures, shortest path and other graph algorithms. No prior knowledge of Operations Research is necessary. Prerequisite: 137A or equivalent.

3 units, Aut (Dantzig) 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 (——) 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—(Same as Electrical Engineering 386.) 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 (Enroll in Electrical Engineering 386.)
3 units, Spr (Baskett) TTh 1:15–2:30

249. Topics in Programming Systems — Given only when a suitable faculty member is available.

By arrangement


256A. 3 units, Win (McCarthy) MWF 10
256B. 3 units, Spr (Floyd) MWF 10

259. Topics in Theory of Computation—Given only when a suitable faculty member is available.

By arrangement
4 units, Aut (Schank) TTh 10:30–12:00

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 9

317. 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

318. 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

319. 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

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

390. Advanced Reading and Research.
Any quarter (Staff) by arrangement

The following courses offered in other departments may be of special interest to students of computer science:

Analog Computation—See Electrical Engineering 283.


Discrete Mathematics—See Electrical Engineering 284.


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 484.

DRAMA

Emeriti: James G. Emerson (Professor); Helene Blattner, Elisabeth Buckingham (Associate Professors); Naomi Wrage (Assistant Professor)
Chairman: Michael Barry
Professors: Michael Barry, Wendell Cole, Eleanor Prosser, H. Donald Winbigler
Associate Professors: Shirlee Dodge, Douglas A. Russell, Helen W. Schrader
Senior Lecturer: Evelyn Draper
Assistant Professors: John Chicles. Acting: John Cochran, William S. Eddelman, Amnon Kabatchnik
Lecturers: Barbara Cox, Frederick Hunt, 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 allow the student wide latitude in developing his special aptitudes. Students are encouraged to declare their major in Drama in their sophomore year.

The minimum program required of all majors:

1. Development of Drama. 90, 91, 92
2. Theatre Practice. 160 (Acting) (2 units minimum)

3. Fundamentals of Acting I. 164A, 164B
4. Movement. 164L (to be taken concurrently with 164A and 164B)
5. Directing. 166A
6. Theatrical Makeup. 173A
7. Introduction to Design and Technical Production. 74A, 74B, 74C
8. Visual Arts for Theatre or Art History, or Seminar in Art and Theatre. (6 units to be chosen from 170A, 170B, 170C, 71, or Art courses)
9. Technical Production Laboratory. 162 (8 units minimum)
10. Senior Seminar in Dramatic Literature 190 (4 units)

Two years of a foreign language at college level or the equivalent. In special circumstances, by petition, a program of related studies may be substituted for the language requirement.

A grade average of C must be maintained in all course work in major field.

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:

164A, 164B. Fundamentals of Acting I
164L. Movement (concurrent with 164A, 164B
166A. Directing
90, 91, 92. Dramatic Literature

Six units to be chosen from Drama 71, 170A, 170B, 170C or Art History

Electives in theatre and drama totaling at least nine units at the undergraduate course level, or at the graduate course level with consent of the instructor. One Senior Seminar in dramatic literature must be included in these nine units.

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
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.

Standard Teaching Credential (Secondary)—Students wishing to obtain the Stanford Standard Secondary Credential should consult the Credential Secretary of the School of Education for the general requirements, and the teacher training adviser, Professor Helen Schrader, in the Department of Drama for Departmental requirements.

Advanced Degrees

Any student wishing to enter upon graduate work in the Department of Drama should write directly to the Department for information and applications. All applicants for graduate study must furnish their scores on the Aptitude Test of the Graduate Record Examination as part of their application. Applicants to the Ph.D. program must also submit a sample of their best written scholarly work. Applicants to the M.F.A. programs are required to attend a personal interview/audition conducted in the United States; thus it is contrary to Department policy to accept applications to the M.F.A. programs from students living outside of North America. All 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.

Master of Fine Arts

Programs for the Master of Fine Arts degree are offered for exceptionally gifted students in the areas of acting, costume, lighting, stage design, and technical production. The acting program is designed for two years; the curriculum for designers is planned for three years. For students with a strong background in drama, the three-year curriculum could be reduced to two years. Advanced standing would be based on special examination.

In addition to regular University requirements for admission, all applicants will be interviewed. Applicants to the acting program must prepare material for audition; design applicants must submit a portfolio of their work. Auditions and interviews are held in late-February. While overall scholastic ability will be a factor in admission, primary emphasis will be placed on evidence of superior potential in theatre arts. Application for admission must be completed by February 1.

The program is based on eight units of course work per quarter. Unit credit is not earned for theatre laboratory training, but the training is evaluated as a part of the total progress of the student. M.F.A. candidates must maintain a grade average of B in all course work and satisfactorily complete all aspects of the theatre laboratory training.

Note—Certain of the following course sequence requirements can be fulfilled by special examination given early in autumn quarter. Students are urged to prepare for examinations in areas in which they are proficient.

Costume Design Major

Candidates for the M.F.A. degree in Costume Design are required to complete 65 units of course work beyond the Bachelor's degree. The course requirements are as follows:

First Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>271A, 271B, 271C</td>
<td>Costume I</td>
<td>6</td>
</tr>
<tr>
<td>297, 298</td>
<td>Theatres and Staging</td>
<td>4</td>
</tr>
<tr>
<td>170A, 170B, 170C</td>
<td>Visual Arts for the Theatre</td>
<td>6</td>
</tr>
<tr>
<td>281A, 281B, 281C</td>
<td>Scene Design I</td>
<td>6</td>
</tr>
<tr>
<td>276</td>
<td>Costume Construction</td>
<td>1</td>
</tr>
<tr>
<td>280</td>
<td>Rendering</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>272A, 272B, 272C</td>
<td>Costume II</td>
<td>6</td>
</tr>
<tr>
<td>251A, 251B, 251C</td>
<td>Lighting I</td>
<td>6</td>
</tr>
<tr>
<td>173A, 173B</td>
<td>Theatrical Makeup</td>
<td>2</td>
</tr>
<tr>
<td>166</td>
<td>Directing</td>
<td>2</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
<td>4</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>20</strong></td>
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</tbody>
</table>

Third Year

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electives (to include courses in Art and Architecture)</td>
<td>9-12</td>
<td></td>
</tr>
<tr>
<td>Dramatic Literature or Elective (one quarter dramatic literature required)</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>21-24</strong></td>
</tr>
</tbody>
</table>
SCENE DESIGN MAJOR

Candidates for the M.F.A. degree in Scene Design are required to complete 68 units of course work beyond the Bachelor's degree. The course requirements are as follows:

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>281A, 281B, 281C. Scene Design I</td>
<td>6</td>
</tr>
<tr>
<td>297, 298. Theatres and Staging</td>
<td>4</td>
</tr>
<tr>
<td>241A, 241B, 241C. Technical Production I</td>
<td>6</td>
</tr>
<tr>
<td>170A, 170B, 170C. Visual Art for the Theatre</td>
<td>6</td>
</tr>
<tr>
<td>260. Rendering</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>282A, 282B, 282C. Scene Design II</td>
<td>6</td>
</tr>
<tr>
<td>271A, 271B, 271C. Costume I</td>
<td>6</td>
</tr>
<tr>
<td>251A, 251B, 251C. Lighting I</td>
<td>6</td>
</tr>
<tr>
<td>166. Directing</td>
<td>2</td>
</tr>
<tr>
<td>Elective</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>283A, 283B, 283C. Scene Design III Thesis</td>
<td>3</td>
</tr>
<tr>
<td>Dramatic Literature or Project (one quarter dramatic literature required)</td>
<td>9</td>
</tr>
<tr>
<td>Electives (courses in Art)</td>
<td>9-12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21-24</strong></td>
</tr>
</tbody>
</table>

LIGHTING DESIGN, TECHNICAL PRODUCTION MAJOR

Candidates for the M.F.A. degree in Lighting Design and Technical Production are required to complete 64 units of course work beyond the Bachelor's degree. The course requirements are as follows:

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>251A, 251B, 251C. Lighting I</td>
<td>6</td>
</tr>
<tr>
<td>297, 298. Theatres and Staging</td>
<td>4</td>
</tr>
<tr>
<td>170A, 170B, 170C. Visual Art for the Theatre</td>
<td>6</td>
</tr>
<tr>
<td>241A, 241B, 241C. Technical Production I</td>
<td>6</td>
</tr>
<tr>
<td>280. Rendering</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>281A, 281B, 281C. Scene Design I</td>
<td>6</td>
</tr>
<tr>
<td>252A, 252B, 252C. Lighting II</td>
<td>6</td>
</tr>
<tr>
<td>242A, 242B, 242C. Technical Production II</td>
<td>6</td>
</tr>
<tr>
<td>166. Directing</td>
<td>2</td>
</tr>
<tr>
<td>Elective</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Third Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>243A, 243B. Technical Production III</td>
<td>2</td>
</tr>
<tr>
<td>253A, 253B. Lighting III</td>
<td>2</td>
</tr>
<tr>
<td>243C. Technical Production Thesis or 253C. Lighting Thesis</td>
<td>2</td>
</tr>
<tr>
<td>271A, 271B, 271C. Costume I</td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td>9-12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21-24</strong></td>
</tr>
</tbody>
</table>

ACTING MAJOR

The candidate for the M.F.A. in Acting is required to complete 48 units of course work.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>282A, 282B, 282C. Scene Design II</td>
<td>6</td>
</tr>
<tr>
<td>271A, 271B, 271C. Costume I</td>
<td>6</td>
</tr>
<tr>
<td>251A, 251B, 251C. Lighting I</td>
<td>6</td>
</tr>
<tr>
<td>166. Directing</td>
<td>2</td>
</tr>
<tr>
<td>Elective</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>23</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Second Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>283A, 283B, 283C. Scene Design III Thesis</td>
<td>3</td>
</tr>
<tr>
<td>Dramatic Literature or Project (one quarter dramatic literature required)</td>
<td>9</td>
</tr>
<tr>
<td>Electives (courses in Art)</td>
<td>9-12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
</tr>
</tbody>
</table>

Note: At least three electives must be in dramatic literature.

MASTER OF ARTS

The Department of Drama does not admit students who plan to terminate their graduate study with a Master of Arts degree. Under exceptional circumstances, the A.M. may be awarded to students in the Ph.D. program who have creditably completed an undergraduate major in drama or its equivalent and who have satisfactorily completed 45 units of graduate work, of which 36 units must be taken at Stanford. At least 36 units must be taken in drama and theatre, including 12 units in 360A,B,C and a minimum of 16 additional units in dramatic literature and theatre history at the level of 200 or above.

DOCTOR OF PHILOSOPHY

University requirements for the doctorate (residence, dissertation, examinations, etc.) are discussed in 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 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. Before the second year of residence, the candidate must demonstrate advanced reading knowledge of one language by satisfactorily completing a literature course in which readings are in the original language of the literature studied.

2. Course requirements. The candidate is required to take the course sequence in research and criticism (360A, 360B, 360C) and a minimum of four seminars in dramatic literature. Depending on the candidate's preparation, courses in theatre arts and history may be required.

3. Theatre Arts requirement. Before scheduling his comprehensive examinations, the candidate will demonstrate his general understanding of all the theatre arts by submitting a directorial analysis of one play of his choice.

4. Examinations. When course work is completed, the candidate takes written comprehensive examinations in his 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 four fields.

5. Dissertation. Either immediately preceding or after completion of his 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 candidacy by repassing comprehensive examinations on dramatic literature.

**Specialization** — During the first year of residence, the candidate, in consultation with his 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.

**Fellowships**

The Department of Drama awards a number of fellowships to graduate students in both the M.F.A. and Ph.D. programs. 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.

Limited opportunities are also available for teaching assistantships, but they are awarded to the student who has completed one year of course work in residence.

**Summer Session**

A special brochure is available, with full details of courses given in the summer by the Department of Drama.

**THEATRE AND DRAMA UNDERGRADUATE COURSES**

60. Introduction to the Contemporary Theatre—Survey of the arts of the theatre; lectures and discussion of readings in contemporary drama. May not be offered in support of the major.

3 units, Win (Eddelman) MWF 9
61. Theatre Practice (Technical Production)—Credit may be earned for participation in the technical areas of departmental productions. Open to all undergraduates. The number of units received is determined by the instructor. May not be repeated. Prerequisite: consent of instructor.

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

64. Acting for Freshmen—An introduction to the elements of self-awareness, characterization, and theatrical expression for the beginning actor. Open to freshmen only.

3 units, Aut, Win, Spr (Staff) TTh 1:15–3:05

71. Seminar in Art and Theatre—Ten great periods of western visual style will be related to directing and design for the theatre. Emphasis will be on the relationship between the structural methods of a playwright and the related compositional methods of the visual artist in a given subject.

3 units, Spr (Russell) T 10–12 and Th 11

74A,B,C. Introduction to Design and Technical Production—A lecture-laboratory course that introduces the undergraduate to the theatrical arts and crafts of costume, stage design, lighting design, and technical production. Need not be taken in sequence.

74A. Scene Design and Construction—An introductory course in the fundamental processes involved in theatrical design and execution.

3 units, Aut (Eddelman, Ramsaur) MWF 9; lab. by arrangement

74B. Stage Lighting—An introductory course to the art and practice of stage lighting design. Emphasis is placed upon the theory of light design as it applies to proscenium, thrust, and arena stages for drama, musical comedy, and opera. Other subjects include instrumentation, basic electrical practices, control systems, and color.

3 units, Win (Hunt) MWF 9; lab. by arrangement

74C. Costume Design and Construction—Introduction to the process and literature of costume design. The course will include basic design concepts and materials, use of various media to express ideas, introduction to materials and methods available to the costume designer, some work with the wearing of costumes and their underpinnings, and a short resume of costume history. Design and construction projects worked on in class and in laboratory.

3 units, Spr (Cox) MWF 9; lab. by arrangement

90. Development of Drama (Classical to Renaissance)—Survey of the western drama and theatre from origins in Greece to the Renaissance.

4 units, Aut (Chioles, Eddelman) MTWTh 1:15

91. Development of Drama (Baroque to Romantic)—Survey of the western drama and theatre from the late Renaissance through the early 19th century.

4 units, Win (Cole) MTWTh 1:15

92. Development of Drama (Modern)—Survey of the western drama and theatre from Ibsen to the present.

4 units, Spr (Staff, Eddelman) MTWTh 1:15

141A,B,C. Technical Production I—See 241A,B,C for course description. Prerequisites: 74A and consent of instructor.

141A. 3 units, Aut (Hunt) TTh 10–12; F 11

141B. 3 units, Win (Ramsaur) TTh 10–12; F 11

141C. 3 units, Spr (Ramsaur) TTh 10–12; F 11

151A,B,C. Lighting I—See 251A,B,C for course description. Prerequisites: 74B and consent of instructor.

151A. 3 units, Aut (Ramsaur) TTh 9; lab. by arrangement

151B. 3 units, Win (Ramsaur) TTh 9; lab. by arrangement

151C. 3 units, Spr (Ramsaur) TTh 9; lab. by arrangement

160. Theatre Practice (Acting)—Students who have been cast in departmental productions may receive credit for their participation as actors. The number of units to be received is 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 3 units, any quarter (Staff) by arrangement
161. **Theatre Practice (Technical Production)**—Credit may be earned for participation in the technical areas of departmental productions. These assignments include assistant to the director, stage manager, special work in one of the production areas such as costume or set construction, lighting, properties, or running crew. The number of units to be received is determined by the instructor. May be repeated. Prerequisite: consent of instructor.

1 to 3 units, any quarter (Ramsaur) by arrangement

162. **Technical Production Laboratory**—Application and development of technical skills in the theatre arts. The drama major is required to participate in four departmental productions. Each student will receive three assignments; one in each area of theatre arts. The fourth assignment will be in an area of the student's choice. Prerequisite: consent of instructor.

1 to 3 units, any quarter (Ramsaur) by arrangement

164A, 164B, 164C. **Fundamentals of Acting I**—An introduction to the elements of self-awareness, characterization, and theatrical expression for the beginning actor. Prerequisite: sophomore standing. 164A,B,C must be taken in sequence. To be taken concurrently with 164L.

164A. 3 units, Aut (Olon-Scrymgeour) TTh 10–12
164B. 3 units, Win (Olon-Scrymgeour) TTh 10–12
164C. 3 units, Spr (Olon-Scrymgeour) TTh 10–12

164L. **Dance Drama**—To be taken concurrently with 164A,B,C.

Section 1: 1 unit, Aut, Win, Spr (Dodge) T 3:15–5:05
Section 2: 1 unit, Aut, Win, Spr (Dodge) W 2:15–4:05

165A,B,C. **Fundamentals of Acting II**—Prerequisites: 164A, 164B. 165A,B,C must be taken in sequence.

165A. 3 units, Aut (Cochran) TTh 2:15–4:05
165B. 3 units, Win (Cochran) TTh 2:15–4:05
165C. 3 units, Spr (Cochran) TTh 2:15–4:05

166A,B. **Directing**—The director's art explored in its relation to the script, the actors, and the physical production. Each student prepares pantomimes and scenes, as well as a one-act play for public work-in-progress performance. Prerequisite: 164A or consent of instructor.

166A. 2–3 units, Aut (Kabatchnik) TTh 10–12
166B. Prerequisites: 166A and consent of instructor.

2–3 units, Win (Kabatchnik) TTh 10–12

170A,B,C. **Visual Art for the Theatre**—A survey of painting, sculpture, architecture, and the minor arts of the western world as source material for the designer and the director. The use of visual sources in planning settings and costumes for production. May be taken separately or in sequence.

170A. Ancient, Classical, and Medieval.
2 to 3 units, Aut (Russell) MWF 1:15
170B. Renaissance and Baroque to 1750.
2 to 3 units, Win (Russell) MWF 1:15
170C. Romanticism, Realism, and Relativity.
2 to 3 units, Spr (Russell) MWF 1:15

171A,B,C. **Costume I**—(See 271A,B,C for course description.) Prerequisites: 74C and consent of instructor.

171A. 3 units, Aut (Russell) T 9 and Th 9–11; lab. by arrangement
171B. 3 units, Win (Russell) T 9 and Th 9–11; lab. by arrangement
171C. 3 units, Spr (Russell) T 9 and Th 9–11; lab. by arrangement

173A,B. **Theatrical Make-up**—Laboratory course in the art and craft of stage make-up. Problems in design using pancake and grease paint for large and small theatre. Emphasis in 173A on basic techniques. 173B deals with more complex materials, three-dimensional make-up, life mask casting.

173A. 1 unit, Aut (Cox) Sec. 1, T 10–12
173B. Prerequisite: 173A.
1 unit, Win (Cox) T 10–12
181A, B, C. Scene Design—(See 281 A, B, C for course description.) Prerequisites: 74A and consent of instructor.

181A. 3 units, Aut (Eddelman) W 10-12 and F 10; lab. by arrangement
181B. 3 units, Win (Eddelman) W 10-12 and F 10; lab. by arrangement
181C. 3 units, Spr (Eddelman) W 10-12 and F 10; lab. by arrangement

190. Senior Seminar: Dramatic Literature—Topics to be investigated will vary. May be repeated for credit.

Modern Drama.
4 units, Aut (Staff) MW 2:15-4:05
Comparative Study of Genre.
4 units, Win (Chioles) MW 2:15-4:05
Jacobean Drama.
4 units, Spr (Prosser) MW 2:15-4:05

193. Special Research—Individual reading in dramatic literature. Prerequisite: consent of instructor.
1 to 4 units, any quarter (Staff) by arrangement

194. Special Projects—Individual projects in theatre arts. Prerequisite: consent of instructor.
1 to 4 units, any quarter (Staff) by arrangement

200. Drama Workshop—A Directing Workshop for advanced undergraduates and graduates. Students may direct a play in workshop context under close faculty supervision. To enroll in the course, the student must first consult with a Department of Drama faculty member, who will supervise the project. A petition is then submitted to the Department of Drama for approval.
1 to 4 units, any quarter (Staff) by arrangement

3 units, Aut (Cole) MWF 11

3 to 4 units, Spr (Prosser) TTh 2:15-4:05

GRADUATE COURSES FOR M.F.A.

Open by permission to qualified undergraduate and graduate students

(Note—All courses are year-long and conducted as a combination of class and studio work. These courses are offered as a sequence autumn, winter, and spring.)

241A, B, C. Technical Production I—Introduction to technical production and scenicographic techniques. Prerequisite: consent of instructor.

241A. An introduction to scenicographic techniques; fundamentals of orthographic projections, basic pictorial sketching, and mechanical perspective. This introductory course prepares the student for the use of drawings as an elemental means of communication in the theatre arts. Two 2 hour drafting sessions and one lecture hour weekly.
2 units, Aut (Hunt) TTh 10-12 and F 11

241B. Lecture-laboratory course in basic production practices; theory and use of traditional tools and materials for stage scenery, concentrating on paper, wood, and fabric.
2 units, Win (Ramsaur) TTh 10-12 and F 11

241C. Lecture-laboratory course on theory and use of new tools and materials for stage scenery, concentrating on steel, foam, fiberglass, and plastics.
2 units, Spr (Ramsaur) TTh 10-12 and F 11

242A, B, C. Technical Production II—Advanced technical production. Prerequisite: consent of instructor.

242A. Introductory survey of contemporary American theatre architecture since 1960 leading to examination of the specific problem of audience/performer relationship as solved by representative theatres. Particular attention is given to the solutions as realized by architect and consultant in the areas of stage mechanics, space relationships, and performance support facilities.
2 units, Aut (Hunt) by arrangement

242B. A continuation of study of contemporary American theatre architecture focusing on selected California theatres built since 1965. Primary to this examination are
field trips to these theatres for on the site inspection and discussion.

2 units, Win (Hunt) by arrangement

243C. Seminar and independent research on stage machinery concentrating on electro-mechanical and hydraulic devices. Particular emphasis will be placed on current European and American developments and usage.

2 units, Spr (Ramsaur) by arrangement

243A,B,C. Technical Production III — Research and thesis. Prerequisite: consent of instructor.

243A. Student initiated projects in the area of technical theatre. Topics include equipment design and fabrication, construction techniques, use of materials, and management.

1 unit, Aut (Ramsaur) by arrangement

243B. Advanced research projects in the field of theatre planning, facility management and equipping. Specific attention will be given the preparation of specifications and bidding. Preparatory research may be undertaken in support of thesis work.

1 unit, Win (Hunt) by arrangement

243C. Thesis.

1 unit, Spr (Hunt, Ramsaur) by arrangement

251A,B,C. Lighting I—Introduction to stage lighting. Prerequisite: consent of instructor.

251A. Lecture-laboratory course dealing with the fundamentals of electricity, light sources, stage lighting instruments, and techniques of control.

2 units, Aut (Ramsaur) TTh 9; lab. by arrangement

251B. Introduction to conventional lighting design for the proscenium, thrust, and arena forms. Approaches to dance, opera, musicals, and drama will be discussed.

2 units, Win (Ramsaur) TTh 9; lab. by arrangement

251C. Advanced work in stage lighting to include the development of the design, psychological factors, and the theory of color. Lighting designers for departmental projects will be chosen from this course.

2 units, Spr (Ramsaur) TTh 9; lab. by arrangement

252A,B,C. Lighting II — Advanced stage lighting. Prerequisite: consent of instructor.

252A. Projects of an advanced nature in the field of lighting design will be resolved and presented through experimentation, class discussion, and written report. Areas of concentration will include projection, color, and special effects.

2 units, Aut (Hunt) by arrangement

252B. The role of the theatrical lighting consultant will be examined with particular emphasis on design facility requirements for lighting support areas, electrical and heat loads, equipment specifications, and the latest technology and hardware for theatre lighting control systems.

2 units, Win (Hunt) by arrangement

252C. Lighting for film and television to include laboratory experience in lighting projects for this media.

2 units, Spr (Ramsaur) by arrangement

253A,B,C. Lighting III—Project and thesis. Prerequisite: consent of instructor.

253A. 1 unit, Aut (Hunt) by arrangement

253B. 1 unit, Win (Hunt) by arrangement

253C. 1 unit, Spr (Hunt) by arrangement

261A,B,C. Acting I—Includes two quarters Theatrical Makeup. (To be taken autumn and winter. See 173A and 173B for day and time.)

261A. 3 units, Aut (Kabatchnik) MWF 10-12

261B. 3 units, Win (Kabatchnik) MWF 10-12

261C. 3 units, Spr (Kabatchnik) MWF 10-12

262A,B,C. Acting II—Open M.F.A. actors only.

262A. 3 units, Aut (Olon-Scrymgeour) MWF 10-12

262B. 3 units, Win (Olon-Scrymgeour) MWF 10-12

262C. 3 units, Spr (Olon-Scrymgeour) MWF 10-12

263A,B,C. Voice — Open to M.F.A. Actors only.

263A. 1 unit, Aut (Draper) by arrangement

263B. 1 unit, Win (Draper) by arrangement

263C. 1 unit, Spr (Draper) by arrangement

265A,B,C. Dance Drama—Open to M.F.A. Actors only.

265A. 1 unit, Aut (Dodge) MWF 12:30-2:00
SCHOOL OF HUMANITIES AND SCIENCES

265B. 1 unit, Win (Dodge)  
MWF 12:30-2:00

265C. 1 unit, Spr (Dodge)  
MWF 12:30-2:00

271A,B,C. Costume I—Introduction to costume history, design, planning, and construction with weekly discussions on class design assignments. Prerequisite: consent of instructor.

271A. Presentation and Planning; History to 1500.  
2 units, Aut (Russell) T 9 and Th 9-11

271B. Line, Color and Fabrics; History to 1750.  
2 units, Win (Russell) T 9 and Th 9-11

271C. Patterns and Construction; History to 1960.  
2 units, Spr (Russell) T 9 and Th 9-11

272A,B,C. Costume II—Projects in costume design.

272A. 2 units, Aut (Russell) by arrangement

272B. 2 units, Win (Russell) by arrangement

272C. 2 units, Spr (Russell) by arrangement


273A. 1 unit, Aut (Russell) by arrangement

273B. 1 unit, Win (Russell) by arrangement

273C. 1 unit, Spr (Russell) by arrangement

276A,B,C. Costume Construction—Techniques of costume construction and pattern making. Flat patterning and draping, use of fabrics, advanced sewing and tailoring techniques. In 276C the concentration is on special techniques—millinery, armor, non-fabric materials, painting, and dyeing. Prerequisite: consent of instructor.

276A. 1 unit, Aut (Cox) Th 11-2

276B. 1 unit, Win (Cox) Th 11-2

276C. 1 unit, Spr (Cox) F 12-2

280. Rendering Techniques—Drawing and painting laboratory in the handling of various media. Prerequisite: consent of instructor.

1 unit, Spr (Staff) MF 10-12

281A,B,C. Scene Design I—Visual analysis of historical styles as interpreted for the modern theatre and developed through 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: consent of instructor.

281A. 2 units, Aut (Eddelman) W 10-12 and F 10; lab. by arrangement

281B. 2 units, Win (Eddelman) W 10-12 and F 10; lab. by arrangement

281C. 2 units, Spr (Eddelman) W 10-12 and F 10; lab. by arrangement

282A,B,C. Scene Design II—Theatrical and practical explorations in selected theatrical forms and styles. Emphasis on designing for various kinds of theatrical genres including opera, ballet, and musical theatre. Prerequisite: consent of instructor.

282A. 2 units, Aut (Eddelman) by arrangement

282B. 2 units, Win (Eddelman) by arrangement

282C. 2 units, Spr (Eddelman) by arrangement

283A,B,C. Scene Design III—Advanced problems in scenic design relating to contemporary concepts. Specific work in multi-dimensional theatrical approaches and their relationships to new theatre forms. Prerequisite: consent of instructor.

283A. 1 unit, Aut (Eddelman) by arrangement

283B. 1 unit, Win (Eddelman) by arrangement

283C. 1 unit, Spr (Eddelman) by arrangement

297. Theatres and Staging I (Classical)—Survey of theatres, staging methods, styles of theatrical production from the Greeks through the Neo-Classical.  
2 to 3 units, Aut (Cole) MWF 9

298. Theatres and Staging II (Modern)—Survey of theatres, staging methods, styles of theatrical production from Neo-Classical to Modern.  
2 to 3 units, Win (Cole) MWF 9

PH.D. COURSES

Beginning with Winter Quarter, 1972-73, admission to all seminars will require evidence of adequate preparation in the topic
to be covered. This prerequisite can be met by taking Drama 300, offered in the preceding quarter by the instructor of the given seminar, or by offering evidence of equivalent preparation.

300. Proseminar—Individual study of reading list in preparation for seminar the following quarter. Required for all seminars. Students who qualify for exemption from the requirement should consult with the instructor.

1 unit, any quarter (Staff) by arrangement

301. Seminar in Classical Drama (Greek and Roman).
3 to 4 units (Chioles) given 1973-74

302. Seminar in Medieval Drama.
3 to 4 units, Aut (Prosser) MW 2:15-4:05

303. Seminar in Renaissance Drama.
3 to 4 units (Prosser) given 1973-74

304. Seminar in Baroque Drama—Seminar in French Neo-Classical Drama.
3 to 4 units, Aut (Chioles) TTh 2:15-4:05

305. Seminar in Romantic Drama.
3 to 4 units (Cole) given 1973-74

306. Seminar in Modern Drama.
Seminar: The “isms” in Modern Drama.
3 to 4 units, Spr (Chioles) TTh 10-12
Seminar: Irish Drama.
3 to 4 units, Spr (Barry) MW 2:15-4:05

3 to 4 units, Win (Lyons) MW 2:15-4:05

308. Seminar in Comedy.
3 to 4 units, given 1973-74

309. Seminar in Early American Drama.
3 to 4 units (Cole) given 1973-74

310. Seminar in Contemporary American Drama.
3 to 4 units (Cole) given 1973-74

312. National Drama.
Seminar in Italian Drama.
3 to 4 units, Win (Prosser)
TTh 2:15-4:05

360A. Research Methods.
4 units, Aut (Prosser) MW 10-12

360B. History of Dramatic Criticism.
4 units, Win (Chioles) MW 10-12

360C. Contemporary Critical Techniques.
4 units, Spr (Lyons) MW 10-12

390. Special Research in Drama and Theatre History—Prerequisite: consent of instructor.
1 to 4 units, any quarter (Staff) by arrangement

391. Special Projects in Theatre Arts—Prerequisite: consent of instructor.
1 to 4 units, any quarter (Staff) by arrangement

400. Dissertation Research.
Any quarter (Staff) by arrangement

INTER-PERSONAL AND SMALL GROUP COMMUNICATION

The following courses provide experience-based learning in inter-personal communication in small interacting groups. The members of the group learn a method of continually expanding competence in observing and assessing their own communication with others and of discovering their feelings, reactions, and perceptions about the processes of interaction.

100. Independent Study.
1 to 3 units, any quarter (Schrader) by arrangement

120A. Exposition — Focuses on inter-personal communication in the small group.
3 units, Aut, Win (Schrader) MWF 11 and 1:15
Spr (Schrader) MWF 11

120C. 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

132. Group Communication — Focuses on inter-personal processes of communication as they relate to inter-group experience. Prerequisite: 120A or 120C 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: Albert E. Dien
Director of Master's Program: John Gurley

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 University'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.

Students enrolled in the program are eligible for the National Defense Foreign Language fellowships as well as East Asian Committee fellowships. The NDFL is available for the academic year as well as for intensive language study in the summer. Applicants for financial aid are encouraged to apply for NDFL fellowships; for application forms, write to: Graduate Overseas and Special Programs, Building 460, Stanford University, Stanford, California 94305.

**ECONOMICS**

*Emeritus: Bernard F. Haley (Professor)*  
*Chairman: Moses Abramovitz*  
*Vice Chairman: James N. Rosse*  

**Associate Professors:** Takeshi Amemiya, James N. Rosse. Visiting: Donald J. Harris, Charles E. McLure, Karl Shell


**Lecturers:** Claudio Gonzales-Vega, Frederick C. Nold, Andrew T. Williams, Robert D. Willig

**Affiliated Faculty:**

Professors: Roger W. Gray, Bruce F. Johnston, William O. Jones, Benton F. Massell (Food Research Institute), Gerald M. Meier (Graduate School of Business), Robert B. Wilson (Graduate School of Business), Pan A. Yotopoulos (Food Research Institute)

Associate Professors: Martin Carnoy (School of Education), William E. Comanor (Graduate School of Business), Henry M. Levin (School of Education), Robert C. Lind (Graduate School of Business), Keith G. Lumsden (Graduate School of Business)

Assistant Professors: Dean T. Jamison (Graduate School of Business), Tetteh A. Kofi (Food Research Institute), Scott R. Pearson (Food Research Institute), Myra H. Strober (Graduate School of Business), C. Peter Timmer (Food Research Institute)

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**OFFERINGS AND FACILITIES**

The Department's purposes are to acquaint students with the economic aspects of modern society, to familiarize them with techniques for the analysis of contemporary economic problems, and to develop in them an ability to exercise judgment in evaluating public policy. There is training for the general student as well as for those who plan careers as economists in civil service, private enterprise, teaching, or research. Associated with the Department are the Research Center in Economic Growth in Encina Hall, for research and graduate training in problems of economic growth in both industrialized and developing countries, and comparable facilities in Encina Hall for mathematical economics and econometrics.

The University Library is well supplied with literature in all fields of economics. The Hopkins Transportation Library holds invaluable material on transportation problems, and there are special collections on the institutions and commerce of Latin America, the Orient, and Pacific Coast development. Advanced students have access to the Hoover Institution, with its comprehensive collections of original and secondary materials on many foreign nations. The Food Research Library in Encina Hall is particularly valuable for International Trade and Economic Development.

Qualified graduate students in economics are given the opportunity for training and research in the special fields of the Food Research Institute. A few 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) 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.

b) Courses taken at other universities may be included in the 25 units of 100 level courses and 45 units of economics courses. The Director of Undergraduate Studies for the Economics Department will establish the amount of credit to be granted toward completion of the Departmental requirements. Students who have taken a year's elementary econom-
ics course at another university will normally be required to take Economics 51, 52, and 53.

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 point 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.

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 quar-
ter of their senior year. Application should be made to the Director of Graduate Studies for the Economics Department. In addition to meeting the requirements for the Bachelor of Arts in economics, students are required to complete the requirements for the Master of Arts as stated below. If the student takes Honors Program I, he may submit his Honors thesis for the A.B. 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.

**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 economics 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.

**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 himself 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 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 student for his performance in comprehensive exams and for his research capability. If a student has submitted a thesis proposal
and had it approved by his 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 his thesis proposal approved by his thesis adviser, he 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.

**Option B—With a Minor Subject.** Consistent with the objectives of their program, 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 take 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 his 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
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 1970–71.

1. Elementary Economics—The functioning of a modern market economy: the determination of national income and its distribution; the composition of output; growth of the economy.

   5 units, Aut, Win, Spr (Shaw, Lumsden, Gurley) MTWThF 9
   4 units, Sum (——) MTWThF

51. Economic Analysis I—The nature of economic systems; performance evaluation criteria. Consumer choice and production theory. The role of markets and prices in allocating resources in a decentralized system. Problems of equity and efficiency. (May be taken as 151 by graduate students.) Prerequisite: 1 or equivalent preparation.

   5 units, Aut (Leland) MTWThF 10
   Win, Spr (Ratcliffe) MTWThF 10

52. Economic Analysis II—An analysis of equilibrium and instability in the economic system as a whole. National accounts and aggregate relationships among stocks and flows in markets for goods, services, and financial assets. (May be taken as 152 by graduate students.) Prerequisite: 51.

   5 units, Aut, Win, Spr (Scadding, Hurd, Shaw) MTWThF 11

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 (Willig) MTWThF

90. Introduction to Accounting—An introduction to the principles and concepts underlying financial reports such as the income statement, statement of financial position, and the "funds" statement, and to the uses of such reports. No prior accounting is assumed. Students who have taken or are now taking a college-level accounting course may not enroll. (May be taken as 190 by graduate students.)

5 units, Aut (Samuelson)

Sec. 1 MTWThF 8;
Sec. 2 MTWThF 10
Win (——) MTWThF 8

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 (——) MTWThF 8

100. Topics in the History of Economic Thought—(Graduate students enroll in 200.) The philosophy of science; the nature of scientific revolutions; and the development of economic analysis. The classical school from Smith through Mill; Marxian economics; the marginalists; institutional economics; general equilibrium from Walras through Debreu. Their relation to economic conditions in their time and to modern economics.

5 units, Aut (Boskin) MW 11–1

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) MWF 9

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) MW 4:15–6:05

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) W 4:15–6:05

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) MTWTh 11


5 units, Spr (Scitovsky) MTWThF

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) MTWThF
114. Nineteenth Century Imperialism —
This course will be conducted as a seminar and will offer students the opportunity to study both the development of systematic thought regarding the economic causes and consequences of imperialism, and the historical experience of imperialism in the nineteenth century. Prerequisites: non-majors 1; majors 51 and 52.
5 units, Spr (Edelstein) MTWThF

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, Spr (Edelstein) 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, Win (Sanderson) 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 (Harris) MTWThF 2:15

119. Planning, Control and Growth in a Socialist Economy — Description and theoretical examination of centrally controlled systems, comparisons with market economies, analysis of problems, advantages and shortcomings. This course will be offered during Spring Quarter by an internationally distinguished economist, Professor Janos Kornai, visiting from Hungary.
5 units, Spr (Kornai) 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 9

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, Lau) 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 — Problems and principal features of economic development in Latin America. Emphasis is on the application of modern analytical methods and on policy implications of recent economic research. Prerequisite: 1.
5 units, Spr (Gonzalez-Vega) MTWThF

125. Economic History of Russia — This course deals with the economic history of Russia from the mid-eighteenth century to 1939. About two-thirds of the course will deal with the Soviet period.
5 units — MTWThF

126. Postwar Development of the Japanese Economy — The course will consist of a brief review of the background for Japan’s post-
war growth: the foundations laid in the Tokugawa, Meiji, Taisho, and Showa periods. Followed by an examination of the factors accounting for Japan's rapid growth in the postwar period: high rates of saving and capital formation, organization of labor and human resources, the role of government, the interaction of government and business, productivity increase. The course will also examine the background of the current imbalance in trade between Japan and the U.S. and the prospects for continued growth.

5 units (——) MTWThF

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 monoeconomies, land tenure systems, agricultural development, foreign investment and multinational businesses, industrialization, balance of payments and debt servicing, terms of trade and remunerative incomes from sales of primary produce, commodity agreements and related problems. Contemporary theories of economic imperialism and dependency models of development will be analyzed.

Research papers initiated in the first or second quarter will emphasize area studies or case studies of individual countries—hypotheses will be formulated and tested qualitatively or quantitatively. Prerequisites: 1. 5 units each quarter, Aut, Win (Kofi) TTh 4:15–6:05

128. Economics of War — This course will consider the evolution of economic writing and economic theory on the subject of warfare. The general relationship between war and the economy in the past and in the present will be studied as well as certain more detailed and specific problems to do with the nature of war economies.

5 units (——) MTWThF

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

131. Population Problems—(Same as Food Research Institute 135 and Sociology 130.) Analysis of U.S. and world population growth. Economic and social causes and consequences of trends in births, deaths, and migration. Population in relation to food and development; population theories and policies; national family planning programs. Prerequisite: 1.

5 units, Win (Kirk) MTWTh 9

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 (Williams) MTWThF 2:15

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, Win (McLure) 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

145. Economics of Labor—Analysis and description of U.S. labor force and labor markets. Wage determination; effects of unions and institutional forces on wages; causes and cures of unemployment. Brief history of
American unionism and collective bargaining. Prerequisite: 51.
5 units, Spr (Strober) MTWThF

146. Women in the Labor Force—(Same as Business 330.) This course analyzes economic aspects of women's changing role in the labor force. Present labor force inequality between the sexes is assumed; the course then focuses on the causes and consequences of this inequality and on possibilities for its reduction. Particular topics examined are: determinants of labor force participation; turnover, absenteeism, and productivity; discrimination by exclusion; wage inequality; the role of the law; leisure and the value of housework; socialization and education of women; training for labor force re-entry; women in the professions and in management; the economics of child care centers; and the implications of "Women's Lib." Prerequisite: non-majors 1; majors 51.
5 units, Aut (Strober) TTh 1:15-3:05

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, Aut (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, Spr (Williams) MTWThF

149. Location Theory and Spatial Analysis—(Same as Food Research Institute 153.) 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 (Mandell) TTh 2:15-4:05

150. Economic Analysis I—See 51.
152. Economic Analysis II—See 152.
154. Health Care Delivery Systems: Their Institutional Evolution and Economic Implications—This course will be conducted as a seminar focused on the development of institutional arrangements in the health care field in the U.S. during the twentieth century.
The implications of government medical programs, third party payments, the objectives and functioning of hospitals, and alternative organization structures, are among the topics to be considered. Prerequisite: non-majors 1; majors 51. Enrollment limited to 15-20.
5 units, Spr (Davis) MTWThF

157. Organization and Social Control of Industry—Structure of industry and organization of markets; methods of evaluating economic efficiency; economic regulation of public utilities, communication, and transportation; antitrust laws and attempts to preserve competition. Prerequisite: 51.
5 units, Win (Owen) MTWThF

158. Market Power and Economic Welfare—(Same as Business 308.) In the United States, the actions of private firms have a dominant influence on the economic welfare of the society. The purpose of this course is to consider the nature of this influence, with specific reference to the effects of the varying degrees of market power achieved by private firms. The course examines possible conflicts between the pursuit of maximum profits by individual firms and the general welfare of society. A framework of analysis is presented which focuses on the impact of industry structure and business policies on both economic efficiency and technological progress. The framework is then applied to various economic problems in which government action has been sought. Some typical problems are (1) the question of protecting the U.S. steel industry from foreign imports; (2) the relationship between high profits and high research in the pharmaceutical industry, and the implications of this relationship for public policy; (3) the issue of conglomerate mergers and appropriate standards for antitrust. Prerequisite: 51.
5 units, Spr (Comanor) MTWThF

160. Trade and Development Problems of
Tropical Africa—(Same as Food Research Institute 160.) Analysis of selected international aspects of tropical African economic development. Topics include African/non-African international trade and economic relations (theoretical background, historical perspective, case studies of export-led growth, and the impacts of international capital flows) and intra-African trade and economic integration (customs union theory, historical perspective, case studies of African economic integration). Prerequisite: 1.

3 to 5 units, Win (Pearson) MW 4:15–6:05

165. International Economics I—Comparative advantage in production and trade among nations; the international monetary mechanism; domestic monetary, fiscal, and tariff policies and their relationship to foreign trade. Prerequisite: 1. Should be taken by majors after 51 and 52.

5 units, Aut (Gonzalez-Vega) MTWThF 1:15

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) MTWThF

170. Introduction to Econometrics I—Review of probability, random variables, distribution theory. Theory of estimation and hypothesis testing. Introduction to regression and correlation analysis. Applications to economics. Prerequisites: 51 and 52; Mathematics 7 or 43 or the equivalent; Statistics 60 or the equivalent.

5 units, Aut (Nold) MTWThF 10

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) MTWThF

172. Applied Econometrics—Critical review of the literature in econometric applications. Discusses the estimation of production functions, demand functions, consumption functions, etc. Prerequisite: 171 or equivalent.

5 units, Spr (Lau) MTWThF

180. Mathematics for Economists — Training in areas of mathematics which have frequent applicability to economic problems. Intended for students who have already had some calculus but lack a strong mathematical background. Topics covered include: functions of several variables; partial derivatives and differentials; mean value theorem and Taylor's theorem, integral calculus; elementary matrix algebra, determinants, and characteristic roots; quadratic forms; and maximization of a function of several variables subject to equality constraints. Selected applications in economics are discussed. Prerequisites: 51 and Mathematics 41 or the equivalent.

5 units, Aut (——) MTWThF 9

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 (Shell) MTWThF

190. Introduction to Accounting—See 90.

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)

COURSES PRIMARILY FOR GRADUATE STUDENTS


In each group below, courses marked (*) constitute continuous courses. Registration will be accepted and grades given only for the entire sequence except with consent of instructor.

A. CORE THEORY CURRICULUM
(Professors Boskin, Hickman, Hurd, Kurz, Lau, Leland, McKinnon, Muth, Rosse, Scadding, Scitovsky, and Tarshis)

200. Topics in the History of Economic Thought—See 100.
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, Marxist, 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) MW 1:15-3:05

*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 (Rosse)


5 units, Spr (Kurz)


*210, *211, *212. The Theory of Income and Economic Fluctuations — Theory of money, employment, income considered from points of view of comparative statics, causes of instability and long-term change. 210 is prerequisite for 211; 210 and 211 are prerequisites for 212. Consent of instructor required for 210, 211, and 212.

210. 5 units, Aut (Scitovsky)
TTh 1:15-3:05
211. 5 units, Win (Scadding)
212. 5 units, Spr (Hurd)

301A,B,C. Seminar in Microeconomics. 10 units (——) by arrangement

310A,B,C. Seminar in Macroeconomics. 10 units (——) by arrangement

B. ECONOMIC DEVELOPMENT
(Professors Gurley, Kornai, Lau, Manne, Ratcliffe, and Scitovsky)

*215. Economic Development I—Comparative analysis of presently underdeveloped economies. The process of development. Alternative theories of growth. Prerequisites: 204 and 212 or consent of instructor.

5 units, Win (Scitovsky)

*216. Economic Development II — Major problems of development policy. Planning, prices, and market processes. Investment criteria and resource allocation, technological choices, agricultural problems, investment in social overheads, foreign trade, population and manpower. Programming meth-
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, Win (Edelstein)

228. Postwar Growth in Industrialized Countries—Historical and analytical treatment of the postwar growth records of industrialized countries in the light of their longer term experience. Topics include the growth of resources and productivity, structural change in output, employment, and international economic relations and the interconnections of demand and potential output growth.
   5 units (—)

325A,B,C. Seminar in Economic History.
   10 units (—) by arrangement

D. MONETARY THEORY AND INSTITUTIONS
(Professors Gurley, Scadding, and Shaw)

*230. Monetary Theory—Advanced topics in monetary theory with special reference to policy criteria and control techniques. Prerequisite: 211.
   5 units, Spr (Scadding)

   10 units (—) by arrangement

E. PUBLIC FINANCE
(Professors Boskin and McLure)

*241, *242. Public Finance and Taxation I and II—Role of government expenditures in light of welfare economics; direction and development of expenditures; types of taxes, their distributional and allocative effects; pricing policies in government enterprises; compensatory finance; the public debt. Prerequisites: 204 and 212 or consent of instructor.
   5 units, Win (Boskin)
   242. 5 units, Spr (McLure)

243. State and Local Government Finance—Taxation and public expenditure decisions in the local (open) economy; taxation and human resource development; and intergovernmental fiscal relations.
   5 units (—)
341A,B,C. Seminar in Public Finance—Prerequisite: 241 or consent of instructor.  
10 units (——) by arrangement

F. ECONOMICS OF LABOR  
(Professors Boskin and Pencavel)

5 units (——)

5 units (——)

345A,B,C. Seminar in Labor Economics.  
10 units (——) by arrangement

G. URBAN ECONOMICS  
(Professor Muth)

*249. Urban Economic Analyses—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; and problems of the local public sector, including the determinants and effects of local taxation and expenditure, the structure of local government, and fiscal problems of central cities. Prerequisite: 204 or Engineering-Economic Systems 212.  
5 units, Aut (Muth) TTh 3:15-5:05

*250. Wealth and Poverty in the Urban Economy—Analysis of urban labor markets with special reference to problems of poverty; income sources of urban dwellers, wages, transfers, property income, income subsidies, and guaranteed employment; urban-rural migration; the family labor supply; local against national wage structures; ethnic and racial groups.  
5 units, Win (Muth)

349A,B,C. Seminar in Urban Economics.  
10 units (——) by arrangement

H. ECONOMICS OF INDUSTRY  
(Professors Manne, Owen, and Rosse)

254. Economics of Industry I—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 economics-of-scale and oligopoly problems; inter-industry analysis; public goods; congestion and pollution.  
5 units, Aut (Manne) TTh 11-1

256. Economics of Industry II—Investment and growth of the firm; mergers; stochastic theories of industry structure; industry structure, innovation, and technological change; location and transportation; public utilities; problems in the formation of public policy.  
5 units, Spr (Owen)

10 units (——) by arrangement

I. INTERNATIONAL ECONOMICS  
(Professors McKinnon, Scitovsky, and Tarshis)

*265. International Finance — Capital movements. Balance of Payments adjustments. Domestic economic effects of alternative international monetary institutions. Prerequisites: 204 and 212 or consent of instructor.  
5 units, Aut (McKinnon) MW 1:15-3:05

*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 (McKinnon)

365A,B,C. Seminar in International Economics.  
10 units (——) by arrangement

J. ECONOMETRICS  
(Professors Amemiya, Anderson, Hurd, Jorgenson, Lau)

*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 (Amemiya) TTh 1:15-3:05


5 units, Win (Jorgenson)

370A,B,C. Seminar in Econometrics.
10 units (——) by arrangement

K. MATHEMATICAL ECONOMICS

(Professors Kurz, Leland, Majumdar, and Shell)

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) MW 11-1

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, Spr (Jamison)

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, Win (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, Win (Shell)

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, Spr (Shell)

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, Aut (Kurz) TTh 10-12

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.

385A,B,C. Seminar in Mathematical Economics.
10 units (——) by arrangement

L. COLLOQUIUM

395A,B,C. Seminar in Political Economy.
10 units (——) by arrangement

ENGLISH

Emeriti: John W. Dodds, Paul H. Kocher, Herbert D. Meritt, George F. Sensabaugh, Wallace E. Stegner (Professors)

Chairman: W. B. Carnochan
Vice-Chairman: Richard P. Scowcroft
Director of the Creative Writing Center: Richard P. Scowcroft

Professors: Robert W. Ackerman (on leave autumn quarter, 1972), Donald Davie (on leave winter and spring quarters, 1972-

Visiting:
Hamlin Hill, Murray Roston, George F. Sensabaugh

Associate Professors: W. B. Carnochan, George D. Dekker, J. Martin Evans (on leave spring quarter, 1973), John Felstiner, Albert J. Gelpi (on leave autumn quarter, 1972), David Halliburton (English and Comparative Literature), Robert M. Polhemus, Ronald A. Rebholz (on leave autumn quarter, 1972), Lucio P. Ruotolo, Elizabeth C. Traugott

Senior Lecturer: Larry Friedlander


Lecturers: William Abrahams, Paulette Bates, Barbara C. Gelpi, David R. MacDonald, Jane Palmer, Belle K. Randall, Helen Trimpi, 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 in the University Library as a center for its work in Creative Writing. The Jones Room includes a library, records, 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 English).

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, 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, 102, 104, 201, 203, 204, 205; Anthropology 168.


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, 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. Although no formal minor program is required of English majors, all students are strongly urged to take as many relevant courses as possible in other departments. 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 admission to the Honors Program during the spring quarter of their sophomore year. Applications during the junior year will sometimes be accepted. Admission will be selective.

Students admitted to the program will take one course in each of the six divisions required of English majors. In their junior year students in the program 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). They should submit to the Honors Committee a detailed prospectus, a short annotated bibliography, and a more extensive prospective bibliography during November of the senior year. The prospectus and bibliographies 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 if their program of study has been approximately equivalent to that required of regular honors students.
Note: Exceptional English majors who are not in the Honors Program but elect Senior Independent Study (199) may be invited in their senior year to apply for departmental 'Honors.'

**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.

**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>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Major</td>
<td></td>
</tr>
<tr>
<td>Freshman English</td>
<td>5</td>
</tr>
<tr>
<td>One course in the English language, English 102 or 204.</td>
<td>5</td>
</tr>
<tr>
<td>English 201. Introduction to Modern Linguistics</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. Background of Modern British Literature</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>
<tr>
<td>Electives (courses in literature by and about American minorities, and in literary criticism are strongly recommended)</td>
<td></td>
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</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Minor</td>
<td></td>
</tr>
<tr>
<td>Freshman English</td>
<td>3</td>
</tr>
<tr>
<td>English 191. Advanced Exposition</td>
<td>3</td>
</tr>
<tr>
<td>English 102. Introduction to 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. Backgrounds of Modern British Literature</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American literature</td>
<td>10</td>
</tr>
<tr>
<td>Elective, preferably in the English novel or English 201, Introduction to Modern Linguistics</td>
<td>5</td>
</tr>
</tbody>
</table>

A candidate for the Stanford Community College Credential must begin the program during the summer or autumn quarter. He should apply to the Department of English in advance of registration. The Department will accept only those applicants who seem promising candidates for an advanced degree offered by the Department and meet the standards for col-
lege 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. Among the courses for the A.M., two courses are required from the following alternatives:
      1) Education 262 (Curriculum and Instruction in Secondary School English) or English 396 (The Teaching of Composition).
      2) Education 239 (Study Skills and Developmental Reading) or English 203 (Problems in the English Language) or Linguistics 321 (Linguistics and the Teaching of English).
   b) Education 248 (Student Teaching in the Community College). Other courses in Education and English may be suggested or recommended by the student's adviser.

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 has 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 an approved Credential Program, 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 has demonstrated his 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 gradu-
ate 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 will be expected to offer at least 90 units of graduate work 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.

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. Teaching is considered an essential 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. A description of the degrees in English philology and English medieval literature will be furnished by the Department of English on request.

Requirements of the Ph.D. program in English literature are as follows:

1. A five-unit course in Old English (usually to be 205) and a five-unit course in Middle English language or literature (read in the original)—or equivalent work elsewhere.

2. A minimum of four seminars, in different genres and periods as approved by the adviser.

3. A minimum of 60 additional units of graduate courses and seminars (200–399), distributed according to the adviser's judgment and the candidate's needs.

4. A candidate may qualify for the doctoral program in one of the following ways: (1) a written or oral examination based on a Reading Guide, to be taken at the end of the summer after the first year of graduate work; (2) the recommendation of a committee of advisers who would plan a course of study with the student, meet with the student regularly throughout the first year, evaluate a project of summer work (which would be a retrospective bibliography with annotations and a prospective bibliography for future study), and at the end of summer make a recommendation as to the student's qualification. The final decision is made by the Graduate Examination Committee in consideration of the student's course record in conjunction with his performance in the examination or with the recommendation of the committee of advisers.

A student coming to Stanford from graduate work in another university, where he took a qualifying examination and received an A.M., may petition for exemption from the qualifying examination here. However, all petitions are subject to rulings by the Graduate Examination Committee.

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 his 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. A five-unit course in Old English (usually to be 205) and a five-unit course in Middle English language or literature (read in the original)—or equivalent work elsewhere.

2. A minimum of 35 units of graduate courses (200–399) 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.

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 his 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 Herbert Lindenberger, 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 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 only, passage of Latin 51 and 52 with a grade of B or higher.

Dissertation—As early as possible during his graduate study, a Ph.D. candidate will be expected to find a topic requiring extensive original research and to enlist the services of a member of the Department as his adviser. The adviser will request the Chairman to appoint a committee to supervise the dissertation. The candidate should take this crucial step as early in his graduate career 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. A candidate taking more than five years will be required to reinstate his 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 his 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 (autumn) or David Halliburton (winter, spring) in the English Department.

COURSES NUMBERED 1 THROUGH 99 ARE INTRODUCTORY COURSES DESIGNED PRIMARILY FOR STUDENTS WHOSE MAJOR IS UNDECLARED OR IS NOT IN ENGLISH

1, 2. Freshman English—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 English—For foreign students.

1F. A specially designed course in expository writing which undergraduate foreign students may substitute for 1.

3 units, Win (Staff)

2F. Continuation of 1F.

3 units, Spr (Staff)

4. Freshman English — Creative writing. Open by invitation to a limited number of students who have already shown (in English 1 or 2, or the equivalent) the capacity to write lucid expository prose. There will be
small groups devoted to various kinds of writing, including fiction and poetry. This course may replace, for those invited, one quarter of regular Freshman English.

3 units, Win, Spr (Staff)


5 units, Win (Roston)

20. Masterpieces of American Literature—Intensive study of selected masterpieces of American literature, including poetry, drama, the essay, the novel.

5 units, Aut (Islas)

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, Win (Foster)

40. Drama—(Same as Comparative Literature 40.) Principal dramatic forms; development of dramatic art, masterpieces of the theater from various periods, countries.

5 units, Spr (Lindenberger)

45. The Tragic—(Same as Comparative Literature 45.) The articulation of tragic forms in English and European literature. The course will attempt to define various insights and tendencies we connect with the term tragedy by studying the works of major writers in drama, the novel, and poetry. Authors will include Shakespeare, Racine, Webster, Dickens, Stendhal, Ibsen, Beckett, Yeats, and Faulkner. (May be taken as 145 by English majors.)

5 units, Win (Friedlander)

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, technique, and critical theory, through writing, and through the slow reading of poems.

5 units, Spr (Felstiner)

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.)

5 units, Aut (Young)

62A. Chicano Literature—Primarily a writing course, but representative Chicano works will be studied intensively. A working knowledge of Spanish is required. (May be taken as 162A by English majors.) Prerequisite: consent of instructor.

5 units, Aut (Islas)

62B. Contemporary Mexican Writers—(in translation). An intensive study of Mexico's major twentieth century novelists, poets, and philosophers. Enrollment limited. (May be taken as 162B by English majors.)

5 units, Win (Islas)

63. Images of Women in Literature—The role of women in nineteenth and twentieth century novels. Emphasis on the situation of women in a male-dominated cultural milieu. (May be taken as 163 by English majors.)

5 units, Win (Middlebrook)

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—A survey of Old Norse-Icelandic literature in translation. The course will deal with historical, cultural, and mythological backgrounds as well as with explication of texts. (May be taken as 167 by English majors.)

5 units, Spr (Harris)


5 units (Momaday) given alternate years

69. Literature Under Attack—A study of the devaluation of literary experience in the work of important contemporary thinkers in politics, religion, and science, and the response to such attacks by major writers.

Speakers from other disciplines will share in
the teaching. (May be taken as 169 by English majors.)

5 units, Spr (Friedlander)

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)

Sum (Ryan)

90. Narration—Basic problems of narrative and imaginative writing. Prerequisite: completion of the writing requirement.

5 units, Aut, Win, Spr, Sum (Staff)

92. Reading and Writing Poetry—An introductory course in the understanding and writing of poetry. Prerequisite: completion of the writing requirement.

5 units, Aut, Win, Spr (Staff)


COURSES NUMBERED 100 THROUGH 199 ARE MAINLY BASIC UNDERGRADUATE SURVEYS, SEMINARS, AND WORKSHOPS

Note: Students who wish to take a course numbered 100-199 for graduate credit should receive consent of the instructor and should register for English 398.

100A-G. Basic Seminars—Basic seminars on the scholarly and critical study of literary texts; given each quarter and strongly recommended for beginning English majors. English 100A-F will satisfy the appropriate area requirements A-F (see program for Bachelor of Arts, 1, above). The subject matter of English 100A will be mainly linguistic studies; of English 100B, medieval literature; of English 100C, Renaissance literature; and so on. The subject matter of English 100G, which will count as one of three required electives (see program for Bachelor of Arts, 2, above), will be mainly the theory of literary genres. This course is limited to students who have previously declared an English major and have taken at least one course in English or American literature (not including Freshman English). Sign up at the English Department. (Instructors: E. Brown, Carnochan, Dekker, Fields, Fifer, Ford, Foster, B. Gelpi, Grommon, Harris, Hill, Moser, Roston, Ruotolo, Whitaker.) Consult the Time Schedule for specific offerings.

5 units, Aut, Win, Spr

102. Introduction to the English Language—Studies in the evolution of the English language as a medium of literary expression.

5 units, Aut, Win (Staff)

104. Principles of Standard English—(Same as 204.) Phonetics, syntax, derivation, etymology, meanings; consideration of recent developments in the study of language.

5 units, Sum (Ackerman)

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 (E. Brown)

113. The Renaissance.

5 units, Aut (Whitaker)

115. The Neoclassic Period.

5 units, Win (Loftis)

117. Modern British Literature.

5 units, Spr (Felstiner)

121. American Literature to 1855.

5 units, Aut (Dekker)

122. American Literature, 1855-1917.

5 units, Win (Moser)

125. American Literature, 1930 to the Present—Major works of the last forty years, with strong emphasis on black literature. Hemingway, Dos Passos, Faulkner, Wright, Ellison, Mailer, Nabokov, Ginsberg, Lowell, Baraka, Plath, etc.

5 units, Spr (Chace)

135. Forms of the Modern Novel.

5 units, given alternate years

137. Development of the Short Story—Required of creative writing students in fiction; recommended as a sophomore class. Reading and discussion of American, British, and
Continental short stories, with emphasis on changes and developments in the form.
  5 units, Win (Packer)

140. History of the English Theater.
  5 units, Aut (Roston)

145. The Tragic—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

  5 units, Win (Middlebrook)

160. The Minority Voice in Contemporary Literature—See 60.

161. Forms of Afro-American Literature—See 61.

162A. Chicano Literature—See 62A.

162B. Contemporary Mexican Writers—in translation.) See 62B.

163. Images of Women in Literature—See 63.

164. Neo-African Literature of the Caribbean—(Same as Comparative Literature 164.) With focus on the literature of the former French and British islands.
  5 units, Win (Davis)

165. American Humor—A survey of the major "schools" of American humor in literature and popular culture. About half the course deals with classic native American humorists of the nineteenth century; the other half with twentieth-century humorists, including the "New Yorker School," Lenny Bruce, and current Black Humor.
  5 units, Win (Hill)

166. The English Bible as Literature—See 66.

167. Edda and Saga—See 67.


169. Literature Under Attack—(Same as Modern Thought and Literature 169.) See 69.

171. Chaucer—Enrollment limited to 70. Sign up at English Department.
  5 units, Aut (E. Brown)
  Spr (Ryan)
  Sum (Ackerman)

173A. Shakespeare—Intensive study of eight plays: Richard III, Richard II, Merchant of Venice, Twelfth Night, Julius Caesar, Lear, Macbeth, Tempest. Students may take any or all of the 173 series in any order.
  5 units, Aut (Ryan)

173B. Shakespeare—I Henry IV, Henry V, Much Ado, As You Like It, Troilus and Cressida, Hamlet, Lear, Measure for Measure, Winter's Tale.
  5 units, Win (Whitaker)

173C. Shakespeare.
  5 units, given alternate years

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, Win (Scowcroft)

191. Advanced Exposition—Advanced course dealing with problems of writing expository prose. Prerequisite: 2 or the equivalent.
  3 units, Aut, Win, Spr (Staff)
  Sum (Grommon)

  5 units, Aut (Middlebrook)
  Win (Taylor)
  Spr (W. Trimpi)

195. Ad Hoc Undergraduate Seminars—In any quarter a group of undergraduates (at least three but preferably more) who wish in the following quarter to study a subject or
an area not covered by regular courses may plan an informal seminar and approach a member of the Department to supervise it. A syllabus for the course should be submitted to the director of undergraduate advising at least two weeks before the end of the quarter. No more than five units of credit will be given for English 195 and/or English 198 in any one quarter. English 195 may not be used to fulfill Departmental area or elective requirements without permission.

Any quarter, by arrangement

196A. Junior Honors Seminar—Required of all juniors in the English Honors Program.
5 units, Win (Lindenberger)  
Spr (Harris)

196B. Senior Honors Seminar—Required of all seniors in the English Honors Program.
5 units, Aut (Halliburton)

197. Senior Honors Essay.
15 units (during 2 quarters)  
Aut, Win, Spr (Staff)

198. Individual Work — Advanced undergraduates who wish to study a subject or an area not covered by regular courses may, with permission, enroll for individual work under the supervision of some member of the Department. No more than five units of credit will be given for English 198 and/or English 195 in any one quarter. English 198 may not be used to fulfill Departmental area or elective requirements without permission. Group seminars are not considered appropriate to English 198.

Any quarter, by arrangement

199. Senior Independent Study — Enrollment limited to 50. Open, on approval by the Department, to seniors majoring in English who wish to work throughout the year on a critical or scholarly essay of about 10,000 words (see "Note" under "Honors Program in English"). Applicants should submit (1) a sample of their expository prose and (2) a proposed topic for independent study to the secretary of the Department before preregistration in May of their junior year. Each student who is accepted will be assigned to an instructor, with whom he 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 departments who wish to broaden their programs will find many of these courses useful.

201. Structure of the English Language—
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)

203. Problems in the English Language—
Study of basic works on the language important for teachers at all levels and including attention to modern linguistics. Prerequisite for undergraduates: consent of instructor.
5 units, Win (Ackerman)

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 — History, dialects of Middle English; readings of representative selections from the literature. Prerequisite: 205 or equivalent.
5 units, Win (Ackerman)

208. Post-Classical Latin — (Same as Comparative Literature 208 and Classics 208.)
Careful reading of Latin texts of graded difficulty, beginning with the Vulgate Bible, working through various patristic writings and medieval literature to the Latin of the Renaissance. Intended primarily for students not in classics. Prerequisite: two years’ high school Latin or equivalent.
5 units, Aut (G. Brown)

5 units, given alternate years

211. Readings in Medieval English Literature.
5 units, given alternate years
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>212A</td>
<td>Medieval to Renaissance: The Development of Literary Forms.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>212B</td>
<td>Continuation of 212A.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>213</td>
<td>Literature of the Sixteenth Century.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>214</td>
<td>Literature of the Seventeenth Century: Backgrounds, Forms, Styles.</td>
<td>5</td>
<td>Win (Sensabaugh)</td>
</tr>
<tr>
<td>215</td>
<td>Literature of the Eighteenth Century.</td>
<td>5</td>
<td>given alternate years</td>
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<tr>
<td>216</td>
<td>Literature of the Nineteenth Century.</td>
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<tr>
<td>216A</td>
<td>English Romantic Poetry and Prose.</td>
<td>5</td>
<td>Aut (Ford)</td>
</tr>
<tr>
<td>216B</td>
<td>Victorian Poetry and Poetics.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>218A</td>
<td>The Culture of England, 1890–1914—(Same as Comparative Literature 218A, History 244, and Modern Thought and Literature 218A.)</td>
<td>5</td>
<td>Win (Felstiner, Stansky)</td>
</tr>
<tr>
<td>219</td>
<td>Modern British Comic Writers—Readings and discussion of writers such as Lewis Carroll, Wilde, Shaw, Beerbohm, Joyce, Beckett, Burgess, Pinter.</td>
<td>5</td>
<td>Win (Polhemus)</td>
</tr>
<tr>
<td>223</td>
<td>Varieties of American Romanticism.</td>
<td>5</td>
<td>Aut (Simpson)</td>
</tr>
<tr>
<td>226</td>
<td>American Literature of the 1930's.</td>
<td>5</td>
<td>Sum (Chace)</td>
</tr>
<tr>
<td>227</td>
<td>Modern Southern Writers.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>231</td>
<td>The English Novel through the Eighteenth Century—Study of the most significant novels, with emphasis on development of the form.</td>
<td>5</td>
<td>Aut (Scowcroft)</td>
</tr>
<tr>
<td>232</td>
<td>The English Novel in the Nineteenth Century—Study of the most significant novels, with emphasis on development of the form.</td>
<td>5</td>
<td>Spr (Polhemus)</td>
</tr>
<tr>
<td>233</td>
<td>The Twentieth Century English Novel</td>
<td>5</td>
<td>given alternate years</td>
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<td></td>
<td>—The course will include the following novelists: Conrad, Joyce, Ford, Woolf, Lawrence, Cary, Greene, Amos.</td>
<td>5</td>
<td>Aut (Ruotolo)</td>
</tr>
<tr>
<td>234</td>
<td>Nineteenth Century American Fiction.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>234A</td>
<td>The American Novel, 1870–1920—Novels of the major and minor American writers of the “Realistic” period—Twain, Howells, James, Howe, Eggleston, Garland, Norris, and Sinclair Lewis; the evolution of realism from its Romantic sources in American literature.</td>
<td>5</td>
<td>Spr (Hill)</td>
</tr>
<tr>
<td>235</td>
<td>The Impressionist and Experimental Novel—(Same as Comparative Literature 235.)</td>
<td>5</td>
<td>given 1973–74</td>
</tr>
<tr>
<td>237</td>
<td>Eighteenth Century Prose—Representative prose writers (excluding the major novelists) of the eighteenth century such as Swift, Addison, Steele, Johnson, Goldsmith, Reynolds, and Burke.</td>
<td>5</td>
<td>Spr (Fifer)</td>
</tr>
<tr>
<td>238</td>
<td>Victorian Prose — Ruskin the central figure for study. Related reading in Carlyle, Mill, Arnold, and Pater.</td>
<td>5</td>
<td>Win (B. Gelpi)</td>
</tr>
<tr>
<td>242</td>
<td>Drama of Medieval and Renaissance England.</td>
<td>5</td>
<td>Spr (Loftis)</td>
</tr>
<tr>
<td>245</td>
<td>Drama of the Restoration and Eighteenth Century.</td>
<td>5</td>
<td>Win (Loftis)</td>
</tr>
<tr>
<td>250</td>
<td>The English Lyric.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>251</td>
<td>Popular Ballad and Folksong.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>252</td>
<td>Renaissance Poetry: Intentions, Structures, and Styles.</td>
<td>5</td>
<td>Win (W. Trimpi)</td>
</tr>
<tr>
<td>254A</td>
<td>Some Eighteenth Century Poets—Readings in Rochester, Dryden, Swift, Pope, Johnson, and others.</td>
<td>5</td>
<td>Win (Carnochan)</td>
</tr>
<tr>
<td>254B</td>
<td>Poetry and Ideas: Johnson to Blake.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
<tr>
<td>255</td>
<td>Nineteenth Century Poetry as Myth-Making.</td>
<td>5</td>
<td>given alternate years</td>
</tr>
</tbody>
</table>
5 units, Win (Fields)

258. American Poetry since 1945.
5 units, given alternate years

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.) Nietzsche as a philosopher of culture; the force of his ideas in the novels of D. H. Lawrence, Thomas Mann, Malraux, and Belyj. Reading knowledge of French or German or Russian desirable.
5 units, Spr (Foster)

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.) Forms of existential commitment in the protagonists of writers like Sartre, Joyce, Woolf, Ellison, and Malamud.
5 units, Spr (Ruotolo)

266. Romantic Historical Literature
(Same as Comparative Literature 266.) The rise of Romantic historical drama and fiction in Europe and America: Goethe, Scott, Cooper, Hawthorne, Pushkin, Tolstoy, Stendahl, and Buchner.
5 units, Aut (Dekker)

269A. Toward an Understanding of Romanticism
(Same as Comparative Literature 269A and Modern Thought and Literature 269A.) Study of such major developments in Romantic thought and literature as concepts of the self, historicism, and visionary poetry. Reading knowledge of French or German desirable.
5 units, Spr (Lindenberger)

269B. Toward an Understanding of Modernism
(Same as Comparative Literature 269B and Modern Thought and Literature 269B.)
5 units (Lindenberger) given 1973-74

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 (G. Brown)

271. Chaucer.
5 units, given alternate years

272. Spenser and the Renaissance Tradition
— Reading of The Faerie Queene; study of its literary background and context.
5 units, Win (Bender)

273. Advanced Study of Shakespeare — Detailed study of four or five plays, including attention to sources, staging, and important criticism. Extensive prior study of Shakespeare's works is assumed. Prerequisite: 73 or 173A, B, or C, or equivalent.
5 units, Spr (Whitaker)

5 units, Spr (W. Trimpi)

276. Milton.
5 units, given alternate years

277. Dryden, Swift, and Pope.
5 units, Spr (Loftis)

278. Johnson and His Circle.
5 units, given alternate years

280A. Wordsworth and Coleridge.
5 units, given alternate years

280B. Byron, Shelley, and Keats.
5 units, Spr (Ford)

281. Dickens and Trollope.
5 units, Aut (Polhemus)

282. Browning and Tennyson.
5 units, given alternate years

284A. Emerson and Thoreau.
5 units, given alternate years

284B. Emerson, Whitman, and Emily Dickinson.
5 units, given alternate years

285A. Hawthorne and Melville.
5 units, given alternate years

285B. Twain, Howells, and James.
5 units, given alternate years
287. Conrad and Faulkner.
   5 units, given alternate years

288. Joyce — Joyce's essential work up to Finnegans Wake.
   5 units, Spr (Chace)

289A. Eliot and Pound — Early poetry and criticism with special emphasis on The Waste Land and Hugh Selwyn Mauberley.
   5 units, Spr (Dekker)

289B. Yeats, Eliot, Neruda — (Same as Comparative Literature 289B.) Introduction by way of Yeats, followed by intensive reading of two long poems, Four Quartets and Alturas de Macchu Picchu. Students should have done some work in modern poetry, and have a reading knowledge of a Romance language.
   5 units, Win (Felstiner)

291. Workshop in Creation and Criticism—
   (Same as Modern Thought and Literature 291.)
   3 to 5 units, given alternate years

Curriculum and Instruction in Secondary School English I—See Education 262.

COURSES NUMBERED 300
THROUGH 399 ARE GRADUATE SEMINARS AND WORKSHOPS;
OPEN TO UNDERGRADUATES ONLY WITH PERMISSION

Note—Some of these courses are relatively broad in scope; some focus on a single theme or genre. Students should consult the instructor before registering for any course in this category.

301. Seminar: Language and Literature.
   5 units, given alternate years

310. Seminar: Problems in Old English Literature—A close study of works and genres, such as those in the Vercelli manuscript, not ordinarily examined in other Old English courses. Prerequisite: 205, or equivalent.
   5 units, Spr (G. Brown)

311. Seminar: Methods and Materials for the Study of Medieval Literature — (Same as Comparative Literature 311.) An examination of the major medieval works of mythology, hagiography, Biblical exegesis, beast lore, numerology, astrology, and the like, and with modern aids to their use, followed by individual research projects.
   5 units, Win (E. Brown)

312. Seminar: Middle English Literature—Prerequisite: 206 or equivalent.
   5 units, given alternate years

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.

314A. Seminar: Intellectual History of the Sixteenth Century—An introduction to the main currents of thought and taste in the Tudor period.
   5 units, Aut (Whitaker)

315. Literary Problems of the Restoration and Eighteenth Century—Prerequisite: 115 or 215, or equivalent.

315A. Seminar: Eighteenth Century Fiction.
   5 units, Spr (Carnochan)

315B. Seminar: Swift and Pope.
   5 units, given alternate years

315C. Seminar: Johnson and His Circle.
   5 units, Win (Fifer)

315D. Seminar: Literary and Social Content of Drama.
   5 units, given alternate years

315F. Seminar: The Enlightenment and Its Literary Traditions—(Same as Comparative Literature 315F and Modern Thought and Literature 315F.)
   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 Romanticisms.
   5 units, given alternate years

316B. Seminar: Nineteenth Century Poetry.
   5 units, given alternate years

316C. Seminar: Romantic Irony.
   5 units, given alternate years

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, given alternate years

322. Problems of Nineteenth and Twentieth Century American Literature.

322A. Seminar: Nineteenth Century Views of American Colonial Experience—King Philip's War and Anglo-Dutch relations in eighteenth century New York, as recorded by colonial historians and such nineteenth century writers as Irving, Paulding, Cooper, Parkman, and Hawthorne.
5 units, Spr (Dekker)

332. Seminar: Nineteenth Century Comic Fiction.
5 units, given alternate years

5 units, Aut (Guerard)

335. Seminar: The Modern Novel—(Same as Comparative Literature 335.)
5 units (Guerard) given 1973–74

5 units, given alternate years

5 units, given alternate years

5 units, given alternate years

355B. Seminar: British Poetry Since Hardy.
5 units, given alternate years


5 units, given alternate years

360A. Seminar: History of Literary Theory: Ancient—(Same as Comparative Literature 360A.)
5 units, Win (W. Trimpi)

360B. Seminar: History of Literary Theory: Medieval/Renaissance—(Same as Comparative Literature 360B.) Prerequisite: 360A.
5 units, Spr (W. 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. Limited to 15.
5 units, Aut (Guerard)

362A. Seminar: Psychology and Literature—(Same as Modern Thought and Literature 362A.) Readings in psychology, psychological literary criticism, and in such novelists as the Brontes, Dostoevsky, Kafka, Ford, Conrad, Hemingway, Sartre, Camus.
5 units, Win (I. Yalom, M. Yalom)

362B. Seminar: Problems of Psychological Interpretation—(Same as Comparative Literature 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, Spr (Moser)

364. Topics in British Literature.

364A. Seminar: Literature of World War I.
5 units, given alternate years

365. Topics in American Literature.

365A. Seminar: Realism and Naturalism in American Literature.
5 units, given alternate years

365B. Seminar: Politics and Society in American Literature, 1880–1930—(Same as Modern Thought and Literature 365B.)
5 units, Win (Simpson)

367. Topics in Modern Literature.

367A. Seminar: Capitalism and Literature in the Nineteenth Century—(Same as Modern Thought and Literature 367A.)
5 units, given alternate years

368. Topics in Criticism.

368A. Seminar: Literature and the Visual Arts—(Same as Comparative Literature 368A.) The relationship between leading English writers or schools and the movements in European painting, architecture, and sculpture to which they most closely correspond.
5 units, Spr (Roston)

368B. Seminar: American Critics—(Same as Comparative Literature 368B.) Study
of influential theorists and critics such as Poe, James, Kenneth Burke, Lovejoy, Yvor Winters, and J. Hillis Miller and movements such as the Chicago school and hermeneutics.

5 units, Aut (Halliburton)

369. Seminar: Major Modern Critics — (Same as Comparative Literature 369.) Study of such central figures as Auerbach, Spitzer, Frye, and Gombrich.

5 units, Win (Lindenberger)


5 units, Spr (E. Brown)

373. Seminar: Shakespeare — Prerequisites: the equivalent of 73, or 173A or B or C, or 213; and 242.

5 units, given alternate years

374. Seminar: Donne and the Metaphysical Poets—The metaphysical “wit” of Donne, Herbert, Marvell, and others in the context of the Counter-Renaissance distrust of logic; the relationship between the roguish love verse and the devotional poetry.

5 units, Aut (Roston)

376. Seminar: Milton.

5 units, Win (Sensabaugh)

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, given alternate years

385C. Seminar: Wallace Stevens.

5 units, given alternate years

385D. Seminar: William Carlos Williams.

5 units, given alternate years

385E. Seminar: Twain.

5 units, Aut (Hill)

387. Seminar: James, Conrad, and Ford.

5 units, Win (Moser)

388. British Authors of the Nineteenth and Twentieth Centuries

388A. Seminar: Conrad.

5 units, given alternate years

388B. Seminar: Virginia Woolf and Her Circle—A study of Virginia Woolf’s fiction and criticism against the background of her Bloomsbury environment.

5 units, Win (Ruotolo)

390. Advanced Fiction Writing — A workshop group open by permission to graduates and exceptionally advanced seniors. All applicants should leave samples of their writing with the Creative Writing secretary at least ten days before the beginning of each quarter.

3 to 5 units, Aut (Scowcroft)

Win, Spr (Abrahams)

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 (H. Trimpi)

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 (Davie) given 1973–74

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. Seminar in the Teaching of Composition—Open only by consent of the Director of Freshman English.

2 units, Spr (Director of Freshman English)

396A. Teachers’ Workshop — Discussion of the methods new teachers of Freshman English are using in their classes and evaluation of the effectiveness of those methods. Consideration of ways of improving the teaching of Freshman English. Open to graduate students during the two quarters in which they teach Freshman English for the first time. The units may not be counted toward the Department’s requirements for the degree.
FRENCH AND ITALIAN 309

5 units, Aut, Win, Spr (Director and Administrative Assistant of Freshman English) by arrangement

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 244. Structural Studies of Myth.
Modern Thought and Literature 256. Philosophy, Culture, and Society.
Modern Thought and Literature 257. Modernity and Its Discontents.
Modern Thought and Literature 260A, B. "Modernisms."
Modern Thought and Literature 382. Seminar: Dynamic Psychology.

For additional offerings in literature, see Comparative Literature.

FRENCH and ITALIAN

Emeriti: Georges E. Lemaitre, Roberto B. Sangiorgi (Professors); Jessie E. Smith (Assistant Professor)
Chairman: To be named.
Associate Professors: Marc Bertrand, Ralph M. Hester (on leave spring quarter, 1973)
Senior Lecturer: John G. Barson

Acting Assistant Professor: Josué Harari (French and Comparative Literature)
Lecturers: Marguerite Bauer, Clio P. Dorr, Jacqueline Ollivier.

ITALIAN DIVISION

Director: Paolo Braghieri
Assistant Professors: Michael Leone. 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

BACHELOR OF ARTS IN FRENCH

Candidates should normally have completed the series of first- and second-year courses in French 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.

All candidates are expected to take at least three advanced language courses (123, 124, and 125), and also the series of introductory courses to French literature (130, 131, 132). Beyond this French majors must take a minimum of seven courses in French literature and culture, all numbered above 132. These may be freely chosen with the sole proviso that they be distributed so that at least one course be taken in each of three different periods of literature extending from the Middle Ages to the twentieth century. Candidates for graduate school are urged to take courses in all periods of French literature.

Students who contemplate a teaching career in college or university should note that most graduate schools require for the doctorate in French a reading knowledge of Latin and proficiency in at least one additional modern language.

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.

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) 30 units of Italian courses beyond the 52 level. Among the courses selected, students will be required to take Italian 101, 102, and 103.

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.

Students are encouraged to structure their program individually in consultation with a departmental adviser.

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.

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.

DEPARTMENTAL PROGRAM AT THE UNIVERSITY OF ORLÉANS-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 Orléans-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 accompanies the group. Applications must be received by April 15. Forms and information may be obtained from the Department.

INTENSIVE LANGUAGE WORK IN EUROPEAN STUDY CENTERS—(Open to all students.)

Each student accepted by the Committee on General Studies for work at a Stanford center in Tours, France or Florence, Italy, will complete twelve units of Intensive French or Italian during the six months of his residence abroad. The intensive work is oriented to the development of the student's
individual ability to understand, speak, write, and read French or Italian. All courses regardless of the level at which the work is completed bear the designation French 80 or Italian 80, with the successive levels, the lowest 2 and the highest 6, indicated as second digit. Assignment to a particular level is made by the director of each center.

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. (See above.)

MASTER OF ARTS IN FRENCH I

(Terminal Program)

This program is designed to meet the needs of students who do not seek the doctorate. Work is normally completed in three quarters of concentrated study. Competence in a modern foreign language other than French is strongly recommended, but not required. No thesis is required, but, in addition to course work, candidates take a one-hour oral examination in a major area of study (literary or linguistic-teaching methodology) of their choice.

By University regulation, students desiring the M.A. degree must complete a minimum of 36 units of graduate work. Students enrolled in a full-time program for three quarters (with an average of 12 units per quarter) can fulfill the M.A. requirements in one year—which they are strongly advised to do. The basic course program, intended for those who plan eventually to teach French (modifications are possible for those who do not), is as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>French 122. Phonetics</td>
<td>3</td>
</tr>
<tr>
<td>French 205. Modern French</td>
<td>3</td>
</tr>
<tr>
<td>French 210. Expression écrite</td>
<td>3</td>
</tr>
<tr>
<td>French 310. Introduction to Romance Linguistics</td>
<td>3</td>
</tr>
<tr>
<td>1 Seminar (French 350)</td>
<td>3</td>
</tr>
<tr>
<td>3 literature courses (minimum) numbered</td>
<td></td>
</tr>
<tr>
<td>French 200 or higher</td>
<td>9</td>
</tr>
<tr>
<td>Electives</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
</tr>
</tbody>
</table>

MASTER OF ARTS IN FRENCH II

(With Thesis)

Candidates for this degree must be admitted to the Ph.D. degree program, although the M.A. is not required for the Ph.D., but is maintained primarily for graduate students who may wish to write a Master's thesis or who may (for one reason or another) find themselves unable to continue to the Ph.D. With the exception of 6 units of thesis writing (French 399), the course requirements (by University regulations a minimum of 36 units of graduate work) correspond to the normal first-year work done for the Ph.D. They are as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Problèmes de l'expression écrite</td>
<td>3</td>
</tr>
<tr>
<td>b) Three courses in philology</td>
<td>9</td>
</tr>
<tr>
<td>French 310, 311, 312</td>
<td></td>
</tr>
<tr>
<td>c) Five graduate courses in literature</td>
<td>15</td>
</tr>
<tr>
<td>d) One seminar</td>
<td>3</td>
</tr>
<tr>
<td>e) French 399 (thesis) or electives to be chosen with the approval of the graduate adviser</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
</tr>
</tbody>
</table>

DOCTOR OF PHILOSOPHY: FRENCH

General Requirements — 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, including the courses listed above as requirements for the A.M. Beyond the course requirements for the A.M., all candidates, regardless of their area of specialization, must take at least three additional graduate courses in French literature and four additional seminars (of which two are to be outside the candidate's special field of interest. Each candidate must take at least two courses (or seminars) in each century (for the purposes of this requirement, the Middle Ages count as a century).

2. Examinations. Preliminary written examinations are in two parts, one of which is on a broad historical period of literature and taken in October of the third year of study and the other on a broad literary genre and taken in January of the third
year. Success in these examinations qualifies a student for taking the University oral examination, which requires comment on a text in the student's area of specialization and a defense of his or her dissertation project.

3. Dissertation. The doctoral dissertation must be judged worthy of publication as a contribution to study in the field.

4. Teaching experience is normally required of all candidates as a condition of receiving the Ph.D. degree. Teaching assistantships are available to help candidates fulfill this requirement.

5. There is no formal language requirement other than French and English. Students working in areas of specialization in which additional languages are essential may be expected to prepare themselves in those languages before beginning work on the dissertation.

Minor in Italian—The Department offers a Ph.D. in French with a minor in Italian. Interested candidates are invited to discuss this degree with the Graduate Adviser.

Minor in Comparative Literature—Students working toward the doctorate in French Literature may, after their first quarter of graduate work at Stanford, apply for admission for a minor in Comparative Literature. For more detailed information and also for additional course offerings in literature see the section “Comparative Literature.”

Joint Ph.D. in French and Humanities

The Department of French and Italian participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in French and Humanities. For a description of that program see the section “Humanities Special Programs” in this Bulletin.

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, including Stendhal, Balzac, Hugo, Flaubert, Huysmans, and Zola.

3 to 4 units, Aut (Giraud) TTh 10; one hour by arrangement

104. Contemporary French Novelists—Significant authors of contemporary France: Proust, Gide, Malraux, Sartre, Camus, etc. Lectures, readings in English.

3 units, Spr (Cohn) TTh 11

105. The Writings of Albert Camus.

3 units, Aut (Cohn) TTh 11

106. The Fictional and Critical Writings of Sartre.

3 units, Win (Cohn)

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 (Giraud) given 1973-74

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, Spr (Weinstein) MW 11

French and Comparative Literature

113. Problems of Narrative in Eighteenth Century Fiction—A study of the concepts of time and space, system and structure, in order to explain the logic and the organization of narrative discourse. Readings from Defoe, Fielding, Richardson, Smollet, Sterne, Diderot, Prevost, Voltaire, Sade, and Laclos.

3 to 4 units, Spr (Harari) TTh 2:15-3:30

114. Myth and Violence in Literature—An analysis of Greek, French, and English theater in conjunction with anthropological material. Readings from Sophocles, Aeschylus, Euripides, Shakespeare, Racine, Sade, Genet, Artaud, Malinowski, and Levi-Strauss.

3 to 4 units, Aut (Harari) MW 9; one hour by arrangement

115. The Tradition of French Poetry—Reading and interpretation of French poetry from the early Middle Ages to the contem-
porary period. Literary analysis of topics such as theme, image, archetype, structure, point of view. Marxist, Freudian, and Jungian criticism. Text: The Penguin Books of French Verse.

3 to 4 units, Win (Calin) T 2:15-4:05

116. The Fate of Modern Fiction—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.

3 to 4 units (Harari) given 1973-74

117. Literary Criticism and Structural Analysis—A methodological approach to various literary texts using the structural techniques developed by Levi-Strauss, Foucault, Barthes, etc.

3 to 4 units (Harari) given 1973-74

118. The Helen of Sparta Legend in European Literature.

3 to 4 units (Newman-Gordon) given 1973-74

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 23, 25, 27, and October 2 (for autumn quarter); November 20, January 3 and 5 (for winter quarter); February 28, April 2 and 4 (for spring quarter); May 23 (for summer and autumn quarters). The placement test is not given in the summer.

1. Initiation au français—Étape 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

2A. La France d’aujourd’hui—(Supplément du Français 2.) 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: 1 or equivalent.

3 units, Aut, Win, Spr (Staff)


4 units, Aut, Win, Spr (Staff) MTWThF

3A. Le français sans complexes—(Supplément du Français 3.) Cours de conversation. Elaboration du 2A au niveau linguistique du Français 3. Prerequisite: 2 or equivalent.

3 units, Aut, Win, Spr (Staff)

5. Intensive French for Beginners—(Equivalent to 1 and 2.) Offers preparation in speaking, writing, and reading the language.

10 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
Sum (Staff) MTWTh

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


4 units, Aut, Win, Spr (Staff) MTWTh

23. Le français en action II—Continuation du Français 22. Difficultés de grammaire et de syntaxe. Lectures fondées sur différents
genres littéraires. Discussion de points de vue personnels.

4 units, Aut, Win, Spr (Staff) MTWTh


4 units, Aut, Win, Spr (Staff) MTWTh

26. Le français en action I et II — Cours accéléré de deuxième année. Révision complète de grammaire essentielle, lectures choisies de genres différents, et discussions. Correspond au Français 22 et 23. Prerequisite: one year of college French or equivalent.

6 units, Sum (Staff) MTWThF

30. Conversation et Culture — La France vue par des écrivains français et étrangers. Présentation et discussion des opinions. Prerequisite: French 23 or equivalent.

3 units, Aut, Win, Spr (Staff)

82-86. Intensive French — Given only at Stanford in France.

6 units for any two quarters, Aut-Win, Spr-Sum (Staff) MTWTh, two hours daily

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

122. Phonétique et Orthoépie—Etude théorique et travaux correctifs: articulation, rythme, intonation. Pédagogie de la graphie traditionnelle et de la graphie phonétique. Prerequisite: 24 or equivalent.

3 units, Win (Juillard) MWF 10

123. Composition, grammaire et étude de textes—Convergences et divergences de la langue orale et écrite, grammaire descriptive et normative, analyse logique, analyse grammaticale. Prerequisite: 24 or equivalent.

3 units, Aut (——) MWF 10

124. Langue, style et écriture — Continuation du Français 123. Le commentaire littéraire, les styles de la critique, composition originale.

3 units, Win (——) MWF 9

125. Cours avancé. Le français littéraire—Exercices de style, traduction et explication de texte; enrichissement du vocabulaire. Prerequisites: 123 and 124 or equivalent.

4 units, Aut (Lapp) M 2:15-4:05 and T 2:15

128. Stylistique—Cours basé sur l'examen de brèves compositions discutées et corrigées en classe. Etude des rapports entre la grammaire et le style, entre la stylistique générale et la stylistique française. Prerequisites: 123 and 124 or equivalent.

3 units, Aut (Juillard) WF 2:15-3:30

Literature Courses

For literature courses in English, see also General Courses, page 312.

130. L'Amour, la société et la rébellion — Étude générale de la littérature française du roman courtois du Moyen-Age jusqu'à l'essai philosophique de la Renaissance (Chrestien de Troyes, Villon, poètes du 16ème siècle, Rabelais, Montaigne). Prerequisite: 24 or equivalent.

3 units, Aut (Harari) MWF 1:15

131. La Liberté, la volonté et la passion—Étude générale de la littérature française de la tragédie classique jusqu'au roman érotique du 18e siècle (Corneille, Racine, Molière, Diderot, Rousseau). Prerequisite: 24 or equivalent.

3 units, Win (Harari) MWF 10


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 1973–74

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 (Hester) given 1973–74


4 units (Lapp) given 1973–74


4 units, Aut (Calin) M 7–9 p.m. and one hour by arrangement

150. Roman et anti-roman au 17ème siècle; la crise morale—Le roman aux prises avec la société; Sorel. Le Roman comique (extraits). Mme de La Fayette, La Princesse de Clèves, La Bruyère, Caractères et La Rochefoucauld, Maximes. Pascal, Pensées.

4 units (Lapp) given 1973–74


4 units (Lapp) given 1973–74

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, Win (Lapp) M 2:15–4:05 and T 2:15

161. La femme dans la littérature du 18ème siècle—La féminité et ses avatars, présence et absence de la femme dans la littérature du 18ème siècle. Lectures de Montesquieu, Prévost, Marivaux, Diderot, Voltaire, Sade, Rousseau et Laclos.

4 units, Win (Harari) TTh 3:15–4:30

163. L’Europe des Lumières II—La tradition philosophique du 18ème siècle.

4 units (Harari) given 1973–74


4 units (Giraud) given 1973–74


4 units (Giraud) given 1973–74

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 (Cohn) given 1973–74

175. Le Théâtre au 19ème siècle—Lectures principales: Dumas père, Hugo, Vigny, Musset, Dumas fils, Augier, Becque, Rostand.

4 units, Spr (Weinstein) MWF 1:15

180. La Poésie française du Symbolisme au Surréalisme.

4 units (Newman-Gordon) given 1973–74

181. Le Théâtre français au 20ème siècle.

4 units (Newman-Gordon) given 1973–74

182. Le Roman en France depuis 1898.

4 units, Aut (Newman-Gordon) MWF 11

183. Individu et société dans le roman français contemporain—De La Peste de Camus au “roman de contestation” actuel.

4 units, Spr (Bertrand) TTh 11; one hour by arrangement

186. Le Théâtre de la Résistance en France.

4 units, Win (Newman-Gordon) MWF 11

187. Poètes de notre temps—Michaux, Char, Prévert, Supervielle, Reverdy, Léon-Paul Fargue.

4 units (Newman-Gordon) given 1973–74

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, Spr (Newman-Gordon) MWF 10

Civilization Courses

Note—Prerequisites for the following courses are normally French 123 and one course
of the 130, 131, 132 series, or equivalent preparation.

195. La France: société,politique et culture I—Le monde féodal et la Renaissance.  
4 units (Bertrand) given 1973–74

196. La France: société, politique et culture II—Le centralisme monarchique; la Révolution de 1789; l'Empire napoléonien.  
4 units (Bertrand) given 1973–74

197. La France: société, politique et culture III—La poursuite de la légitimité: de la Restauration à l'époque contemporaine.  
4 units, Win (Bertrand) TTh 11:00–12:15

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 enchaînement; la question de l'é 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, Spr (Juilland) T 2:15–4:05

3 units, Aut (Lapp) T 10–12

3 to 5 units, Spr (Cohn) M 2:15–4:05

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.  
3 units, Aut (Barson)

295. Littérature africaine d'expression française: roman et poésie—Etude des auteurs suivants: Camara Laye, Mongo Beti, Hamidou Kane, Sembene Ousmane, Yambo Ouologuem, Senghor, Tchicaya U Tam'si.  
3 units (Calin) given 1973–74

GRADUATE COURSES

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.  
3 units, Aut (Juilland) Th 2:15–4:05

311. Introduction to Medieval Literature—Study of five masterpieces of medieval French literature from the perspective of modern criticism. No prerequisite.  
3 units, Win (Calin) M 2:15–4:05 and Th 10

312. 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.  
3 units, Spr (Juilland) Th 2:15–4:05

315. Grammaire historique de la langue française.  
3 units (Calin) given 1973–74

3 units (Calin) given 1973–74

341. La Renaissance en France I—Les Prosateurs; Rabelais et Montaigne.  
3 units (Hester) given 1974–75

342. La Renaissance en France II—Les poêtes de la Pléiade et les poêtes baroques de la fin du 16ème siècle.  
3 units (Hester) given 1973–74

343. La Poesie de la Renaissance avant la Pléiade—Les Rhétoriqueurs, Marguerite de Navarre; les poètes de Lyon: Scève, Louise Labé, Pontus de Tyard.  
3 units (Hester) given 1974–75
350. Graduate Seminars.

Medieval Fiction: Epic and Romance.
3 units, Spr (Calin) W 2:15-4:05

Medieval Allegory: Le Roman de la Rose and Guillaume de Machaut.
3 units (Calin) given 1974-75

Rabelais.
3 units (Hester) given 1973-74

Montaigne.
3 units (Lapp) given 1973-74

Ronsard et d’Aubigné.
3 units, Aut (Calin) T 2:15-4:05

Flaubert.
3 units, Aut (Giraud) W 2:15-4:05

Mallarmé.
3 units (Cohn) given 1973-74

Baudelaire.
3 units, Win (Cohn) W 2:15-4:05

Rimbaud.
3 units (Cohn) given 1973-74

351. La Poesie de Malherbe à La Fontaine.
3 units, Win (Lapp) T 10-12

360. Poetry from Saint-Amant to Chenier—Saint-Amant, La Fontaine, Boileau, Voltaire, Chenier and others.
3 units (Calin) given 1973-74

3 units, Spr (Harari) F 2:15-4:05

3 units (Harari) given 1973-74

367. L’Envers des signes—Lecture en filigrane de textes de Voltaire et de Rousseau à partir de leur correspondance.
3 units (Harari) given 1973-74

3 units (Weinstein) given 1973-74

372. The Symbolist Poets.
3 units (Cohn) given 1973-74

373. La Critique littéraire au 19ème siècle — Sainte-Beuve, Taine, Brunetière, and others.
3 units (Weinstein) given 1973-74

380. La “grande génération”—Proust, Gide, Péguy, Claudel, Romain Rolland, Valéry.
3 units, Aut (Newman-Gordon) F 2:15-4:05

3 units (Giraud) given 1973-74

3 units (Newman-Gordon) given 1973-74

388. Apollinaire—Alcools et Calligrammes.
3 units, Win (Newman-Gordon) F 2:15-4:05

3 units (Bertrand) given 1973-74

3 units (Bertrand) given 1973-74

396. Introduction to Existentialism — The modern predicament; theory of being; theory of knowledge; theory of value; anguish and the human condition; freedom; death; love; existentialism and pragmatism; existentialism and modern philosophy.
3 units, Win (Juilland) Th 2:15-4:05

398. Graduate Colloquia—Directed reading and group discussion of individual projects, preferably related to dissertation preparation. Topics may be in any genre or period.
3 units, Aut (Cohn) M 2:15-4:05

Win (Bertrand) by arrangement
Spr (Newman-Gordon) 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 (politics, 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 linguistic approach to Italian through contemporary readings (short stories or novels) or viewing and studying of films and their scripts.
   4 units, Aut, Win, Spr (Staff) MTWThF

4. 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, Win, Spr (Staff)

5. Intensive Italian for Beginners—Equivalent to 1 and 2. Offers preparation in speaking, writing, and reading the language.
   4 units, Aut, Win, Spr (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, Win, Spr (Staff)

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)

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)

Note: Italian 51, 52, 53 are offered for 3 units. May be taken for 4 units by arrangement with instructor.

52–86. Intensive Italian — Given only at Stanford in Italy.
   6 units for any two quarters, Aut-Win or Spr-Sum (Staff) MTWTh two hours daily

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 considered the equivalent of Italian 50A and Italian 50B.

Survey Courses

The following series of courses is designed to provide students with the necessary background in the main periods, movements, and figures of Italian culture and civilization. Whenever possible, guest lecturers from other departments will be invited to expand the scope of the course by presenting facets of the period under examination in fields other than the literary. Students interested in projects combining literature with other disciplines, may do so in joint consultation with the other department(s) involved.

101. Survey of Italian Literature and Civilization (13th–15th Century)—Prerequisite: 53 or equivalent.
   4 units, Aut (Leone) MWF

102. Survey of Italian Literature and Civilization (15th–18th Century) — Prerequisite: 101 or consent of instructor.
   4 units, Win (Braghieri)

103. Survey of Italian Literature and Civilization (18th–20th Century) — Continuation of 102. Prerequisite: 102 or consent of instructor.
   4 units, Spr (Leone)

Literature Courses

140. Dante, The Divine Comedy — Reading and discussion of the main cantos of the Inferno and Purgatorio, with selected cantos from the Paradiso. In Italian.
   4 units, Win (Leone)

147. The “Real” and the “Ideal” in the Literature of the Middle Ages—Study of the principal social, philosophical, ethical, and political attitudes of the medieval period as reflected in such authors as Andreas Capelanus, Jean de Meun, Dante, Petrarch, Boccaccio, Chaucer, and others. In English.
   4 units, Win (Leone)
161. Facets of the Italian Renaissance—
Literature, philosophy, art, music, architecture, politics. Guest lectures from other departments' members will contribute to the course. In Italian.

4 units, Aut (Braghieri) MWF 1:15

170. Literature and the Emergence of the Bourgeois—The literature of the 18th and 19th centuries in Italy against the historical background marked by the emergence of one of the most important and controversial social classes. In Italian.

4 units, Spr (Braghieri)

173. Impotence in Modern Poetry — An analysis of the reaction of the modern poet to the growing feeling of impotence that characterizes western culture from the period of its fundamental crisis at the end of the 19th century to the present. In Italian.

4 units, Aut (Braghieri) MWF 3:15

174. The Concepts of Chaos, Cosmos and Metamorphosis in Literature — (Same as Comparative Literature 174.) An experimental approach to the history of ideas tracing the concepts of chaos, cosmos, and metamorphosis in ancient literature, in the Renaissance, and in such later writers as Melville, Pirandello, Kafka, Buzzati and Betti. In English.

4 units, Spr (Braghieri)

185. Freud and Marx in Twentieth Century Italian Narrative—Reading and discussion of significant novels reflecting the influence of two of Europe's most important intellectual figures.

4 units, Spr (Leone)

186. The Modern Italian Novel—Reading and discussion of the most significant works of such authors as Svevo, Moravia, Pavese, Vittorini, etc. In Italian.

4 units, Aut (Leone) MWF 2:15

188. Three Forms of Drama—(Same as Comparative Literature 188.) Dramatic form as perceived during three of the major periods of literary history: ancient Greece, the 16th and 17th century, and the modern period. In English.

4 units, Win (Braghieri)

199. Individual Work—Open only to majors in Italian and 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 (Politzer) given 1973–74

**Geography**

Undergraduate courses in Geography will be offered by the Food Research Institute.

**German Studies**

Emeriti: Helmut R. Boeninger, Kurt F. Reinhardt, F. W. Strothmann (Professors)

Chairman: Edgar Lohner


Associate Professor: A. Peter Foulkes

Senior Lecturer: Gertrude Mahrhozl

Assistant Professors: Joachim Bark, Margret Eiffer, John M. Flores, Ann Mason, Ann Snow

Lecturers: Peter R. Frank (Curator, German Collection, Stanford Library), Josef Hustschneider, Ulrike Lieder

**Offerings and Facilities**

The Department accepts candidates for the degree of Bachelor of Arts, Master of Arts, and Doctor of Philosophy. The requirements for these degrees are given below under Programs of Study.

**Master of Arts in Teaching**

The degree of Master of Arts in the Teaching of German is offered jointly by the School of Education and the Department. The program includes 25 units of German in courses selected in consultation with the Department adviser. For a statement of requirements other than German see the section “School of Education” in this bulletin.

**Graduate Program in Humanities**

The Department participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in German and Humanities. Students accepted for this program complete the requirements for a Ph.D. in
German as given below as well as those described in this bulletin under “Humanities Special Programs.”

**Intensive Language Work Abroad**

Each undergraduate student accepted by the Overseas Campuses Program for work at a Stanford center in Germany or Austria may complete up to 12 units of German during the six months of his 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 taken at a center are identified by the number 80 with a second digit indicating the level at which the 12 units were taken. Course identification may vary from 82, the lowest, to 86. A student majoring in German will have the work taken abroad evaluated on his return in terms of the specific degree requirements.

**Stanford Cologne Program**

The University maintains a program in Cologne, Germany, for the benefit of advanced students majoring in German or in such programs as German History, Humanities, Art History, Musicology, etc. To participate at least a B average in German is required. Qualified juniors or seniors majoring in German may enroll for two quarters. While in Cologne, they can complete specific course requirements as well as a number of courses in the elective area. The latter are chosen from courses offered by the Universities of Cologne and Bonn. A.M. candidates and occasional Ph.D. candidates may also take part in the program.

**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 two German courses per quarter. The total requirement for the Bachelor of Arts degree in German is a minimum of 45 units of work beyond the basic first- and second-year courses (1 through 52) or equivalent, except in the area of German Studies, as described below. All majors are required to take the Undergraduate Record Examination.

Students have the opportunity to select any one of four areas of concentration, without, however, 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.”

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 Geistesgeschichte-series and two Senior Seminars.

4. **German Studies**
   
   The aim of this program, which permits maximum flexibility, is to allow the students to plan a more broadly based major than is possible in the other areas of concentration. The student can combine the study of German language and literature with such fields as Art History, Musicology, Political Science, History, Economics, Anthropology, Comparative Literature, etc. The requirements are (a) at least 25 units of German courses beyond the 52 level, (b) at least 25 units of courses outside the Department, but in the Central European field, to be planned and presented to the Department by the student. Every student will participate in at least one Stanford Overseas Program.

Majors in German Studies should formulate their plans in quarterly consultation with the undergraduate major adviser.

**Honors in German**

Majors with a minimum grade average of "B" in German courses are eligible for departmental honors. In addition to requirements listed above, each honors 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, including those in German Studies. 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 final year, he 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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<tr>
<th>Units</th>
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<tbody>
<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>
</tr>
<tr>
<td>Two courses in German thought</td>
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<td><strong>Total</strong></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 or 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 the 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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<tr>
<td>201 and 202. Language and Style</td>
</tr>
<tr>
<td>205. Introduction to Modern German</td>
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<tr>
<td>228. Middle High German</td>
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<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>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Electives chosen from graduate level courses in German or approved courses in related 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 autumn 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 first year, will require research papers.

Three units of Individual Work (course 301) may be used to read, under the supervision of the student's adviser, the "Reading List for Ph.D. Candidates in Literature."

By carefully planning their programs, students may choose a minor by participating 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 and Humanities, German and Comparative Literature, or German and Modern Thought and Literature. Usually such minors 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 autumn 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 and Humanities, German with a minor in Comparative Literature, or German with a minor in Modern Thought and Literature. Usually such programs require more than a total of 9 quarters of course work.

**GENERAL COURSES**

(119A–168A, given in English)

The courses in this section are given in English and do not require a knowledge of German. They are open to all students. German majors taking these courses as a part of their requirements must do the assigned readings in German.

119A. Geography of the German-Speaking Countries — Physical, economic, political, and historical.

3 units, Sum (Lohnes) given at Stanford in Germany

120A. Politics and Literature in East and West Germany—Readings and discussions of important cultural, social, and political trends and issues. Works by Günter Grass, Christa Wolf, and others will be examined as reflections of the socio-political situation of the two Germanies.

3 units, Spr (Eifler) MWF 10

122A. Nietzsche.

3 units (Sokel) given 1973–74

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, Aut (Mason) MWF 1:15

125A. From Realism to the Theater of the Absurd: The Twentieth Century as Presented in Its Theatre—Course will include readings in Ibsen, Chekov, Strindberg, Pirandello, Brecht, Hofmannsthal, Ionesco, Beckett.

4 units, Sum (Lohner) given at Stanford in Austria

126A. Contemporary German Literature.

3 units (Flores) given 1973–74

130A. Brecht and the Modern Drama—The place of Brecht's dramatic theory and practice in the development of the modern drama. Ibsen, Strindberg and Expressionism, Pirandello, Brecht, Beckett and the Theater of the Absurd.

3 units (Flores) given 1973–74

132A. The Existential Quest in the Continental Novel — Reading and discussion of works by Dostoevsky, Rilke, Kafka, Sartre, Camus, and Frisch.

3 units (Sokel) given 1973–74
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 after effects 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

138A. The Problem of Guilt in Post-War Germany.

3 units (Foulkes) given 1973–74

141A. Marx and Freud.

3 units, Win (Flores) MWF 1:15

142A. Poetry and Drama in Hugo von Hofmannsthal.

4 units, Sum (Lohner) given at Stanford in Austria

GERMAN COURSES

UNDERGRADUATE COURSES

(1–199)

First- and second-year language courses are under the direction of Walter F. W. Lohnes.

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)

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 (Lohnes, Staff) MWF 10

Spr (Staff) MWF 10

3V. German Conversation — (For students going to Vienna; open to others.) Prerequisite: 1.

3 units, Win (Schulz, Staff) MWF 10

Spr (Schulz, Staff) MWF 11

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) MTWThF 9

Sum (Staff) MTWThF 9

51. Second-Year German — This course introduces the student to a wide variety of contemporary literary 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, Win (Staff)

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 Austria and 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 (Hutschneider) TTh 11
ADVANCED AND GRADUATE COURSES
(200-299)

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 11

203. Problems of Translating Literature — Enrollment limited to 15. Prerequisites: 84, 85, and 86.
3 units, Sum (Lohnes) given at Stanford

204. History of the German Language.
3 units, Aut (Schuelke) MWF 9

205. Introduction to Modern German — Contrastive analysis of English and German morphology and syntax.
4 units, Win (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 (Lieder) given 1973-74

227. Medieval Thought.
4 units, Aut (Snow) MWF 11

228. Middle High German.
4 units, Aut (Schuelke) MTWTh 10

229. Readings in Middle High German — Prerequisite: 228.
4 units (Staff) given in 1973-74

4 units (Eifler) given 1973-74

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 (Flores) MWF 1:15

242. Deutsche Geistesgeschichte II — Von der Romantik bis Nietzsche.
4 units, Win (Sokel) MWF 2:15

4 units, Spr (Bark) MWF 11

250B. Richard Wagner’s Ring des Nibelungen — Given in English. Prerequisite: 52 or consent of instructor.
4 units, Aut (Hutschneider) TTh 12:15-1:05; W 8-10 p.m.

251. Goethe’s Faust.
4 units (Lohner) given 1973-74

255. Hölderlin.
4 units, Aut (Lohner) M 2:15; Th 2:15-4:05

258. Epic Theater from Büchner to Brecht.
4 units (Sokel) given 1973-74

259. Rilke und Hofmannsthall.
4 units, Win (Mason) MWF 10

261. Kafka.
4 units (Mason) given 1973-74

263. Thomas Mann.
4 units (Eifler) given 1974-75

264. Thomas und Heinrich Mann — Ihre gesellschaftskritische und politische Stellungnahme.
4 units, Spr (Eifler) MWF 9

265. Brecht.
4 units, Aut (Flores) MWF 3:15

4 units (Bark) given 1973-74

275. Deutsche Literatur in Ost und West.
4 units, Win (Flores) MWF 3:15

276. Frisch und Dürrenmatt.
4 units (Eifler) given 1973-74

279. Moderne Lyrik.
4 units (Mueller-Vollmer) given 1973-74

290. Senior Seminar — May be elected by non-majors who have completed three German literature courses. “The” Germans and
102. German Composition — Continuation of 101.
   3 units, Win (Hutschneider) TTh 11

103. Introduction to the Contemporary German Language.
   3 units, Spr (Lohnes) given at Stanford in Germany

105. German Newspapers — Current newspapers from East and West Germany will be read and discussed in German. This course may be repeated once. Prerequisite: 51 or equivalent.
   3 units, Aut (Eifler) MWF 11
   Spr (Hutschneider) 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.
111. Readings in German History — The classical German historians from Winckelmann to Mommsen.
   3 units (Mueller-Vollmer) given 1973–74
112. Readings in German Art History.
   3 units, Win (Snow) MWF 9
113. Readings in German in Political Science.
   3 units (Eifler) given 1973–74
114. Readings in German Psychology.
   3 units (Foulkes) given 1973–74
115. Readings in Twentieth-Century German History.
   3 units, Spr (Mahrholz) MWF 9

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 (Bark) given 1973–74
142. Poetry from Nietzsche to the Present.
   4 units, Spr (Mason) MTWTh 10
143. Drama from Storm and Stress to Expressionism.
   4 units, Aut (Eifler) MWF 9
144. Drama from Expressionism to the Present.
   4 units (Snow) given 1974–75
145. The Novelle.
   4 units, given 1973–74

146. Modern Fiction.
   4 units, given 1973–74

147. Zentren der Kultur.
   4 units, Win (Schulz) MWF 11

   4 units (Eifler) given 1973–74

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 (Mason) MTWTh 10
152. Romanticism and Realism.
   4 units, Win (Snow) MTWTh 10
153. From Naturalism to the Present.
   4 units, Spr (Mason) 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, Win (Bark) MWF 11

161T. Translation of Texts in the Social Sciences.
   3 units, Aut (Lieder) by arrangement
162T. Translation of Texts in the Social Sciences.
   3 units, Win (Lieder) by arrangement
163T. Documentary Translation.
   3 units, Spr (Lieder) by arrangement
190. Thomas Mann and Politics — Enrollment limited to 15.
   3 units, Spr (Lohnes) given at Stanford in Germany.

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
“the” Americans: Cultural interchange, stereotypes, and prejudices.
4 units, Spr (Frank) T 3:15–5:05

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

299C. Individual Work — Exclusively for Cologne and Bonn University courses completed by undergraduate students in the Stanford Cologne Program.
1 to 8 units, Aut, Win (Staff) by arrangement

GRADUATE COURSES
(300–400)

300. Proseminar.
4 units, Aut (Bark, Frank) T 2:15–4:05

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

301C. Individual Work — Exclusively for Cologne and Bonn University courses completed by graduate students in the Stanford Cologne 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, Aut (Lohnes) TTh 11

303. Curricular Problems — Given on request only.
3 units (Lohnes) by arrangement

304T, 305T, 306T. Advanced Documentary Translation—Texts will be taken from the fields of business, economics, law, science, and technology. Interpreting of bilingual conversations and negotiations will also be included.
Given in 1973–74

307T. Interpretation — Interpretation of conversations and negotiations; introduction to consecutive interpretation; continuation of note-taking systems; conference terminology and parliamentary procedure; writing of reports and précis.
Given in 1973–74

308T. Interpretation — Continuation of 307T, with the addition of simultaneous interpretation.
Given in 1973–74

309T. Interpretation — Continuation of 308T.
Given in 1973–74

312. Old Norse — Introduction to the language; reading of selected texts.
4 units, Win (Schuelke) MTWTh 10

313. Old Icelandic Sagas — Study of the sagas; reading of one or more in the original. Prerequisite: 312.
4 units, Spr (Schuelke) MTWTh 10

314. Old High German and Old Saxon — Introduction to the early documents of High and Low German.
4 units (Snow) given 1974–75

319. Early New High German — Introduction to the language and literature 1350–1600. Prerequisite: 228.
4 units, Spr (Schuelke) TTh 2:15–4:05

322. Recent Developments in German Linguistics.
4 units (Lohnes) given 1973–74

325. Seminar — All seminars dealing with linguistic or philological problems will be listed under this number. The topics will be announced.

GERMAN LITERATURE (326–350) (See also Courses 228 and 313.)

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 1973–74

329. Gottfried von Strassburg — Prerequisite: 228.
4 units (Snow) given 1973–74

330. Einführung in das Studium der mittelalterlichen Literatur.
4 units, Win (Bumke) MWF 1:15
4 units (Snow) given 1974-75

335. Drama des Barock.  
4 units (Lohner) given 1973-74

340. Der klassische und der späte Goethe.  
4 units (Lohner) given 1973-74

341. Schiller — Das dramatische Werk im Zusammenhang mit den philosophischen und ästhetischen Schriften Schillers.  
4 units (Lohner) given 1973-74

342. Colloquium: Modern Lyric Poetry from Baudelaire to Benn — Discussions of the theory and interpretation of poems by Baudelaire, Mallarmé, Rimbaud, Poe, Whitman, Pound, Stevens, Yeats, Dario, Alberti, Nietzsche, Trakl, Benn. The objectives of the colloquium are three-fold: to analyze the theoretical assumptions of these poets; to increase, by encouraging close reading, the students’ appreciation of modern poetry and to make them aware of the rigorous methods of interpretation.  
4 units, Win (Lohner) Th 4:15-6:05

342B. Colloquium—Continuation of 342.  
4 units, Spr (Lohner) Th 4:15-6:05

343. Realism in Nineteenth-Century European Fiction—(Same as Comparative Literature 343.)  
4 units, Win (Sokel) given 1973-74

345. Readings in Nineteenth-Century Literature.  
4 units, Spr (Foulkes) given 1973-74

4 units, Spr (Sokel) MWF 1:15

349. Methodenlehre der Literaturwissenschaft — (Same as Comparative Literature 349.)  
4 units (Mueller-Vollmer) given 1973-74

350. Seminars — All seminars dealing primarily with creative literature will be listed under this number. These seminars may also be taken as colloquia.  

4 units, Win (Bumke) T 2:15-4:05

350C. Kafka—(Same as Comparative Literature 350C.)  
4 units, Win (Sokel) Th 2:15-4:05

350D. Iwein.  
4 units, Spr (Snow) W 2:15-4:05

GERMAN THOUGHT AND LITERATURE (351-400)

351. German Literature—Problems in Interpretation.  
4 units, Win (Bark) by arrangement

4 units (Bark) given 1973-74

380. The Poetic Revolution of the Latter Eighteenth Century: Sturm und Drang in Its European Context—(Same as Comparative Literature 380.)  
4 units (Sokel) given 1973-74

382. Die Romantik — (Same as Modern Thought and Literature 374.)  
4 units (Mueller-Vollmer) given 1973-74

400. Seminars—All seminars in this group will be listed under this number. The topics will be announced.

400B. Humboldt and Structuralism — (Same as Comparative Literature 400B and Modern Thought and Literature 375.) A close study of Humboldt’s writings on linguistics and the nature of language and their relation to modern structuralism. It is the aim of the seminar to examine critically the notion of structure and the limits of its applicability in literary studies. Taught in English. Readings in German.  
4 units (Mueller-Vollmer) given 1973-74

HISTORY


Chairman: Gordon A. Craig


Assistant Professors: Frederick P. Bowser, Kennell A. Jackson, Jr., Paul Robinson, Joyce Ross. Acting: Alan E. Bernstein, Richard Gillam

Instructors: John W. Coffey, John T. Evans, Simon R. Green, Howard S. Rosen

Lecturers: Margot Drekmeier, George S. Rentz, Stephen Stein. Visiting: Ingrid Thienel (autumn and winter quarters, 1972-73)

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 his duties as a citizen and to give him instruction which will aid him 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 the student to concentrate his 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. Only two civilization courses, e.g. African Civilizations, East Asian Civilizations, Western Civilization may be counted toward the total of twelve courses. 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.

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 his duties as a citizen and to give him instruction which will aid him 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.

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

(Note—The Cory and Riotte scholarships are available for women students in the Department.)
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 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 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 Birdsall Weter prizes may be awarded each year to students who submit outstanding essays.

**HISTORY IN THE SECONDARY TEACHER'S CREDENTIAL**

Applicants for the Stanford Secondary Teacher's Credential in the social studies may get details of the requirements by applying to the Credential Secretary, School of Education.

**CO-TERMINAL A.B. AND A.M. PROGRAM IN HISTORY**

The Department admits each year a limited number of undergraduate History majors to work for a co-terminal A.B. and A.M. degree in History. Applications for admission to this program should be submitted during the Spring Quarter of the student's junior year and must be submitted no later than November 1 of his senior year. Applicants will be screened by a committee of three members of the History Department faculty, including the Director of Graduate Study. The students must meet all requirements for both degrees. He must complete 15 full-time quarters (or the equivalent) or 3 full quarters after completing 180 units for a total of 216 units. During his senior year he may, with the consent of the instructors, register for as many as two graduate courses. During his final year of study he 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.

A student who has been admitted to graduate standing does not automatically become a candidate for a graduate degree, but when he is admitted, it is with the expectation that he will be working toward a Doctor of Philosophy degree, and that he may become a candidate to receive a Master of Arts degree at the end of his first or second year of graduate study.

**MASTER OF ARTS**

The Department requires the completion of nine courses (totaling 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 have 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 student will have a member of the department designated as his adviser and he should plan his program in consultation with this adviser. During the first two years of graduate study, the student will spend much of his time taking courses, but he should be aware from the outset that the ultimate objective of his work is not merely the completion of courses, but the preparation for general examinations and for writing a dissertation.

The student’s 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. An applicant for the doctoral program must proceed by two steps: First, he must apply for admission to (not candidacy in) the Ph.D. program. Students 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 applicant shall be admitted to the Ph.D. program or that he must terminate his work in History at Stanford.

Second, after admission to the program and after the completion of certain further requirements, the student must apply for acceptance for candidacy for the doctorate in the Graduate Division of the University. The student must meet the following requirements:

1. He must select, in consultation with his adviser, a major field of study from the list below in which he will concentrate his study and in which he will 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 his first year of graduate study, the student will normally enroll in the core colloquium in his major field.

3. The student is required to take two research seminars, at least one in his major field. Normally, research seminars should be taken in the second year.

4. The student, in consultation with his adviser, defines 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 1845
- Russia to 1800
- Eastern Europe to 1800
- Russia since 1800
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, a student 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 student in consultation with his 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 student may take the general examination in his major field.

(5) Each student should plan in consultation with his 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 student’s technical competence as historian or broaden his approach to the problems of his research field.

(6) Each student, before the Ph.D. is conferred, is required to teach for one quarter a small class of undergraduates. Normally this will be done in the third graduate year, and, normally, it will consist of leading two weekly discussion sections in a course given by a faculty member.

(7) There is no university or departmental foreign language requirement for the Ph.D. degree. A reading knowledge of one or more foreign languages is required in fields where appropriate. The faculty in the major field prescribes the necessary languages. In no field will a student be required to take examinations in more than two foreign languages; and examinations, administered by the appropriate language departments, must be passed before taking the oral examination in the major field.

(8) The student is expected to take the University oral examination in his major field early in his third graduate year.

(9) He 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.

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 to him. 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

EUROPEAN SOCIETY AND CULTURE

The staff of the European Society and Culture program offers a variety of courses to provide freshmen with an understanding of the historical development of values and institutions in the Western world. We regard the past not as a collection of facts, but as a vantage point from which we can gain insight and perspective. In this way, history, as the record of man's thought, action, and feeling, is an important source of knowledge of ourselves. Requiring no particular background in history, these courses are designed for non-history majors as well as potential history majors. They will be limited in size to facilitate personal contact among faculty and students. Each course is offered independently and does not have to be taken in any particular sequence.

5. The Emergence of Western Civilization.
   5 units, Aut (Green)

6. The Religious and Philosophical Foundations of Western Civilization.
   5 units, Aut (Coffey)

Thematic approaches to the basis of European society in the ancient world, with emphasis on the Judaeo-Christian and Greco-Roman traditions. (Students who have taken History 1 or its equivalent will not receive credit for either of these courses; credit will be given for only one of these two.)

10. Aspects of European Intellectual History, 300–1789.
    5 units, Aut (Evans)

    5 units, Aut (Green)

15. Religious and Philosophical Currents of Thought from the Medieval Era to the Enlightenment.
    5 units, Win (Coffey)

Thematic approaches to the development of Western civilization from the Middle Ages to the eve of the French Revolution. (Students who have taken History 2 or its equivalent will not receive credit for any of these courses; credit will be given for only one of these three.)

16. Historical Conceptions of Progress, 1750 to the Present.
    5 units, Aut (Evans)

17. Aspects of Western Thought Since the Enlightenment.
    5 units, Spr (Coffey)

18. Consciousness and Society, 1789 to the Present.
    5 units, Spr (Rosen)
19. Major Intellectual Currents in the Western World Since the Enlightenment.
   5 units, Win, Spr (Green)
   Thematic approaches to the history of Western civilization from the French Revolution to the present. (Students who have taken History 3 or its equivalent will not receive credit for any of these courses; credit will be given for only one of these four.)

24C. Undergraduate Colloquium: Paris in French History.
   5 units, Win (Rosen)

25C. Undergraduate Colloquium: Modern Europe as Seen Through the Eyes of the Novelist.
   5 units, Win (Green)

27C. Undergraduate Colloquium: The Worlds of Thomas More and Henry VIII.
   5 units, Win (Evans)
   For a more detailed description of these courses, see Approaching Stanford, and the Time Schedule for each quarter.

32. 20th Century Europe — Introductory survey of major trends and problems. Lectures and discussion groups.
   5 units, Aut (Wright)

91. History of East Asian Civilizations.
   5 units, Aut (Kahn, Staff)

92. History of East Asian Civilizations.
   5 units, Win (Kahn, 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 102, 103, 112, 113, 160, 261, 262, all of which are accepted for credit toward a major in history.

MEDIUM AND RENAISSANCE EUROPE

105. The Emergence of Medieval Europe.
   4 units (Bark) given 1973-74

106. Medieval Universities.
   5 units, Spr (A. Bernstein)

107A. Medieval Civilization, 1050–1450.
   4 to 5 units, Win (A. Bernstein)

   5 units (Langmuir) given 1973-74

109A. Renaissance Society and Culture — (Same as Humanities Special Programs 109A.) Civic life and humanism from the 14th century 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, Win (Spitz, Forster, Ryan)
   MTWTh 10

109B. Renaissance Society and Culture — (Same as Humanities Special Programs 109B.) Protestant reform and the high Renaissance in Germany, France, Italy, and England.
   5 units, Spr (Spitz, Forster, Ryan)
   MTWTh 10

110. Age of the Reformation.
   5 units, Aut (Spitz)

112. Representative Protestant Thinkers.
   4 to 5 units, Win (Pauck)

MODERN EUROPE

118A,B. Russian Intellectual History — (Same as Slavic Languages and Literatures 118A,B and Comparative Literature 118A, B.)
   8 units, Aut, Win (Brown, Emmons)
   given 1973-74

120A. Russia to 1700.
   5 units, Aut (Boss)

120B. Russia, 1700–1917.
   5 units, Win (Boss)

123A. The Soviet Union: Politics and Society Since 1917— (Same as Political Science 119A.)
   5 units, Spr (Dallin) MTWTh 10

123B. International Communism: From the First International to the Present.
   5 units, Aut (Dallin)

126B. The Balkans Since 1800.
   4 to 5 units, Win (Vucinich)

128. Central Europe in the Nineteenth Century.
   4 to 5 units, Win (Craig)
SCHOOL OF HUMANITIES AND SCIENCES

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<td>128A</td>
<td>War and Society.</td>
<td>5</td>
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<td>129</td>
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<td>Europe from the Time of Newton to the French Revolution.</td>
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<td>130</td>
<td>The Old Régime in France (1589–1770).</td>
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<td>Post-Revolutionary France, 1810–51.</td>
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<td>132A</td>
<td>The Industrial Revolution in the Western World, Eighteenth to Twentieth Centuries.</td>
<td>4-5</td>
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<td>133A,B</td>
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<td>134C</td>
<td>How Nations Deal with Each Other.</td>
<td>5</td>
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<td>135A,B</td>
<td>The History of West Africa.</td>
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<td>European Intellectual History in the Nineteenth Century.</td>
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<td>137A,B</td>
<td>Problems of Arms Control and Disarmament.—(Same as Political Science 138A, B.)</td>
<td>5</td>
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<td>138A,B</td>
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AFRICA

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<td>4-5</td>
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<td>142A,B</td>
<td>The History of West Africa.</td>
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THE UNITED STATES

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<td>The Slavery Issue in American Politics, 1770–1860.</td>
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<td>Black Community and Leadership, 1739–1877.</td>
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<td>151</td>
<td>American Social History to 1860.</td>
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<td>153</td>
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<td>154</td>
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THE BRITISH COMMONWEALTH AND EMPIRE

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<td>156</td>
<td>Yorkist and Tudor England.</td>
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<td>Stuart England.</td>
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<td>The Revolution, Confederation and Constitution.</td>
<td>4-5</td>
<td>Win</td>
<td>Miller</td>
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<td>152A,B</td>
<td>The Slavery Issue in American Politics, 1770–1860.</td>
<td>4-5</td>
<td>Win</td>
<td>Channing</td>
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<td>Social Thought in America.</td>
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<td>The Old South.</td>
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<td>Spr</td>
<td>Gillam</td>
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<td>American Social History to 1860.</td>
<td>4-5</td>
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<td>159</td>
<td>American Social History 1860–1970.</td>
<td>4-5</td>
<td>B. Bernstein</td>
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<td>The United States, 1877–1929.</td>
<td>4-5</td>
<td>Win</td>
<td>Gillam</td>
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<td>161</td>
<td>The United States, 1929–Present.</td>
<td>4-5</td>
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<td>B. Bernstein</td>
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LATIN AMERICA
176. Latin America to 1825.
4 to 5 units, Aut (Bowser)
177. Modern Latin America.
4 to 5 units, Spr (Stein)
179. History of Modern Mexico.
4 units, Aut (Flores)
5 units, Win (Wirth)
181. Contemporary Brazil.
4 to 5 units, Spr (Wirth)
182. Latin America and the African.
4 to 5 units, Win (Bowser)

MIDDLE EAST
186. Ottoman Empire.
4 to 5 units (Vucinich) given 1973–74
3 to 5 units (Rentz) given 1974–75
3 to 5 units, Spr (Rentz)
3 to 5 units (Rentz) given 1973–74

EAST ASIA
191. Aspects of Late Traditional Chinese History.
4 to 5 units, Win (Kahn)
192. Modern China.
4 to 5 units, Win (Witke)
193. Intellectual Trends in Modern China.
4 to 5 units, Spr (Witke)
196A. China and the United States.
4 to 5 units (Van Slyke) given 1973–74

UNDERGRADUATE SEMINARS AND COLLOQUIA
During 1972–73, 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 1972–73. 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 will write a research paper based to a substantial degree upon original sources. In doing so, he has the opportunity to learn how historians arrive at their conclusions, as well as what the results of their work are. In this sense, the subject matter handled in any given seminar is less important than the process of investigation, analysis, and writing. “How do you know?” becomes more important than “What do you know?” (See Time Schedule each quarter for a more detailed listing.)

Courses numbered 200 through 299 (undergraduate seminars and colloquia) are designed primarily for juniors and seniors majoring in history. Requests for admission to seminars and colloquia involve permission of the instructor.

Courses in senior research are intended primarily (though not exclusively) for Honors candidates engaged in writing senior theses.

200. Honors Reading Course in Comparative History.
5 units each for two quarters, Aut, Win, Spr (Staff) by arrangement
5 units (Bark) given 1973–74
207. Undergraduate Colloquium: Medieval History by Medieval Men.
5 units, Win (A. Bernstein)
208. Undergraduate Colloquium: The Christianization of Europe.
5 units (Langmuir) given 1973–74
210. Undergraduate Colloquium: Renaissance Humanism and Reform.
5 units, Spr (Spitz)
215H. Senior Honors: Research in Medieval History.
1 to 5 units (Staff) by arrangement
217H. Senior Honors: Research in Renaissance-Reformation History.
1 to 5 units (Staff) by arrangement
219S. Undergraduate Seminar: Soviet Politics and Society Since 1917—(Same as Political Science 126B.)
5 units, Aut (Dallin) T 2:15–4:05
220. Undergraduate Colloquium: Russian History.
   5 units, Spr (Boss)

221. Undergraduate Colloquium: Medieval Russia.
   5 units (Emmons) given 1973-74

224A. Undergraduate Colloquium: Resistance Movements in the Second World War.
   5 units, Spr (Vucinich)

229. Undergraduate Colloquium: Politics, Society, and Art in Modern European History—(Same as Modern Thought and Literature 229.)
   5 units, Spr (Craig, Paret)

231S. Undergraduate Seminar: Social History Research.
   5 units, Aut (Dawson)

232A. Undergraduate Colloquium: Political, Social, and Economic Problems in Twentieth Century France.
   5 units, Aut (Fohlen)

   5 units, Win (Thienel) Th 2:15-4:05

234. Undergraduate Colloquium: The Child in History.
   5 units, Aut (M. Drekmeier)

234S. Undergraduate Seminar: Good and Evil in the Age of Reason.
   5 units, Win (M. Drekmeier)

236. Undergraduate Colloquium: European Socialisms in the Nineteenth and Twentieth Centuries.
   5 units, Spr (Wright)

237. Undergraduate Colloquium: Modern Sexual Thought.
   5 units, Aut (Robinson)

237S. Undergraduate Seminar: Psychology and History.
   5 units, Spr (Robinson)

239H. Senior Honors: Research in Modern European History.
   1 to 5 units (Staff) by arrangement

   5 units, Spr (Seaver)

242. Undergraduate Colloquium: Research in Local English Archives.
   5 units, Win (Seaver)

243. Undergraduate Colloquium: Fiction and English Society.
   5 units, Spr (Stansky)

244. Undergraduate Colloquium: The Culture of England, 1890–1914—(Same as English 218A, Comparative Literature 218A, and Modern Thought and Literature 218A.)
   5 units, Win (Felstiner, Stansky)

246H. Senior Honors: Research in British History.
   1 to 5 units (Staff) by arrangement

   5 units, Aut (Jackson)

249H. Senior Honors: Research in African History.
   1 to 5 units (Staff) by arrangement

   5 units, Win (Miller)

253S. Undergraduate Seminar: Political Culture in the Early National Period.
   5 units, Spr (Channing)

257. Undergraduate Colloquium: The Black Ghetto in the Twentieth Century.
   5 units, Spr (Ross)

258. Undergraduate Colloquium: Slavery in the New World.
   5 units, Spr (Channing)

259. Undergraduate Colloquium: The Presidency from Washington to Lincoln.
   5 units, Aut (Fehrenbacher)

   5 units, Aut (Gillam)

268. Undergraduate Colloquium: The Shaping of Twentieth Century America.
   5 units, Aut (B. Bernstein)

269S. Undergraduate Seminar: The Cold War.
   5 units, Win (B. Bernstein)

270. Undergraduate Colloquium: Twentieth Century American Imperialism—The course will consider theories of imperialism and examine particular cases of American
imperialism (colonialism and neo-colonialism). In addition, the course will focus upon theories of power, ideology, and consensus, investigate problems of bureaucracy and decision-making, and examine the sources and nature of anti-imperialism.

5 units (B. Bernstein) given 1973–74

275H. Senior Honors: Research in United States History.

1 to 5 units (Staff) by arrangement


5 units (Johnson) given 1973–74

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)

283. Undergraduate Colloquium: Comparative Populist Movements in Latin America Since 1930.

5 units, Spr (Stein)

285H. Senior Honors: Research in Latin American History.

1 to 5 units (Staff) by arrangement

286. Undergraduate Colloquium: Topics in Byzantine Civilization.

5 units, Win (Vucinich)

290. Undergraduate Colloquium: Peasant Rebellion in Pre-Modern China and Europe.

5 units, Spr (Kahn)

292. Undergraduate Colloquium: Youth and Change in Modern China.

5 units, Aut (Witke)


5 units (Van Slyke) given 1973–74

299H. Senior Honors: Research in Far Eastern History.

1 to 5 units (Staff) 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


5 units, Aut (Bowser)

306. Graduate Colloquium: Topics in Medieval History.

5 units (Langmuir) given 1973–74

314D. Directed Reading in Medieval History.

Units by arrangement (Staff)

315H. Research Techniques in Medieval History.

5 units, Aut (A. Bernstein)

316D. Directed Reading in Renaissance and Reformation.

Units by arrangement (Staff)

317H. Graduate Research in Renaissance and Reformation.

Units by arrangement (Staff)

319. Graduate Colloquium: Humanism and the Reformation.

5 units, Aut (Spitz)

320. Graduate Colloquium: Historical Patterns of Urbanization in Europe in the Nineteenth and Twentieth Centuries.

5 units, Aut (Thienel) W 2:15–4:05

322A. Graduate Colloquium: Non-Russian Peoples of the Soviet Union.

5 units (Vucinich) given 1973–74

323B. Graduate Colloquium: Russian History.

5 units, Spr (Boss)

329A. Graduate Colloquium: The History of Military Thought, Institutions, and Policy.

5 units, Spr (Paret)
338. Graduate Colloquium: Social History—Community and Class.
5 units, Spr (Dawson)

334. Graduate Colloquium: Approaches to the Study of the Enlightenment.
5 units, Spr (M. Drekmeier)

336. Graduate Colloquium: Latin Europe, Nineteenth and Twentieth Centuries.
5 units, Win (Wright)

337. Graduate Colloquium: Modern European Intellectual History—(Same as Modern Thought and Literature 337.)
5 units, Aut (Robinson)

338D. Directed Reading in Modern European History.
Units by arrangement (Staff)

339H. Graduate Research in Modern European History.
Units by arrangement (Staff)

341. Graduate Colloquium: Topics in Tudor and Stuart England.
5 units, Aut (Seaver)

345D. Directed Reading in British History.
Units by arrangement (Staff)

346H. Graduate Research in British History.
Units by arrangement (Staff)

348B. Graduate Core Colloquium: The Interpretation of African History.
5 units, Aut (Jackson)

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 (Staff)

374D. Directed Reading in United States History.
Units by arrangement (Staff)

375H. Graduate Research in United States History.
Units by arrangement (Staff)

376. Graduate Colloquium: New Findings in American History—(Open only to Coe Fellows.)
6 units, Sum (Pease)

377. Graduate Colloquium: Topics in Modern Mexican History.
5 units, Aut (Flores)

380. Graduate Colloquium: Latin American History.
5 units, Aut (Wirth)

384D. Directed Reading in Latin American History.
Units by arrangement (Staff)

385H. Graduate Research in Latin American History.
Units by arrangement (Staff)

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 (Witke)

398D. Directed Reading in Far Eastern History.
Units by arrangement (Staff)

399H. Graduate Research in Far Eastern History.
Units by arrangement (Staff)

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.

4 to 5 units, Spr (Tyack) by arrangement

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)

421B. Graduate Seminar in Russian History.
5 units, Win (Boss)
427. Graduate Seminar: Topics in Modern European History.
   5 units, Aut (Craig)
429. Graduate Seminar: Napoleonic and Restoration Europe.
   5 units, Win (Paret)
   10 units, Aut, Win (Dawson)
440. Graduate Seminar in Medieval History.
   5 units (Langmuir) given 1973–74
   5 units, Win (Stansky)
447B. Graduate Seminar: Field Work in African History.
   5 units, Win (Jackson)
   5 units, Spr (Miller)
   5 units, Spr (Ross)
454. Graduate Seminar: American Liberalism from Progressivism to the Cold War.
   10 units, Aut, Win (B. Bernstein)
467. Graduate Seminar: Recent American Intellectual History.
   10 units, Aut, Win (Gillam)
   5 units (Kennedy) given 1973–74
490. Graduate Seminar in Modern Latin American History.
   5 units, Win (Wirth)
   5 units, Spr (Bowser)
489. Graduate Seminar in Chinese History: The Ch'ing Period.
   5 units, Spr (Kahn)
490. Graduate Seminar in the History of Modern China: The Republican Period.
   5 units, Spr (Witke)

HUMANITIES SPECIAL PROGRAMS

Emeriti: John W. Dodds, Paul H. Kocher, Jeffery Smith, F. W. Strothmann (German Studies) (Professors)
Chairman: William A. Clebsch
Professors: Robert M. Brown (Religion), William A. Clebsch (Religion and Humanities), Edwin M. Good (Religion; University Fellow), Philip H. Rhinelander (Philosophy and Humanities), Lawrence V. Ryan (English and Humanities). Visiting: Wilhelm Fauck (Religion) (winter quarter, 1973)
Associate Professor: Lawrence V. Berman (Religion)
Assistant Professors: Winston B. Davis (Religion), Jerry A. Irish (Religion) (on leave spring quarter, 1973), Nancy R. Lethcoe (Religion), Mary K. Wakeman (Religion), Lee H. Yearley (Religion) (on leave winter and spring quarters, 1973). Visiting: Robert E. McGinn (Humanities)

Humanities Special Programs include:
1. Experimental Courses
2. Honors Program in Humanities
3. Graduate Program in Humanities
4. Religious Studies Program

EXPERIMENTAL COURSES

See also listings under Values, Technology, and Society (pp. 540–43).
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, Win (Ryan, Forster, Spitz)
   MTWTh 10
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, Spr (Ryan, Forster, Spitz)
   MTWTh 10
158. **The Philosophy of Sartre** — Critical study of Sartre's philosophical thought, including *L'Étre et le Néant* and *Critique de la Raison Dialectique*. Attention will also be given to the relation of this thought to Sartre's life and its reflection in certain of his literary works (e.g., *La Nausée*). In English.

*5 units, Spr (McGinn) MW 3:15–5:05*

**HONORS PROGRAM IN HUMANITIES**

*Committee in Charge: William A. Clebsch (Director), Philip Dawson, John W. Dodds, Mark Edwards, David Halliburton, Robert E. McGinn, Walter Sokel*

**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.

A student who is admitted to the Program may enroll as a Humanities major:

1. If he is taking the pre-medical curriculum
2. If he chooses a major in Humanities concentrating in one of the following:
   (a) American Studies
   (b) Comparative Literature (see p. 251)
   (c) Religious Studies (see p. 342)
3. If he is 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. 251.)

   *5 units, Spr (McGinn) MW 3:15–5:05*

2. Two Humanities Seminars in the series 190–196—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**—Rousseau, *Faust*, Stendhal, Büchner, Flaubert, Dostoevsky, Nietzsche, Kafka, Lawrence, Beckett.

*5 units, Spr (Sokel, Staff) MW 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*

**190–196. 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.

**190. The Humanities in Western Thought and Literature** — Prerequisites: Humanities 61, 62, and 63.

*5 units (Evans) given 1973–74*
191. History and the Humanities.  
5 units, Win (Rhinelander) by arrangement.

192. Fine Arts and the Humanities.  
5 units, Aut (Smith) by arrangement.

193. Philosophy and the Humanities.  
5 units, Aut (McGinn) by arrangement.

194. Literature and the Humanities — (Same as Comparative Literature 194.)  
The critical study of major texts; theory and practice of criticism.  
5 units, Win (Foster) by arrangement.

5 units, Aut (Clebsch) by arrangement.

5 units, Win (Wakeman) by arrangement.

12 units (Staff) by arrangement.

Graduate Program in Humanities

Committee in Charge: William A. Clebsch (Director), William C. Calin, Robert E. McGinn, David S. Nivison, Lawrence V. Ryan, Lee H. Yearley

The Graduate Program in Humanities supplements the Ph.D. programs of certain Stanford students, especially in Classics, Comparative Literature, 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 have been accepted for graduate work by a Ph.D.-granting program or department at Stanford, and their applications must have been approved by the Committee in Charge.

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, informal Humanities Colloquium for at least one academic year.

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 (Rhinelander) MW 2:15–4:05

253. The Idea of a University — Study of
the nature, aims and development of universities and of crucial issues in contemporary higher education. Authors read will include Newman, Haskins, Ortega y Gasset, Hutchins, Goodman, Maritain, Roszak, and others. Open to graduate and advanced undergraduate students and to others with the consent of the instructor.

4 units (Ryan) given 1973-74

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 (Rhinelander) TTh 4:15-6:05

302. The Roman and Early Christian Period.
4 units, Win (Raubitschek) TTh 4:15-6:05

303. The Middle Ages.
4 units, Spr (Colin) 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 (Strothmann) MW 4:15-6:05

306. Modernism and the Consciousness of the Humanities—Normally taken after completion of 301-305.
4 units, Spr (Halliburton) MW 4:15-6:05

**Religious Studies Program**

The Religious Studies Program provides the student with knowledge of religion as a phenomenon of human life. 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.

**Undergraduate Major**

A limited number of students taking the Honors Program in Humanities may declare majors in Humanities with concentration in Religious Studies. The declaration is made only after the student has planned, in consultation with a Religious Studies faculty member (who must submit the plan to the Religious Studies faculty for approval and for any subsequent alteration), a 40-unit concentration in Religious Studies, including any corollary courses in other departments. Application and presentation of the plan should be made early in the sophomore year, and in no case later than the first week of the first quarter of the junior year.

The plan should include a range of courses involving various modes of the study of religion, and should comprise a coherent scheme of studying a particular aspect of religion.

Normally the plan will be related to the subject of the student's Honors Essay in Humanities.

Each student who majors in Humanities with Concentration in Religious Studies shall enroll in Humanities 196 as one of the junior-year seminars in the Humanities.

**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:** 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. He will be expected to offer at least 90 units of graduate work in addition to his dissertation, of which at least the last 60 units must be taken at Stanford.

**Field of Study:** The Program, relying in part on other graduate offerings in the University, offers specialized work in the humanistic study of religions in the following fields of concentration: classical religious literature, Near Eastern religions, medieval religious thought, Western religious thought, modern theology, Far Eastern religions.

**Courses:** Each student plans his work subject to the approval of a faculty member designated as his adviser. One advanced seminar in preparation for each part of the second-year preliminary examinations must be completed satisfactorily before those examinations are taken.

**Examinations:** Written preliminary examinations are set for all students at the begin-
ning of their third 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 the student's ability to approach his field of concentration in the following ways: exegesis of religious literature; the history of religious movements; the religious thought of three thinkers; the comparison of religions. A student may petition to substitute a group of approved courses for at most one of the four examinations. The preliminary examinations may be taken no more than twice, and are taken by the end of the third year of graduate study. After passing these examinations, the student applies for degree candidacy.

The University oral examination is normally taken in the spring quarter of the third year.

Dissertation: After passing the preliminary examinations, the candidate engages in a colloquium on his proposed dissertation topic, demonstrating his readiness to proceed with the dissertation. An acceptable dissertation must be a contribution to the humanistic study of religion and be written in acceptable English style. The dissertation is written under the direction of the candidate's sponsor and at least two other members of the faculty, at least one of whom shall be a member of another department.

Language requirements: All candidates for the Ph.D. degree must demonstrate by examination a reading knowledge of German and French before beginning the second full year of graduate work at Stanford. Before the written preliminary examinations, each candidate must demonstrate a reading knowledge of some other ancient or modern language if especially relevant to the field of concentration. Use of additional languages may be required for some areas of concentration and dissertations.

Supporting programs: A coherent and substantial supporting program shall be taken in advanced and graduate courses in other departments of the University.

JOINT PH.D. IN RELIGIOUS STUDIES AND HUMANITIES

The Program in 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 of "Humanities Special Programs" in this bulletin.

COURSES

(Courses numbered 10–99 are suitable for all undergraduates.)


5 units (Good) given 1973–74

18. Confucianism and Taoism—Concentration on writings from the classic period: Confucius, Mencius, the Tao Te Ching, the Chuang Tzu, and others.

5 units, Aut (Yearley) MTWTh 10

23. Christian Theology since the Enlightenment.

5 units (Irish) given 1973–74

32. American Religion — Religious movements and thinkers of various periods; the rise of religious pluralism.

5 units (Clebsch) given 1973–74

34. Judaism — The main currents of Talmudic and post-Talmudic Jewish thought: Midrash, Mishnah, and Talmud; the codification of the law; Karaism; theology and philosophy; Kabbalah and Hasidism.

5 units, Spr (Berman) MTWTh 11

35. Islam — The fundamental elements of Islamic thought: analysis of the Koran; the traditional literature; basic concepts of law; sects; theology and philosophy; mysticism.

5 units, Spr (Berman) MTWTh 11

38. Christianity — Major historic types of Christian religiousness: martyr, ascetic, prelate, mystic, theologian, virtuoso, apologist, activist. Study of the life and experience of an exemplar of each type; evaluation of their practicability in the modern world.

5 units, Win (Clebsch) MTWTh 10

41. Contemporary Trends in Religious Thought—Examination of the thought of present-day theologians such as Barth, Bultmann, Buber, Tillich, Teilhard de Chardin, Bonhoeffer, and Rahner, through study of their own writings.

5 units, Aut (Brown) MTWTh 9

51. Jesus in the Gospels—An examination of the varying interpretations of Jesus and
his teaching as they are found in the synoptic and Johannine materials.

5 units, Aut (Brown) MTWTh 11

54. Christian Ethics—The ethics of such figures as Augustine, Aquinas, Calvin, Kant, Rauschenbusch, and Niebuhr, examined in theological context and as employed in decision-making.

5 units, Win (Brown) MTWTh 11

61. Christian Theology — A systematic examination of the major topics of Christian thought, presented in ecumenical perspective.

5 units (Brown) given 1973–74

72. Theology and Contemporary Literature—Theological issues raised by contemporary writers, such as Auden, Beckett, Camus, Greene, Silone, Warren, and others.

5 units (Wakeman) MTWTh 9

81. The Comparative Study of Religions—The nature and variety of religion; interpretations by certain formative comparativists.

5 units (Yearley) given 1973–74

85. Myths of the Ancient World — Cultural and religious uses of myth and motifs such as creation, death and resurrection, fertility, cosmic struggle, as they appear in various types of literature; material from Mesopotamian, Egyptian, Canaanite, Anatolian, and Greek settings.

5 units, Win (Wakeman) MTWTh 9

86. Hinduism—The history of thought and practice in the “great tradition” of India; selected Hindu scriptures.

5 units (Staff) given 1973–74

87. Buddhism — The history of Buddhist thought and practice; selected scriptures.

5 units (Staff)

88. Indian Buddhism—The history of Buddhist thought and practice in India; selected texts.

5 units, Aut (Lethcoe) MTWTh 1:15

89. Chinese Buddhism—The history of Chinese Buddhist thought and practice; selected texts.

5 units, Win (Lethcoe) MTWTh 10

91. History and Structure of Japanese Religion—Historical and structural analysis of religious life in Japan: types of Shintoism, Buddhist sects, Confucian schools; religious outlook of the folk, the dispossessed, the court, and the learned.

5 units, Spr (Davis) MTWTh 9

92. Religion in Japan—The development of a religio-political order from shamanistic and tribal leadership to the emperor-system of modern, pre-war Japan. The relationship between sacrality, power and authority in the history of Japan.

5 units, Win (Davis) MTWTh 9

(Courses numbered 100–199 are suitable for undergraduates at 5 units and for graduates at 4 units.)

100A,B. Hebrew—Introduction to classical Hebrew language.

100A. 5 units, Win (Wakeman) MTWTh 11

100B. 5 units, Spr (Wakeman) MTWTh 11


5 units (Staff) given 1973–74

105. The Prophets of Israel—The Hebrew prophets as poets and activists.

5 units, Aut (Wakeman) MTWTh 10

106. Wisdom in the Ancient Near East — The Wisdom literature of Mesopotamia, Egypt, and Israel, such as: A Dialogue about Human Misery, The Instruction of Amen-opet, the Book of Job.

5 units (Staff) given 1973–74

107. Old Testament Poetry — The use of poetry as a vehicle for religious thought and expression in Old Testament religion; consideration of styles and techniques in representative poetry chosen from the Psalms, the Song of Songs, or other works. Prerequisite: consent of instructor.

5 units (Good) given 1973–74

108. Early Israelite Religion — Critical examination of the traditions of Israel’s “heroic age” with the help of archeological and extra-Biblical literary evidence.

5 units (Staff) given 1973–74


5 units (Berman) given 1973–74

112. Representative Protestant Thinkers—Study of representative Protestant think-
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Instructor</th>
<th>Credits</th>
<th>Time</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>117</td>
<td>Myth and Religion in Greek Art — (Same as Classics 117.)</td>
<td></td>
<td>3</td>
<td>Spr (Webster) TTh 1:15</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>Religion in the Ancient Near East — Development of and relations between Sumerian, Babylonian, Assyrian, Egyptian, Canaanite, Hittite, and Israelite cultures.</td>
<td></td>
<td>5</td>
<td>Aut (Staff) given 1973-74</td>
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</tr>
<tr>
<td>124</td>
<td>Islamic Theology and Philosophy — The thought of leading theologians and philosophers with consideration of the influence of the Greek philosophical tradition.</td>
<td>Berman</td>
<td>5</td>
<td>Win (Berman) TTh 2:15-4:05</td>
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</tr>
<tr>
<td>125</td>
<td>Medieval Jewish Thought — Central problems of thinkers in the post-Classical period of Jewish thought up to the Enlightenment, such as Torah and its interpretation, reason and revelation, the conflict between mysticism and philosophy, and the conflicting ideas of Maimonides and Spinoza on the role of religion in society.</td>
<td></td>
<td>5</td>
<td>Win (Berman) given 1973-74</td>
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<tr>
<td>126</td>
<td>Foundations of Modern Jewish Thought — Consideration of the relation between Talmudism, Hasidism, and Enlightenment; the origins of Zionism and other secular trends; the world of European Jewry and the Holocaust.</td>
<td>Berman</td>
<td>5</td>
<td>Spr (Berman) TTh 2:15-4:05</td>
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<tr>
<td>127</td>
<td>Aquinas — The thought of Aquinas in its historical setting.</td>
<td></td>
<td>5</td>
<td>Aut (Yearley) given 1973-74</td>
<td></td>
</tr>
<tr>
<td>128</td>
<td>Augustine — The thought of Augustine in its historical setting.</td>
<td></td>
<td>5</td>
<td>Aut (Yearley) given 1973-74</td>
<td></td>
</tr>
<tr>
<td>129</td>
<td>Maimonides — The thought of Maimonides as reflected in his Guide of the Perplexed: scripture and its interpretation; concept of God and universe; prophecy; the political role of the law.</td>
<td>Berman</td>
<td>5</td>
<td>Win (Berman) given 1973-74</td>
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</tr>
<tr>
<td>131</td>
<td>Religious Thought in England — Leading religious thinkers of the Reformation, Puritanism, rationalism, pietism, romanticism; their relation to historical, intellectual, and literary developments.</td>
<td>Clebsch</td>
<td>5</td>
<td>Spr (Clebsch) given 1973-74</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td>American Religious Thought — Study of the various American religious thinkers in a variety of traditions and periods.</td>
<td></td>
<td>5</td>
<td>Spr (Clebsch) MTWTh 10</td>
<td></td>
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<tr>
<td>136</td>
<td>Judaism and Islam — Comparison of the two religions throughout the course of their historical development, with some reference to early Christianity and Iranian religion; prophecy, law, religious philosophy, mysticism, and reform movements.</td>
<td>Berman</td>
<td>5</td>
<td>(Berman) given 1973-74</td>
<td></td>
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<tr>
<td>145</td>
<td>The Ecumenical Movement — The development of ecumenical concern in the twentieth century in both Protestantism and Roman Catholicism.</td>
<td>Brown</td>
<td>5</td>
<td>Spr (Brown) MW 2:15-4:05</td>
<td></td>
</tr>
<tr>
<td>162</td>
<td>Problems in Christian Theology — Historical and systematic analyses of one or more major subjects of Christian theology.</td>
<td>Yearley</td>
<td>5</td>
<td>(Yearley) given 1973-74</td>
<td></td>
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<tr>
<td>165</td>
<td>Modern Catholic Thought — Seminar on a thinker or problem in modern Catholic thought.</td>
<td>Yearley</td>
<td>5</td>
<td>(Yearley) given 1973-74</td>
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<tr>
<td>167</td>
<td>Topics in Islamic Thought — Examination of a central problem, a major thinker, or a religious movement in the context of later Near Eastern intellectual history.</td>
<td></td>
<td>5</td>
<td>(Yearley) given 1973-74</td>
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<tr>
<td>174</td>
<td>Philosophical Theology — Problems in traditional theism and consideration of process philosophy as an alternative conceptual framework for the Christian understanding of God in the writings of A. N. Whitehead, Charles Hartshorne, and other contemporary philosophers and theologians.</td>
<td>Irish</td>
<td>5</td>
<td>(Irish) given 1973-74</td>
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<tr>
<td>176</td>
<td>The Sacred and the Social — Major problems in the study of religion in modern times. Emphasis of the course will be on a systematic analysis of some of the major theoretical dilemmas in the sociology of psychosocial &quot;projection,&quot; religion as the &quot;foundation&quot; of culture, magic and religion, the</td>
<td></td>
<td>5</td>
<td>(Irish) given 1973-74</td>
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</tbody>
</table>
nature of religious groups, secularization, non-institutional religion, etc.
5 units, Spr (Davis) MW 4:15-6:05

178. Modes of Religious Thought — Comparative analysis of modes of religious thought on a specific issue with examples drawn from both the Eastern and Western traditions.
5 units (Staff) given 1973–74

5 units (Irish) given 1973–74

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

187. Problems in Buddhology — Historical and doctrinal analysis of one or more major subjects in Buddhist thought, such as: Buddhist theories of knowledge, faith, grace, meditation.
5 units; Win (Lethcoe) TTh 2:15-4:05

188. Religion in Japan — The development of religion in Japan from the earliest records through the flowering of Buddhism.
5 units (Staff)

189A. Religious Traditions of the Far East — Close examination of selected figures or works from the Confucian and Taoist traditions. Topic for 1972–73: Mencius and the Tao Te Ching. Prerequisite: 18 or the equivalent, or consent of the instructor.
5 units, Aut (Yearley) TTh 2:15-4:05

193. Categories of Religion — The utilization of various approaches to the study of religion to examine a fundamental category of religion.
5 units, given 1973–74

196. Religion and the Humanities — Required of majors in Humanities with concentration in Religious Studies. Enrollment limited to 12 students. See Humanities 196.
5 units, Spr (Wakeman) by arrangement

199. Individual Work.
(Staff) by arrangement

(Courses numbered 200 or above are primarily for graduates; advanced undergraduates may enroll by consent of instructor. Except for 201, 221, 241, and 261, these courses are by arrangement, as available, for graduate students.)

201. Graduate Seminar: The Exegesis of Texts—Required of all doctoral students in Religious Studies; may be repeated for credit.
4 units, Aut (Wakeman) MW 2:15-4:05

203. Ancient Near Eastern Religious Texts. (Good, Wakeman) by arrangement

205. Old Testament Interpretation. (Good, Wakeman) by arrangement

212. Arabic Philosophical and Theological Texts. (Berman) by arrangement

213. Hebrew Philosophical and Theological Texts. (Berman) by arrangement

216. Japanese Religious Texts. (Staff) by arrangement

221. Graduate Seminar: Topics in the History of Religious Thought—Required of all doctoral students in Religious Studies; may be repeated for credit. Prerequisite: consent of instructor.
4 units (Staff) given 1973–74

228. Medieval Religious Thought and Movements. (Berman, Yearley) by arrangement

231. English and American Religious Thought. (Clebsch) by arrangement

233. Nineteenth and Twentieth Century Religious Thought. (Brown, Clebsch, Irish, Yearley) by arrangement

241. Graduate Seminar: Systems of Religious Thought — Required of all doctoral students in Religious Studies: may be repeated for credit.
4 units, Win (Berman) MW 2:15-4:05

243. Modern Theology. (Brown, Irish, Yearley) by arrangement

246. Medieval Islamic Thought. (Berman) by arrangement

247. Medieval Jewish Thought. (Berman) by arrangement

254. Topics in Theology. (Brown, Irish, Yearley) by arrangement

261. Graduate Seminar: Comparisons of Religions—Required of all doctoral students
in Religious Studies; may be repeated for credit. Prerequisite: consent of instructor.
4 units (Staff) given 1973–74

263. Ancient Near Eastern Religions.
   (Good, Wakeman) by arrangement

265. Islam.
   (Berman) by arrangement

266. Judaism.
   (Berman) by arrangement

272. Buddhism.
   (Staff) by arrangement

277. East Asian Religions.
   4 units, Spr (Yearley)
   by arrangement

299. Directed Reading for Graduate Students.
   (Staff) by arrangement

300. Thesis.
   (Staff) 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); Gerald M. Meier (Graduate School of Business); John H. Merryman (School of Law); Peter Paret (History); Philip Rhinelander (Humanities)

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.

COURSES

How Nations Deal with Each Other—(Enroll in History or Political Science 135C.) An introductory course in international relations, emphasizing the interaction of political, economic, social, and cultural factors, exploring the various dimensions of national power and the possibilities of international cooperation.
5 units, Aut (George, Willis, Staff)

MWFL15

Legal Aspects of International Control of Armed Conflict — (Enroll in Law 296.) A seminar on the legal problems of international arrangements for the control and prevention of armed conflict. The seminar will focus on a series of examples of such arrangements: the international law of neutrality, neutralization of an area, the informal activities of the United Nations Secretary General, United Nations peacekeeping forces, and the concept of war criminality. Open to non-law students with consent of instructor.
5 units, Aut (Barton)

Graduate Colloquium: Historical Patterns of Urbanization in Europe in the Nineteenth and Twentieth Centuries — (Enroll in History 320.)
5 units, Aut (Thienel) W 2:15–4:05

Undergraduate Colloquium: Sociology of Urban Growth—(Enroll in History 233 or Sociology 144.) Undergraduate colloquium on the socio-economic aspects of urban growth
in Europe during the first decades of modern industrialization.

5 units, Win (Thienel) Th 2:15–4:05

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

5 units, Win, Spr (Barton, Craig, D. Dunn, T. Ehrlich, George, Lederberg, Lewis, Panofsky, Paret, A. Peterson)

Graduate Colloquium: The History of Military Thought, Institutions, and Policy—(Enroll in History 329A.) Advanced undergraduates may enroll with consent of instructor.

5 units, Spr (Meier)

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 studies 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.
longer-term potentialities for decay or recovery in the countries under scrutiny.

5 units, Aut (Dallin, Labelz)

LANGUAGE LABORATORY

Director and Senior Lecturer in Spanish and Portuguese: Phillip B. Petersen
Assistant Director and Electronics Engineer: John Metcalfe

The Language Laboratory with one hundred and fourteen Level III (listen-respond-record) student positions offers varied programs in Arabic, Cantonese, Cebuano, Czech, English as a foreign language, French, German, Greek, Hausa, Hebrew, Indonesian, Italian, Japanese, Korean, Latin, Mandarin Chinese, Norwegian, Persian, Polish, Portuguese, Russian, Spanish, Swahili, 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.

215. Language Laboratory Techniques — (Same as Education 295.)

2 units, Spr (Metcalfe) TTh 1:15
Sum (Metcalfe) MTWThF 11
(short term)

CENTER FOR LATIN AMERICAN STUDIES

Committee in Charge: The Committee on Latin American Studies, a subcommittee of the Committee on International Studies.

Chairman of the Committee and Director of the Center: Bernard J. Siegel

The Center for Latin American Studies administers four principal programs. They are the graduate A.M., and three undergraduate programs, the A.B., the Stanford campus in Mexico, and the Junior Year Summer Research program.

The A.M. program in Latin American Studies provides an interdisciplinary approach to the study of Latin America. The Departments of Anthropology, Economics, History, Political Science, Sociology, Spanish and Portuguese, and the Food Research Institute participate in the program.

To qualify for admission to the program, applicants must have the equivalent of an A.B. or a B.S. degree and a working knowledge of Spanish or Portuguese. Applicants must also take the Graduate Record Examination and have the results sent to the Office of Graduate Admissions.

The student's program is designed 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 in a single base discipline.
4) Two or three courses distributed among other participating disciplines. (Relevant courses may be found in the listings for the participating disciplines.)

b) Competence in Spanish or Portuguese at the level of Spanish 113 (Portuguese 183) or higher. If Spanish or Portuguese is the student's base discipline, he must demonstrate 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.

An interdisciplinary A.B. program with an emphasis on independent study is offered. Each program is designed to fit the individual needs of the student who will, however, be required to fulfill the following after having been admitted to the program:

a) Completion of a coherent interdisciplinary program of at least 55 units, based on an individualized plan of study achieved in conjunction with, and approved by, a three-man faculty advisory group assigned to the student. This program will ordinarily include:
   1) At least 25 units in one discipline.
   2) At least 40 units in 100-level courses or higher, focused directly on Latin America or closely related topics. 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 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 in light of the student's previous training.

d) A grade average of at least 2.5 must be maintained in all courses.

Application to the program should be made no later than the beginning of the winter quarter of the junior year; exceptions will be made only in unusual circumstances.

The Center operates a campus in Mexico in the autumn and winter quarters which stresses study in the social sciences.

Each summer the Center sponsors a small number of juniors to conduct research projects in Latin America. Students must have demonstrated the ability to work independently and to possess the necessary language competence. An extensive written report is required autumn quarter.

Inquiries concerning these 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 — Open to students accepted for the Latin American Studies Undergraduate Summer Program.
   5 units, Spr (Staff) M 4:15-6:05

198. Senior Thesis — Restricted to undergraduate majors.
   1 to 10 units, Aut, Win, Spr (Staff) by arrangement

199. Independent Research—Restricted to students in Latin American Studies Undergraduate Summer 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 4:15-6:05

**LINGUISTICS**


Professor: Charles A. Ferguson

Associate Professors: Clara N. Bush (on leave 1972-73), Elizabeth C. Traugott

Assistant Professors: Joan Bresnan, Eve V. Clark, William R. Leben. Acting: Eduardo Hernandez-Ch., Roger C. Schank

Instructor: Acting: Mohamed Hassan
PROGRAMS OF STUDY

The courses offered by the Committee are primarily intended to prepare candidates for advanced degrees in Linguistics. The undergraduate related courses will give students some acquaintance with the methods, insights, and findings of linguistics, but there is no undergraduate major in Linguistics, so students who wish to enter the field are advised to consider an interdepartmental major in Linguistics, or to select a major in consultation with one of the members of the Committee.

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

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) 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, 202, 204, and 210. 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, dialectology, grammatical theory, historical linguistics, a language or language group, sociolinguistics, hearing and speech sciences, statistical linguistics, 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 Committee on Linguistics 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 the Committee on 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 his 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. Colloquia. Three oral presentations which may be given as colloquia or in seminars during the first three years of study.

4. Teaching and/or Research. A minimum equivalent to one half of one quarter during the second or third year in residence.

5. Examinations. Passing two examinations:
a) 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 L200, 202, 204, and 210. 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, dialectology, grammatical theory, historical linguistics, a language or language group, sociolinguistics, hearing and speech sciences, statistical linguistics, or some combination of these. The examination will normally be taken prior to the end of the third year.

   a) Approval of dissertation topic and appointment of a dissertation committee by the Chairman of the Committee.
   b) Successful passing of a University Oral Examination on the Dissertation project and related areas.
   c) Dissertation (up to 15 units).

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 recognized toward the A.M., M.A.T., and Ph.D. degrees in Linguistics are those listed below, and those approved by the Committee.

   5 units, Aut (Ferguson, Greenberg, Huntington, Staff) MWF 10

   5 units, Aut (Diebold) MWF 1:15

101. Linguistic Ways to Prehistory.
   5 units, Spr (Diebold) given alternate years

110. Tutorial Practicum—A tutorial practicum in the teaching of English language skills. Participants are trained in basic linguistic and reading skills and apply this training to the tutoring of pre-school through high-school Bay Area children to whom school talk is not a first language or dialect. Open to all students interested in tutoring English language skills.
   3 units, any quarter (Staff) MWF 3:15

115. 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 mixture.
   3 units, Spr (Hernandez-Ch.) MWF 2:15

165. Introduction to the Structure of Russian—(Same as Slavic Languages and Literatures 165 for 1972–73. In other years, may be the structure of other languages.) An outline of the phonology, morphology, and syntax of contemporary Russian. Prerequisite: 100, or Slavic 112, or its equivalent.
   3 units, Spr (Crockett) TTh 10

195. Proseminar—Orientation for first-year graduate students and an introduction to different types of research in Linguistics ongoing at Stanford.
   1 unit, Aut (Staff) Th 4:15

199. Independent Study (Undergraduate).
   1 or more units, any quarter (Staff) by arrangement

200. Phonetic Theory—(Same as Hearing and Speech Sciences 212.) Theory and practice of phonetic transcription of speech, including consideration of distinctive features, sound types and units, and the effects of context on sound patterns (both segmental
and prosodic). Phonetic characteristics associated with speech registers and dialects.

4 units, Aut (——) TTh 1:15–3:05

201. 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.

2 units, Win (Huntington) T 3:15–5:05

202. Phonology—Training in linguistic analysis as applied to the sound systems of languages. Lecture-discussion and laboratory. Prerequisite: 200 or consent of instructor.

4 units, Win (Hernandez-Ch.) MWF 1:15

203. Generative Phonology—The phonological component of transformational grammars. Explicit coverage of regularities in the sound systems of a number of languages; elaboration and justification of a theory of phonology capable of expressing and explaining these regularities.

4 units, Spr (Leben) MWF 9

204. 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, and on criteria for evaluating grammars and testing hypotheses.

4 units, Aut (Traugott) MW 1:15–3:05

205. 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, Aut (Bresnan) MWF 9


3 units, Aut (Leben) M 10–12

210. Introduction to Transformational Grammar—Introduction to the transformational theory of syntactic, semantic, and phonological competence. Practical experience in forming and testing linguistic hypotheses, reading and constructing rules, etc. Prerequisite: 204 or consent of instructor.

4 units, Win (Bresnan) MWF 9

211. Advanced Transformational Grammar—In-depth study of particular topics, e.g. relativization, complementation. Emphasis on similarities and differences between recent models of transformational grammar. Prerequisite: 210 or consent of instructor.

4 units, Spr (Bresnan) MWF 11

212. Grammatical Theories—Selected topics in non-transformational grammatical theory. May be repeated for credit. Prerequisite: 204 or consent of instructor.

4 units, Win (Traugott) MW 2:15–4:05

214. Typology and Universals of Language—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.

5 units, Win (Greenberg) TTh 2:15–4:05

215. The Concept of Word.

3 units, Win (Juillard) given alternate years


4 units, Spr (Clark) TTh 1:15–3:05

219. Seminar in Syntax and Semantics—Topics in the theory of syntax, including the relationship of syntax and semantics. Material from English and other languages. May be repeated for credit. Prerequisite: 210.

3 units, Win (Traugott) MW 11:00–12:30

221. Seminar in Typology and Universals of Language—Prerequisite: 214.

3 units (Staff) given alternate years

230. Historical Linguistics—Introduction to the principles and methods of historical linguistics; the development of 20th century trends in historical linguistics. Prerequisite: consent of instructor.

4 units, Win (Traugott) given alternate years

231. Dialectology—Survey of methods and
results of dialect study. Material from various languages.

**4 units, Win (Staff) W 4-6**

232. Introduction to Indo-European Linguistics—(Same as Classics 232.) The course is intended to provide an elementary introduction to comparative and historical Indo-European for Linguistics students. It is also recommended as an introduction to the elements of synchronic and diachronic linguistics for students of Modern Languages and Classics.

**4 units, Aut (Devine) by arrangement**

239. Seminar in Historical Linguistics: Linguistic Change — (Same as Anthropology 265.) Prerequisite: 210 or consent of instructor.

**5 units, Spr (Greenberg) MW 3:15-5:05**


**4 units, Aut (Clark) given alternate years**

260A,B,C. Beginning Hausa.

**5 units, Aut, Win, Spr (Leben) by arrangement**


**5 units, Aut, Win, Spr (Staff) by arrangement**

262A,B,C. Beginning Swahili.

**5 units, Aut, Win, Spr (Kaufman) by arrangement**

263A,B,C. Intermediate Swahili.

**5 units, Aut, Win, Spr (Hassan) by arrangement**

264A,B,C. Beginning Yoruba.

**5 units, Aut, Win, Spr (Kaufman) by arrangement**

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 (Politzer) MWF 10**

271. Topics in Applied Linguistics—Speech and writing: problems of literacy, early reading, design of writing systems. May be repeated for credit. Prerequisite: 100 or equivalent.

**3 units, Win (Ferguson ) TTh 1:15**


**4 units, Aut (Schank) TTh 10:30-12:00**

281. Linguistics and Statistics.

**3 units, Spr (Juilland) given alternate years**


**4 units, Win (Schank) F 1:15-4:05**


**3 units, Spr (Schank) by arrangement**

295. Colloquium.

**1 unit, Win (——) Th 4:15**

296. Colloquium.

**1 unit, Spr (——) Th 4:15**


**1 or more units (Staff) by arrangement**

300. 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 210, or consent of instructor.

**4 units, Aut (Clark) TTh 10:00-11:30**

301. Child Language II—(Same as Psychology 241.) Emphasis on the role played by meaning in first language acquisition. Critical survey of recent research. Of special interest to advanced Linguistics and Psychology students. Prerequisite: 100 or 210.

**4 units, Win (Clark) TTh 11:00-12:30**

309. Seminar in Developmental Psycholinguistics—Topics in the acquisition of the first language. May be repeated for credit.

**3 units, Spr (Clark) TTh 9-11**

310. Sociolinguistics —Selected topics on language and society, including language and social stratification, language standardization, language and national development.

**4 units, Spr (Hernandez-Ch.) MWF 11**
311. Field Research—Methods and research design for the study of language.
   2 units, Win (Hernandez-Ch.) F 10–12

312. Language and Culture—(Same as Anthropology 167.) Relevance of linguistic theory, semantic analysis, and the study of speech as a social behavior to problems of anthropology, sociology, and psychology. Prerequisite: Anthropology 1 or consent of instructor.
   5 units, Aut (Frake) MWF 2:15

   3 units, Aut (Ferguson) W 10–12

320. Languages of the Middle East—Structural sketches and sociolinguistic background information on the major contemporary languages of Southwest Asia and North Africa.
   4 units, Spr (Ferguson) TTh 11:00–12:30

321. Languages of Africa—(Same as Anthropology 269.)
   5 units (Greenberg) given 1973–74

322. Languages of the Pacific—(Same as Anthropology 260.) Comparative Austronesian linguistics, structural characteristics of Oceanic language, sociolinguistics in the Pacific and broader Southeast Asia.
   5 units, Aut (Frake) T 2:15–5:05

397. Directed Reading.
   1 or more units, any quarter (Staff)
   by arrangement

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

399. Dissertation Research.
   1 to 15 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 47, 48, or 58 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 8-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 to 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.

47. Spoken English I—Basic review and practice of grammatical patterns of spoken English with additional assigned practice in language laboratory. Students enrolled in 47 are expected to enroll concurrently in Pronunciation class (50). Prerequisite: consent of instructor.
   5 units, Aut (Politzer) MTWThF 9

48. 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 by arrangement

49. 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 by arrangement

50A,R,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 (Staff) three hours per week by arrangement

52A,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
53A, 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

58. 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

59. Written English II—For students with 
some facility in written English. Emphasis 
on fluency, idiomatic usage, and style. Spe-
cial attention given to mechanics and form 
appropriate to academic papers. May be re-
peated for credit. Prerequisite: consent of 
instrctor.

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

SPECIAL LANGUAGE COURSES

Students interested in studying a modern 
foreign language not regularly taught at 
Stanford, such as Czech, Arabic, Bengali, or 
Modern Hebrew, may propose a Special 
Language Course. Students will be expected 
to give a reasonable justification for includ-
ing the study of the special language in their 
educational experience at Stanford. If the 
proposal is approved and suitable arrange-
ments for instruction and evaluation can be 
made, a course will be set up and students 
may enroll with or without credit. The pro-
posal should be made at least one month be-
fore 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 in-
structor 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 varia-
tion in teaching approaches should be ex-
pected 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 SWOPS1, 
SCIRE, and Undergraduate Specials.

Address all inquiries to Coordinator, Spe-
cial Language Courses, Department of Lin-
guistics, ext. 4284.

RELATED COURSES

CLASSICS

EDUCATION
281. Linguistics for Teachers of Modern 
Languages.
383. Recent Developments in Foreign Lan-
guage Education.
385. Role of Non-Standard Dialects in Ed-
ucation.
388. Foreign Language Education and Bi-
lingual Education in the Elementary School.
482. Research Problems in Teaching and 
Learning a Second Language.

ENGLISH
201. Structure of the English Language.
203. Problems in the English Language.
204. Principles of Standard English.
205. Old English.
206. Middle English.
301. Seminar: Language and Literature.

FRENCH AND ITALIAN
122. Phonétique et Orthoépie.
205. Le français moderne.
310. Introduction to Romance Linguistics.
311. Introduction to Medieval Literature.
312. Histoire de la langue française depuis 
le Moyen Age.
315. Grammaire historique de la langue 
française.

GERMAN STUDIES
204. History of the German Language.
205. Introduction to Modern German.
228. Middle High German.
312. Old Norse.
313. Old Icelandic Sagas.
314. Old High German and Old Saxon.
319. Early New High German.
322. Recent Developments in German Linguistics.
325. Seminar—Topics to be announced.

HEARING AND SPEECH SCIENCES
220. Psychology of Speech.
230. Physiology of Speech Production.
231. Speech Perception.
252. Organic Language Disorders.
281. Seminar in Animal Communication.
310. Experimental Phonetics.

PHILOSOPHY
181. Philosophy of Language.
183. Logic and Language.
201. Mathematical Linguistics.
202. Seminar in Theories of Language.
241A,B. Seminar in the Philosophy of Language.

PSYCHOLOGY
146. Language and Thought.
214. Psycholinguistics.
272. Seminar on Topics in Psycholinguistics.

SLAVIC
201. Synchronic Morphology of Russian Conjugation and Declension.
211. Introduction to Old Church Slavonic and Early Russian Texts.
212. History of the Russian Literary Language.
228. Divergence of Slavic Languages.

SPANISH AND PORTUGUESE
185. Spanish Phonetics.
190. Spanish Linguistics.
200. History of the Spanish Language.
261. Old Spanish.
263. Historical Spanish Linguistics I.
264. Historical Spanish Linguistics II.
266. Hispanic Dialectology.

MATHEMATICS
Emeriti: Harold M. Bacon, Stefan Bergman, George Pólya, Gábor Szegő (Professors)
Chairman: Ralph Phillips
Vice Chairman: Paul W. Berg
Associate Professors: John Coates, Mary V. Sunseri. Visiting: Jon Barwise, Neil Trudinger
Assistant Professors: Bruce M. Bennett, Gregory Brumfiel, James A. Carlson, Paul C. Eklof, Kent B. Erickson, C. Denson Hill, Garo K. Kiremidjian
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.

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) in
a more mathematically systematic way, and explore 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.

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. Eight 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 one course 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. Six 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. The student choosing this option must have his plan 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.

**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 his sophomore year, and not later than the first two weeks of the first quarter of his 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. The applicant must (4) submit a detailed program of course work for the remaining quarters of his undergraduate career (see “Program” below for suggestions). This program will be regarded not as strictly binding, but as indicating his intended plan of study; appropriate substitutions can be made later with the approval of his adviser 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 195 or 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 536 of this bulletin.

**MASTER OF SCIENCE**

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:

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:

In order that a student be admitted to candidacy for the Ph.D. degree, he must have successfully completed 45 units of graduate courses (i.e., courses numbered 200 and above). In addition he 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, 9, 10 or 2:15
Win (——) MTWThF 8

2. Excursions into Mathematics—This course is designed for the general student to communicate some feeling of what mathematics is and what mathematicians do. We shall discuss the nature of mathematical discovery and of mathematical proof. Topics to be treated include paradoxes, the theory of infinity, symmetry in art and nature.

3 units, Aut (deLeeuw) MWF 11

5. Calculus and Probability—The sequence (5, 6, 7) is designed primarily for the general
student and students in the biological and social sciences. The courses will provide the student with the basic ideas of calculus and probability theory. Applications will be chosen mainly from biology, economics and other social sciences. Topics will include the following: Algebra of sets, sample spaces, counting problems. Probability. Random variables, expectation, variance. Real number system. Functions and graphs. Tangent lines, derivatives, rules of differentiation. Derivatives of the elementary functions. Maximum-minimum problems, rates of change. Anti-derivatives, area and other applications. Special probability distributions and applications. Law of large numbers, central limit theorem. Prerequisites: algebra and trigonometry.

3 units, Aut (——) MWF 8, 9, 10, 11, or 2:15
Win (——) MWF 8, 10, or 2:15

Calculus and Probability—Continuation of 5. Prerequisite: 5.

3 units, Win (——) MWF 8, 9, 10, 11, or 2:15
Spr (——) MWF 8, 10, or 2:15

Calculus and Probability—Continuation of 6. Prerequisite: 6.

3 units, Aut (——) MWF 8, 10, or 2:15
Spr (——) MWF 8, 9, 10, 11, or 2:15

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, or 2:15
Win (——) MWF 10

Analytic Geometry and Calculus—Continuation of 10. Prerequisite: 10.

3 units, Win (——) MWF 8, 10, or 2:15
Spr (——) MWF 10

Analytic Geometry and Calculus—Continuation of 11. Prerequisite: 11.

3 units, Aut (——) MWF 8
Spr (——) MWF 8, 10, or 2:15


3 units, Aut (——) MWF 8

Analytic Geometry and Calculus—Continuation of 22. Prerequisite: 22.

3 units, Aut (——) MWF 2:15
Win (——) MWF 8

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 (Bacon) MTWThF 8
(Bacon) MTWThF 9
(Gilbarg) MTWThF 10
Win (Carlson) MTWThF 8

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 (Royden) MTWThF 9

42. Analytic Geometry and Calculus—Continuation of 41. Prerequisite: 41.

5 units, Win (Sunseri) MTWThF 8
(Bacon) MTWThF 9
Spr (Bennett) MTWThF 12

42A. Calculus—Continuation of 41A.

5 units, Win (Sunseri) MTWThF 9

43. Analytic Geometry and Calculus—Continuation of 42. Prerequisite: 42.

5 units, Aut (Carlson) MTWThF 8
Spr (Sunseri) MTWThF 8
(Bacon) MTWThF 9
43A. Calculus — Continuation of 42A. Concurrent registration in 44 is permissible.  
3 units, Spr (Sunseri) TTb 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, 11, or 1:15  
Win (——) MWF 9 or 11  
Spr (——) MWF 9

3 units, Win (——) MWF 9, 11 or 1:15  
Spr (Simons) MWF 2:15

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 (Kiremidjian) MWF 2:15

51. Honors Calculus — 51, 52, 53 constitute an honors sequence in calculus. The material covered is that of 41, 42, 43, and 44, with greater emphasis on the fundamental concepts and rigorous development of the calculus and more extensive discussion of its applications. Prerequisites: algebra and trigonometry.  
5 units, Aut (Berg) MTWThF 9

52. Honors Calculus — Continuation of 51.  
5 units, Win (Royden) MTWThF 9

53. Honors Calculus — Continuation of 52.  
5 units, Spr (Berg) MTWThF 9

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 (deLeeuw) MWF 2:15

55. Honors Calculus — Continuation of 54.  
4 units, Win (Samelson) MWF 9

56. Honors Calculus — Continuation of 55.  
4 units, Spr (Samelson) 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 (Hawley) MWF 2:15

102. Linear Algebra and Differential Equations — Continuation of 101.  
3 units, Win (Hawley) MWF 2:15

103. Linear Algebra and Differential Equations — Continuation of 102. Includes equivalent of 114.  
3 units, Spr (Hawley) 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 (Kiremidjian) MWF 1:15  
Spr (Shields) MWF 2:15  
Sum (——)
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, or 1:15
   Win (Kiremidjian) MWF 1:15
   Spr (Cohen) MWF 9
   Sum (——)

113H. Linear Algebra and Matrix Theory (Honors).

3 units, Aut (Bennett) MWF 1:15

114. Linear Algebra and Matrix Theory—Continuation of 113: A deeper study of certain of the topics indicated as well as additional topics chosen among the following: invariant subspaces, canonical forms of matrices, minimal polynomials and elementary divisors; vector spaces over arbitrary fields; inner products; Hermitian and unitary matrices; multilinear algebra.

3 units, Win (——) MWF 9 or 11
   Spr (Kiremidjian) MWF 10

114H. Linear Algebra and Matrix Theory (Honors).

3 units, Win (Bennett) MWF 1:15

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 or 1:15
   Win (Chung) MWF 11 or 2:15
   Sum (——)


3 units, Win (——) MWF 11 or 1:15
   Spr (Chung) MWF 10


3 units, Spr (Phillips) MWF 11

120. Modern Algebra —Integral domains, fields, polynomials, divisibility theory, groups. Prerequisite: 113.

3 units, Win (Eklof) MWF 1:15
   Spr (Coates) MWF 2:15

121. Modern Algebra—Continuation of 120.

3 units, Spr (Eklof) 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 (Erickson) MWF 11

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 (Erickson) MWF 11

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 (——) MWF 8 or 11
   Win (——) MWF 11 or 2:15
   Sum (——)


3 units, Win (——) MWF 8 or 11
   Spr (Trudinger) MWF 10


3 units, Spr (——) MWF 11 or 2:15

134. Difference and Integral Equations —An introduction to the theory of linear functional equations of the difference and inte-
gral types, with analytical techniques for their resolution and numerous illustrative examples of historical or technical interest.

3 units, alternate years, given 1973-74

136. Introduction to Computing — (Enroll in Computer Science 106.)

137A,B. Numerical Analysis — (Enroll in Computer Science 137A,B.)

142. Higher Geometry—Homogeneous and projective coordinates with applications; projective correspondence in forms of one dimension; involution; projective correspondence in forms of two dimensions; collineations, their classification; correlation, polarity; projective, affine, metric properties of conics.

3 units, alternate years, given 1973-74

143. Topics in Geometry—Discussion of the various geometries and their axiom systems. The coordinization of geometry from the axioms. Development of affine and metric geometry, including the non-Euclidean geometry from projective geometry. Discussion of how classical geometry is connected to other fields such as differential geometry, Lie groups, etc. Prerequisite: 120 and preferably 142, or consent of instructor.

3 units, Win (Cohen) MWF 9

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 (Coates) MWF 11


3 units, Win (——) MWF 8

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, Spr (Brumfiel) MWF 10


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.

Alternate years, given 1973-74

195. Undergraduate Teaching Workshop—This course will be devoted to an examination of some of the basic issues in the learning and teaching of mathematics. The discovery method and guided learning. Symbolic thinking and visual thinking. Teaching and tutoring strategies.

3 units, Win (deLeeuw), 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 the honors mathematics major. The seminars will be designed and con-
ducted 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

198. Honors Seminar — This seminar will provide an opportunity for the members of the honors program to work together and also for a number of faculty members to become acquainted with the honors majors in a seminar setting. The seminar will be given each quarter, the subject matter depending on the interests of the students and of the faculty member in charge, and may be taken any number of times. The seminar is also open to those who are considering applying for admission to the honors program.

1 or 2 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 (Hill) MWF 10
205B. 3 units, Win (Hill) MWF 10
205C. 3 units, Spr (Hill) 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 (Cohen) MWF 11
206B. 3 units, Win (Cohen) MWF 11
206C. 3 units, Spr (Cohen) 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 (Coates) MWF 1:15
210B. 3 units, Win (Coates) MWF 1:15
210C. 3 units, Spr (Coates) 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, Aut (Carlson) MWF 2:15
217B. 3 units, Win (Carlson) MWF 2:15

220A,B,C. Methods of Mathematical Physics — Potential theory, Green's function, integral equations; Hilbert space approach to problems of mathematical physics; elementary spectral theory; variational methods.

220A. 3 units, Aut (Gilbarg) TTh 1:15–2:30
220B. 3 units, Win (Gilbarg) TTh 1:15–2:30
220C. 3 units, Spr (Gilbarg) TTh 1:15–2:30

221A. Calculus of Variations — Euler-Lagrange equations, sufficient conditions; applications to eigenvalue and scattering problems; direct methods, Dirichlet's principle.

3 units, alternate years, given 1973–74

230A,B. Advanced Probability — Fundamental concepts, weak and strong laws of large numbers, convergence of distributions and the central limit theorem, infinitely divisible distributions and stable laws. Prerequisite: 205A.

230A. 3 units, Win (Chung) MWF 3:15
230B. 3 units, Spr (Chung) MWF 3:15

Topics in Stochastic Processes—
Basic concepts. Markov chains in continuous time. Boundary theory. Markov processes and potential theory. Prerequisite: 230A,B, or consent of instructor.

232A. 3 units, Aut (Chung) MWF 3:15
232B. 3 units, Win, by arrangement
232C. 3 units, Spr, by arrangement

Selected Topics in Ergodic Theory—Topics from: The Kolmogorow-Sinai theory of entropy; the isomorphism theorem for Bernoulli shifts and Bernoulli flow; K-automorphisms, applications to mechanical systems, and automorphisms of compact groups.

235A. 3 units, Aut (Ornstein)
235B. 3 units, Win (Ornstein)

Advanced Numerical Analysis—
(Enroll in Computer Science 237A,B,C.)


Alternate years, given 1973–74


244A. 3 units, Aut (Hawley) MWF 11
244B. 3 units, Win (Hawley) MWF 11


Alternate years, given 1973–74

Selected Topics in Analysis.
Alternate years, given 1973–74

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.

Alternate years, given 1973–74


Alternate years, given 1973–74

Lie Groups—Differentiable manifolds, Lie groups and algebras, semisimple Lie algebras, maximal compact subgroup, differential forms and cohomology, real and complex symmetric spaces, representations. Prerequisites: 205, 206, and 210.

Alternate years, given 1973–74

Selected Topics in Abstract Analysis.

Alternate years, given 1973–74

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.

Alternate years, given 1973–74


Alternate years, given 1973–74

Lie Groups—Differentiable manifolds, Lie groups and algebras, semisimple Lie algebras, maximal compact subgroup, differential forms and cohomology, real and complex symmetric spaces, representations. Prerequisites: 205, 206, and 210.

Alternate years, given 1973–74

Selected Topics in Abstract Analysis.

Alternate years, given 1973–74

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.

271A. 3 units, Aut (Levine) MWF 10
271B. 3 units, Win (Levine) MWF 10

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, Aut (Finn) MW 2:15


281A. 3 units, Aut (Milgram) MWF 9
281B. 3 units, Win (Milgram) MWF 9
281C. 3 units, Spr (Milgram) MWF 9


283A. 3 units, Aut (Samelson) MWF 9
283B. 3 units, Win (Brumfiel) MWF 9
283C. 3 units, Spr (Brumfiel) MWF 9

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 (Eklof) MW 2:15–3:30
290B. 3 units, Win (Eklof) MW 2:15–3:30
290C. 3 units, Spr (Barwise) MW 2:15–3:30

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.

291A. 3 units, Aut (Eklof) MWF 1:15
291B. 3 units, Spr (Eklof) MWF 1:15

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. Prerequisite: 290 or equivalent.

292A. 3 units, Win (Barwise) by arrangement
292B. 3 units, Spr (Barwise) by arrangement

293A,B. Topics in Proof Theory — Selected principally from: Gentzen's theory of formal rules for finite and infinitary languages; analysis of formal proof trees by use of ordinal functions, constructive functionals of higher type. Prerequisite: 290 or equivalent.

Alternate years, given 1973–74, by arrangement

294A,B. Topics in Set Theory — Selected principally from: Forcing and generic sets, Boolean valued models and independence results; mathematical consequences of large cardinal assumptions. Prerequisite: 290 or equivalent.

Alternate years, given 1973–74

295. Advanced Automata Theory—(Enroll in Electrical Engineering 484.)

350. Directed Reading.
Any quarter (Staff) by arrangement

351. Seminar Participation — Participation in a student-organized graduate seminar under the general supervision of a faculty member.
Any quarter (Staff) by arrangement

352. Undergraduate Seminar Leadership — Graduate students leading an undergraduate seminar (197) may receive up to 3 units of credit.
Any quarter (Staff) by arrangement
355. Teaching Workshop — The workshop program provides guidance to those graduate students who teach courses in the calculus series. Required of all graduate students teaching for the first time.
   Any quarter (Staff) by arrangement

356. Upper Division Teaching.
   Any quarter, by arrangement

360. Advanced Reading and Research.
   Any quarter (Staff) by arrangement

361. Seminar Participation — Participation in faculty-led seminar which has no specific course number.
   Any quarter (Staff) by arrangement

   By arrangement

381. Seminar in Analysis.
   By arrangement

385. Seminar in Abstract Analysis.
   By arrangement

386. Seminar in Geometry and Topology.
   By arrangement

387. Seminar in Function Theory.
   By arrangement

   By arrangement

389. Seminar in Mathematical Biology.
   By arrangement

391. Seminar in Foundations of Mathematics.
   By arrangement

MILITARY SCIENCE

Chairman: M. J. Asensio, Jr. (LTC, IN)
Lecturer: Dennis J. Gillem (MAJ, IN)

GENERAL

The Military Science Department, through the Reserve Officer Training Corps Program (ROTC), affords the opportunity for qualified students to receive instruction in essential military subjects which, when combined with a baccalaureate degree earned through undergraduate work in fields of their own choice, will qualify them for a Regular Army or a reserve commission in the U.S. Army. The objectives of the Military Science Department are as follows:

1. To prepare the participating student for commissioning in the U.S. Army.
2. To develop in each student the following:
   a) Behavioral patterns of self-discipline, integrity, and a sense of responsibility.
   b) An appreciation of the role of a participating citizen in matters dealing with national security.
   c) The ability to evaluate situations, to make decisions, to understand personal and group behavioral patterns and to practice those attributes considered essential in a leader.

PROGRAMS OF STUDY

Since Stanford University has asked Department of the Army to phase out the ROTC Program by June 1973, only the fourth year curriculum will be offered. See Courses (below) for details. In addition to the academic instruction, leadership laboratory is required during each year. This laboratory supplements the academic instruction. It provides opportunity for each student to develop his ability to communicate with and lead effectively a group of his fellow students. The development of personal confidence and an appreciation for the fundamentals of group dynamics, staff and command procedures is engendered.

Extracurricular activities on a voluntary basis are sponsored to broaden cadet interests and to provide opportunity to apply principles of leadership, management, and staff procedures.

Several awards are made each year to those who excel in the program.

ENROLLMENT IN ROTC

Enrollment in the ROTC program is open only to Stanford University students who are citizens of the United States and who meet the physical requirements. Students to be enrolled must be not less than 14 years of age, nor of an age that will preclude their appointment in the Army by the 28th birthday. Primary criterion is that every enrolled cadet has the potential of becoming an effective Army officer. Classification tests are given periodically to test the progress of cadets, but principal reliance for selection and retention in the program is placed on
the judgment of the Chairman of the Military Science Department and his assistants.

**Advanced Military Science**

Advanced Course students are enlisted in the Army Enlisted Reserve and receive an allowance of $100 per month.

**Commissioning**

Upon successful completion of the entire sequence of required courses in Military Science, together with the University requirements for a baccalaureate degree, Army ROTC students are appointed Second Lieutenants in their selected branch and serve on active duty with the Army as commissioned officers.

**Military Science Laboratory**

The study and practice of principles of leadership and staff and command organization and procedures. This required laboratory provides supplemental learning experiences in the area of military group dynamics and leadership.

**Regular Army Commissions**

Cadets who possess outstanding qualities of leadership, high moral character, and excellent academic standing may be designated Distinguished Military Graduates by the Professor of Military Science with the concurrence of the President of the University. Such graduates are eligible to apply for a commission in the Regular Army. Selection for appointment is made by Headquarters, Department of the Army, from a consolidated order of merit list of applicants. Those selected may apply later for graduate education at selected civilian colleges and universities at government expense while receiving full pay.

**Summer Camp**

Every student attends one six-week ROTC summer camp normally between the junior and senior academic years. The objective of camp training is to provide the ROTC student with practical experience in tactical, technical, and administrative subjects. Camp training is designed to supplement institutional instruction by providing students with applicatory type training which cannot be presented adequately at the University. During this training cadets receive pay and travel allowances. Under exceptional circumstances attendance at summer camp may be deferred until after graduation when this deferment is shown to be essential.

**Courses**

**Fourth-Year**

141. Seminar in Leadership and Management—Analysis of leadership and management problems selected from both within and without the military structure with a view to developing principles which are applicable to military leadership and management. Consult Time Schedule for days and hours course is given.

1 unit, Aut (Gillem)

142. Seminar in Leadership and Management—Continuation of 141.

1 unit, Win (Gillem)

143. Seminar in Leadership and Management—Continuation of 142.

1 unit, Spr (Gillem)

199. Command and Staff Procedures—Theory, practice in developing staff studies and military programs. Prerequisites: completion of basic course and consent of department head.

Aut, Win, Spr (Staff) by arrangement

**Modern Thought and Literature**

*Committee in Charge:* Albert J. Guerard (English), Chairman, David Halliburton (English and Comparative Literature), Acting Chairman (winter and spring quarters, 1973), Marc Bertrand (French), Margot Drekmier (History), Herbert Lindenberg (Comparative Literature and English), Robert Polhemus (English), Robert R. Sears (Psychology), Walter Sokel (German), Irvin Yalom (Psychiatry)

The Committee sponsors a program leading to the Ph.D. in Modern Thought and Literature. This degree is designed for students intending to teach modern literature.
in interdisciplinary programs or in English departments. It assumes serious interest in one or more areas of modern thought: history, psychology, philosophy, anthropology, linguistics, political and social thought, religious studies, the several arts, contemporary culture generally. The term modern is construed to mean, roughly, from the Enlightenment to the present. Thus a student would specialize in modern English and American literature from the Enlightenment to the present, and in addition would pursue an individual program of interdisciplinary studies involving part of the same period. He 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 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 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. Assessment of Progress. A full assessment will be made of progress both in the modern literature of specialization and in the chosen area of interdisciplinary work. This assessment may take the form, at the discretion of the student's advisers, of

(a) written or oral examinations;
(b) a series of monographs covering the work done;
(c) some combination of examinations, monographs, and (for certain areas) public lectures and discussions. The nature of the field precludes any single system or time schedule for assessment. New combinations of subject-matter may involve new methods of assessment.

6. A university oral examination, normally to be taken in the third year of graduate study. Those who spend the third year of
study abroad may arrange to take this examination shortly after their return. The examination will normally cover: a) the field of intensive concentration (as defined by the student and his advisory committee) and b) plans for the dissertation.

7. Dissertation. 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.

Language Requirement — Students must demonstrate a reading knowledge of one foreign language comparable to that required by the Department of English, and, no later than the oral examination, an advanced reading knowledge of one other foreign language. An "advanced" reading knowledge assumes the ability to make a genuine scholarly use of the language: that is, to read prose of ordinary difficulty.

At the termination of his work for the degree each student will prepare a detailed statement of the advanced work he has done outside the literature of specialization. This statement, to be approved by the student's advisers, will be certified by the Committee on Modern Thought and Literature.

**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.) A study of the devaluation of literary experience in the work of important contemporary thinkers in politics, religion, and science, and the response to such attacks by major writers. Speakers from other disciplines will share in the teaching.
5 units, Spr (Friedlander)

173. Individu et société dans le roman français contemporain—(Same as French and Italian 183.) De La Peste de Camus au “roman de contestation” actuel.
4 units, Spr (Bertrand) TTh 11; one hour by arrangement

174. Myth and Violence in Literature—
(Same as French and Italian 114 and Comparative Literature 114.) An analysis of Greek, French, and English theater in conjunction with anthropological material. Readings from Sophocles, Aeschylus, Euripides, Shakespeare, Racine, Sade, Artaud, Malinowski, and Levi-Strauss.
3 to 4 units, Aut (Harari) MW; one hour by arrangement

195. Ad Hoc Undergraduate Seminars—
In a given quarter a group of undergraduates (at least 3 but preferably more) who wish in the following quarter to study a subject or an area not covered by regular courses may plan an informal seminar and approach a faculty member to supervise it. A syllabus for the course should be submitted to the Chairman of the Committee at least 2 weeks before the end of the previous quarter. No more than 5 units of credit will be given for Modern Thought and Literature 195 and/or 198 in any one quarter.
Any quarter, by arrangement

198. Individual Work—Advanced undergraduates who wish to study a subject or an area not covered by regular courses may, with permission, enroll for individual work under the supervision of some member of the faculty. No more than five units of credit will be given for Modern Thought and Literature 198 and/or 195 in any one quarter.
Any quarter, by arrangement
218A. The Culture of England, 1890-1914 — (Same as English 218A, History 244, and Comparative Literature 218A.) History, literature, and art as expressing and influencing the period in related ways. Limited to 30 students, who should have taken a course in 19th and/or 20th century English literature or history.

5 units, Win (Felstiner, Stansky)

229. Politics, Society, and Art in Modern European History — (Same as History 229.) Explorations of the political and social dimensions of art, 1870-1945. The readings and discussions will concentrate on transnational aesthetic movements and their interaction with political and social forces in particular countries.

5 units, Spr (Craig, Paret)

242. Symbolic Anthropology — (Same as Anthropology 142.) The course will concern the content and organization of systems of symbols and belief. Readings will include Freud, Durkheim, and modern anthropologists who have written about myth, magic, pollution, rites of passage, and other aspects of symbolic organization.

5 units, Spr (M. Rosaldo) MWF 10

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: graduate standing in the anthropology department or consent of instructor.

5 units, Aut (R. Rosaldo) TTh 9:00-10:50

244. Structural Studies of Myth — (Same as Anthropology 244.) The purpose of this seminar is to develop a critical language for discussing, evaluating, and applying Levi-Strauss's theories to the study of mythology. The first sessions will involve a discussion of theory; in the last weeks, structural methods will be applied to a body of related myths. Limited enrollment. Prerequisite: consent of instructor.

5 units, Win (M. Rosaldo) TTh 1:15-3:05

256. Philosophy, Culture, and Society — (Same as Political Science 156.)

4 to 5 units, Win (Williams) MTWTThF 11

257. Modernity and Its Discontents — (Same as Political Science 157V.) An exploration of the personal, social, and political contradictions that pervade the lives of men and women in modern societies; of the new forms of freedom and repression, authenticity and alienation. Writers will include Marx, Toennies, Durkheim, Simmel, Weber, Dostoevsky, Freud, Kafka, Sartre, Genet.

5 units, Spr (Berman) MTWTThF 11

258A, B. Theory, Power, and Social Science — (Same as Political Science 158A,B.)

5 units, Win (C. Drekmeier) given 1974-75

260A, B. "Modernisms" — (Same as Political Science 160A,B.) "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) discernible in the period 1900-1940 in fields as divergent as social and political theory, legal theory, philosophy, historiography, literature, art, and even music. A two-quarter course.

260A. 5 units, Aut (Rogat) M 2:15-4:05
260B. 5 units, Win (Rogat) M 2:15-4:05

262. Nietzsche and the Modern Novel — (Same as English 262 and Comparative Literature 262.) Nietzsche as a philosopher of culture; the force of his ideas in the novels of D. H. Lawrence, Thomas Mann, Malraux, and Belyj. Reading knowledge of French or German or Russian desirable.

5 units, Spr (Foster)

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.) Forms of existential commitment in the protagonists of such writers as Sartre, Joyce, Woolf, Ellison, and Malamud.

5 units, Spr (Ruotulo)

269A. Toward an Understanding of Romanticism — (Same as English 269A and Comparative Literature 269A.) Study of such major developments in Romantic thought and literature as concepts of the self, historicism, and visionary poetry. Read-
ing knowledge of French or German desirable.

5 units, Spr (Lindenberger)

269B. Toward an Understanding of Modernism—(Same as English 269B and Comparative Literature 269B.)

5 units (Lindenberger) alternate years, given 1973–74

270. Modern Critical Thought: The Symbolist Heritage—(Same as French and Italian 270.) The development of the main stream of modern French (and related) philosophico-critical thinking, from Baudelaire through Mallarmé, Valéry, Bergson, Proust, Edmund Wilson, Mauron, Blanchot, Richard, Northrop Frye, Benjamin, and Derrida. Readings in French and English; discussions in English.

3 to 5 units, Spr (Cohn) M 2:15–4:05

285. Psychology of Biography — (Same as Psychology 133.) Analysis of novelists' personalities through data from their life histories and creative writing. Lectures, reading, and exercises on analytic methods, including content analysis and relating of social behavior to fantasy and symbolic expressions of motivation. For 3 units: reading of brief psychobiographies and final examination. For 4 units: writing a 25-page psychobiography of a novelist. Recommended: Psychology 1 or 111 or 112.

3 to 4 units, Aut (Sears) TTh 11

291. Workshop in Creation and Criticism—(Same as English 291.) Discussion of student writing and of the aesthetic, psychological, and cultural implications of new forms of fiction, personal narrative, poetry, and film. Open by permission to qualified graduate and undergraduate students. Samples of work should be submitted as early as possible to Professor Guerard.

3 to 5 units (Guerard) alternate years, given 1973–74

315F. Seminar: The Enlightenment and Its Literary Traditions — (Same as English 315F.)

5 units, given alternate years

334. Graduate Colloquium: Approaches to the Study of the Enlightenment—(Same as History 334.)

5 units, Spr (M. Drekmeier)

337. Graduate Colloquium: Modern European Intellectual History—(Same as History 337.)

5 units, Aut (Robinson)

361. Seminar: The Modern Tradition — (Same as English 361.) Introduction to the interdisciplinary study of modern thought and literature. No prerequisite. Limited to 15 students.

5 units, Aut (Guerard)

362A. Seminar: Psychology and Literature — (Same as English 362A and Comparative Literature 362A.) Readings in psychology, in psychological literary criticism, and in such novelists as the Brontës, Dostoevsky, Ford, Conrad, Hemingway, Sartre, and Camus.

5 units, Win (I. Yalom, M. Yalom)

362B. Seminar: Problems of Psychological Interpretation—(Same as English 362B and Comparative Literature 362B.) The relation between the writers' lives and their writing, the use of psychological theories in literary criticism, and the psychology of reader-response. Readings in psychological literary criticism and modern fiction.

5 units, Spr (Moser)

365B. Seminar: Politics and Society in American Literature, 1880–1930—(Same as English 365B.)

5 units, Win (Simpson)

367A. Seminar: Capitalism and Literature in the Nineteenth Century—(Same as English 367A.)

5 units, given alternate years

373. Religionskritik im 19. Jahrhundert — (Same as German Studies 360.)

4 units (Bark) given 1973–74

374. Die Romantik — (Same as German Studies 382.)

4 units (Mueller-Vollmer) given 1973–74

375. Seminar: Humboldt and Structuralism — (Same as German Studies 400B.)

4 units (Mueller-Vollmer) given 1973–74

382. Seminar: Dynamic Psychology — Personality development and psychodynamics from birth through adulthood, with emphasis on motivation, emotions, conflict, anxiety, and effects of early childhood experience. Intended primarily for students interested in literary criticism, biography, history, or other humanistic study. No prerequisite.

5 units, Spr (Sears)
385. Seminar: Freudian Theory—Readings will include *The Interpretation of Dreams*, *Three Essays on the Theory of Sexuality*, and Jones's *Life of Freud* (Trilling abridgement). Primarily for psychiatric residents in the School of Medicine, but open to other qualified students.

5 units, Aut (I. Yalom)

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**

1. Cultural Anthropology.
167. Language and Culture.
245. Political Anthropology.
255. Advanced Psychological Anthropology.
256. Cultural Transmission.

**ART**

123A,B. Modern Sculpture I and II.
155. Picasso.
176. Modern Architecture II: The Twentieth Century.

221. Seminar in Nineteenth Century Art: Rodin.
229B. Seminar in Political, Social Caricatures and Satires in England During the Eighteenth Century.
279. Seminar: Frank Lloyd Wright.

**ASIAN LANGUAGES**

255. The Nature of Literature: Japanese and Western Views.

**CLASSICS**

150, 250. Seminar: *The Ironic Muse* in the Classics of East and West.
163. Comparative Mythology.

**COMMUNICATION**

101. Film Aesthetics.
141. History of Film.

**COMPARATIVE LITERATURE**


**ENGLISH**

61. Forms of Afro-American Literature.
62A. Chicano Literature.
62B. Contemporary Mexican Writers.
63. Images of Women in Literature.
257. Transcendental and Counter Transcendental: Six Nineteenth and Twentieth Century American Poets.
266. Romantic Historical Literature.
269A. Toward an Understanding of Romanticism.
289B. Yeats, Eliot, Neruda.
368B. Seminar: American Critics.
388B. Seminar: Virginia Woolf and Her Circle.

**FRENCH AND ITALIAN**

103. The Nineteenth Century French Novel.
182. Le Roman en France depuis 1898.
188. Three Forms of Drama.
195. La France: société, politique et culture I.
396. Introduction to Existentialism.

GERMAN STUDIES
241. Deutsche Geistesgeschichte I — Von der Aufklärung zur Romantik.
242. Deutsche Geistesgeschichte II — Von der Romantik bis Nietzsche.
350C. Seminar: Kafka.

HISTORY
118A,B. Russian Intellectual History.
136A. European Intellectual History in the Nineteenth Century.
136B. European Intellectual History in the Twentieth Century.
156. Social Thought in America.
237. Undergraduate Colloquium: Modern Sexual Thought.

HUMANITIES
SPECIAL PROGRAMS
63. From the Enlightenment to the Present.
194. Seminar: Literature and the Humanities.
251. Basic Humanistic Problems.
305. The Early Modern Period.
306. Modernism and the Consciousness of the Humanities.

LINGUISTICS
310. Sociolinguistics.

PHILOSOPHY
103. Philosophy in the Nineteenth and Early Twentieth Centuries.
178. Phenomenology and Its Background.
181. Philosophy of Language.
183. Logic and Language.
199. Seminar in Recent Philosophical Literature.

POLITICAL SCIENCE
155. Comparative Marxist Theory.
159. Judeo-Christian Political Thought.

PSYCHOLOGY
121. Social Psychology.
132. Theories of Personality.
136. Abnormal Psychology.
146. Language and Thought.
172. Psychology of Perceptual Experience.

RELIGIOUS STUDIES
(See Humanities Special Programs)
112. Representative Protestant Thinkers.
233. Nineteenth and Twentieth Century Religious Thought.
243. Modern Theology.

SOCIOPHILY
100. Introduction to Sociological Research.
102. Introduction to Comparative Sociology.
112. Social Change.
123. Political Institutions and Behavior.
177. Norms, Values, and Behavior.
250. Basic Problems in Sociological Theory.

MUSIC
Emeritus: Putnam C. Aldrich (Professor)
Chairman: William L. Crosten (on leave spring quarter, 1973)
Associate Professors: Imogene Horsely, George Houle (on leave 1972-73)
Senior Lecturers: Arthur P. Barnes (Director of Bands), Marie Gibson (Voice)
Assistant Professor: John M. Chowning (on leave 1972-73). Acting: William H. Mahrt
Lecturers: Michael Andrews, Martin Bresnick (Theory); Meredith Ellis Little (Early Music Performance); Adolph Baller (on leave autumn quarter, 1973), Earle Blew, Nathan Schwartz*, Naomi Sparrow (Piano); David Abel*, Linda Ashworth, Stuart Canin (Violin); Rolf Persinger (Viola); Bonnie Hampton* (Violoncello); Charles
* Members of the Francesco Chamber Trio.
Siani (Double Bass); Barbara J. Bernhard, Lupe Duran (Flute); Raymond H. Duste (Oboe); Donald O'Brien (Clarinet); Susan Willoughby (Bassoon); Charles R. Bubb (Trumpet); Robert Szabo (Trombone); Earl Saxton (French Horn); Marjorie Chauvel (Harp); Stanley Buetens (Lute); Martha Blackman (Viola da Gamba); Margaret Fabrizio (Harpichord and Early Piano); Joan Benson (Clavichord and Early Piano); Robert Bernard (Voice)

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 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 on the level of 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.

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 (3)*</td>
<td>(3)*</td>
<td></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>
</tr>
</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 his initial registration, the student should be prepared:

(a) to demonstrate proficiency in piano equal to that specified in the A.B. program; (b) to take the requisite foreign language test as indicated below; (c) to take placement tests in theory and music history.

None of Stanford’s required undergraduate courses in music may be credited toward an advanced degree.

Only work that receives a grade of A, B, or plus will be recognized as fulfilling the advanced degree requirements in music.

Doctoral candidates working in absentia on Ph.D. dissertations or D.M.A. final projects which require consultation with faculty members must continue enrollment in the University under the heading of Terminal Graduate Registration.

**Teaching assistantships** — It is the policy of the Department to appoint each Doctoral candidate to a teaching assistantship for at least one quarter.

**Master of Arts**

**Residence** — A minimum of three quarters of full-time study in residence is required.

**Foreign language requirements** — All students are required on entrance to demonstrate: (a) a reading knowledge of one foreign language chosen from French, German, or Italian; and (b) a knowledge of the common musical terms in all three of the above languages.

**Study program** — Students may concentrate in composition, performance (including conducting), music history, or music education. To be recommended for the A.M.
degree, a candidate must complete a program of 42 units based on the graduate courses offered by the Department and including Music 200, 201, ensemble performance (3 quarters), Master of Arts Project (1 or 2 quarters). No more than 6 of these 42 units may be earned in ensemble. Depending on the concentration, the Master of Arts Project will be an investigative essay, a composition, or a demonstration of performance supported by a written commentary on the performance practices that are involved. In any case it should be completed during the last quarter of residence.

**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 his 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 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 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 his 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 work in the field of music history such as a term paper or a Master's thesis.

**Residence**—The candidate must spend at least three consecutive quarters beyond the Master's degree as a registered student at Stanford, and must devote at least one quarter in residence to work on his dissertation.

**Basic requirements**—Each candidate must complete a minimum of two years of full-time work beyond the Master's degree. The program will normally include: (1) readings in music theory; (2) seminars in musical notation, analysis and performance practice; (3) independent research culminating in a dissertation.

**Foreign language requirements**—A reading knowledge of French and German plus any other language necessary to research in the candidate's field of specialization. The examination in one language must be taken prior to the student's first registration. The second language must be certified by the end of the first year of doctoral study.

**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 qualifying examination to be taken prior to enrolling in dissertation work.

**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)

2. *The Concerto*.
   - 3 units (Kuhn)

   - 3 units (Mahrt)

   - 3 units (Salgo)

   - 3 units (____)

   - 3 units (Nanney)

    - 3 units (Nanney)

**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)


   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 (——)

103B. Nineteenth Century Harmonic Practice.
3 units, Spr (Ratner, 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 (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 (Smith)

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 (Smith)

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) given 1973-74

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. Tonality and Structure—Graduate review of harmonic functions; relation between details of progression and total structure.
4 units (Smith)

HISTORY AND LITERATURE

OF MUSIC

Unless otherwise stated, prerequisites for any course in this section are 103A,B.

140. Studies in Medieval and Renaissance Music—Prerequisite: 100.
4 units (Horsley)

140A. The Italian Madrigal.
4 units (Horsley)

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 (Crosten)

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 Music (Cabezón to Bach).
4 units (Nanney)

153B. Organ Music (Bach to Ligeti).
4 units (Nanney) given 1973-74

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.
(Blackman)

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.
3 units, Aut, Win, Spr


172A, 272A. Piano.
(Bailer, 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, Ashworth, Canin)

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)

175B, 275B. Oboe.
(Duste)

175C, 275C. Clarinet.
(O’Brien)

175D, 275D. Bassoon.
(Willoughby)

175E, 275E. Renaissance Wind Instruments.
(Staff)

176, 276. Brass Instruments.

176A, 276A. French Horn.
(Saxton)

176B, 276B. Trumpet.
(Bubb)
176C, 276C. Trombone. (Szabo)

176D, 276D. Tuba. (——)

177, 277. Percussion. (——)

130. Orchestral Conducting—Prerequisite: 127.

130A. 3 units, Win (Salgo) given 1973-74

130B. 3 units, Spr (Salgo) given 1973-74

131. Choral Conducting. 3 units, Aut (Schmidt)

169. Introduction to the Study of Performance Practices—Prerequisites: 23, 100, 101. 4 units, Aut (Little)

230. Advanced Orchestral Conducting.

230A. 4 units, Win (Salgo) given 1973-74

230B. 4 units, Spr (Salgo) given 1973-74

231. Advanced Choral Conducting.

231A. 4 units, Aut (Schmidt)

231B. 4 units, Win (Schmidt)

251. Choral Repertory (1500–1750). 4 units, Aut (Schmidt)

252. Choral Repertory (1750 to Present). 4 units, Aut (Schmidt) given 1973-74

269. Studies in Performance Practices—Performance studied in the light of musical resources, aesthetic attitudes, and theoretical principles of the various historical periods. Lectures, individual research, and practice sessions leading to concert performances. May be repeated for credit. Prerequisite: 169.

269A. Medieval. 4 units, Aut (Mahrt)

269B. Renaissance. 4 units, Spr (Mahrt)

269C. Baroque. 4 units, Win (Little)

269D. Classic. 4 units, Aut (Ratner)

279. Opera Workshop—Study of opera through performance. Coaching in individual 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. Membership in these organizations is not limited to students who register in the courses for credit, and unless otherwise stated, is open to both men and women. An audition, however, is required for admission to any University musical organization. Audition schedules will be announced in advance of each registration period.

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, Andrews) 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.

161B. Studio Band. 1 unit, Aut, Win, Spr (Barnes) by arrangement

161C. Sports Activity Bands. 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 performing 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 ensemble specializing in performance of Renaissance and contemporary music. 1 unit, Aut, Win, Spr (Schmidt) (1)

MT 12–18 (I), TF 12
166. Chamber Orchestra — Open to advanced players who have had orchestral experience.
   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)
   MTh 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 in small combinations for strings, winds, and keyboard instruments.
   1 unit, Aut, Win, Spr (Staff)

271. Performance Special — For students who take part in performances organized in Music 269 or 279 while not enrolled in either of those classes.
   1 unit, Aut, Win, Spr (Staff)

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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)

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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. Master of Arts Seminar in Music History and Analysis.
   4 units, Aut (Crosten)

299. Master of Arts Project.
   4 units, any quarter (Staff)

300. Seminar in Musical Notation.
   300A. 4 units, Aut (Horsley)
   300B. 4 units, Win (Horsley)
   300C. 4 units, Spr (Horsley)

301. Seminar in Music History and Analysis.
   4 units, Aut, Win, Spr (Smith, Horsley, Ratner)

302. Research in Musicology.
   Aut, Win, Spr (Crosten, 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
NAVAL SCIENCE

Chairman: Henry C. Stackpole, III (Major, USMC), Commanding Officer
Lecturers: David O. Maupin (Lieutenant, USN), Henry C. Stackpole, III (Major, USMC)

OFFERINGS AND FACILITIES

The Naval Science Program affords the opportunity for selected students to receive instruction in essential Naval subjects which, in conjunction with a baccalaureate degree earned through undergraduate work in fields of their own choice, will qualify them for a commission in the United States Naval Service.

The Regular NROTC Midshipman is chosen in nation-wide competition and attends the University under Navy sponsorship. In addition to payment for tuition, books, and fees, he draws retainer pay of $100 per month.

Upon successful completion of the required courses in Naval Science, together with the University requirements for a baccalaureate degree, NROTC students are appointed Ensigns and serve on active duty with the Fleet as commissioned officers. Qualified students who so desire may pursue Marine Corps professional studies during the last two years of attendance. Upon completion they may be appointed Second Lieutenants.

All Stanford students are eligible for enrollment in Naval Science courses with the consent of the instructor. The academic year 1972–73 is the final year in which Naval Science courses will be offered at Stanford.

PROGRAMS OF STUDY

ACADEMIC MAJOR

To qualify for commissioning in the U.S. Naval Service, students must satisfy all requirements leading toward a baccalaureate degree. No restriction is placed on the individual's selection of a major other than requiring the Navy scholarship student to pursue a field of study of interest to the Naval Service. Satisfactory programs include, but are not restricted to, Arts, Business, Chemistry, Economics, Education, Engineering, Humanities, Mathematics, Physical Sciences, and Physics.

SPECIFIED COURSES

Additionally students must satisfactorily complete the following courses offered by other departments of the University.

1. A Mathematics series (one of the below)
   - Math 10, 11, 21
   - Math 21, 22, 23
   - Math 41, 42
   - Math 10, 11, and Statistics 50
   - Statistics (2 quarters)
   - Probability (2 quarters)

2. A Science series (one of the below)
   - Physics 21, 23 including lab
   - Physics 51, 53, 55 including lab
   - Chemistry 1, 2
   - Chemistry 4, 5
   - An approved Biology sequence
   - An approved Earth Science sequence

3. Computer Science 105 or 106

COURSES

Naval Science courses are three-quarter courses. Course numbers are assigned by the Naval Science Department and do not correspond to the general University plan for numbering, i.e., none are graduate courses.

413. Naval Leadership—Study of the contemporary problems of personnel interface and resources management of the Naval Organization. Symposia will be conducted on Minority Affairs, All Volunteer Armed Force, Public Affairs, and the Navy's Role in a Modern Society.

   3 units, Spr (Maupin) MTW 12; lab W by arrangement

414. Evolution of Warfare—Study of Warfare as an historical instrument of political action. Analysis of the interaction of warfare with diplomacy, economic competition, international law, religious action, and social reform as components of statecraft. Emphasis is placed on considering the ethical considerations of a nation state both in engaging in war and being prepared for war.

   4 units, Aut (Stackpole) MWF 12

Naval Science Laboratory — Two hours a week of Naval Science Laboratory required of all NROTC students. One hour consists of a continuing leadership seminar. The other hour is practical work conducted in regular classroom sessions.
PHILOSOPHY

Emeriti: John D. Goheen, Jeffrey Smith (Professors)
Chairman: Julius Moravcsik
Director of Graduate Study: To be named.
Director of Undergraduate Study: Thomas Schwartz


Associate Professors: Harvey Friedman (on leave 1972-73), Joseph D. Sneed

Assistant Professors: Joan Bresnan, Dov M. Gabbay, Robert Howell (on leave autumn and winter quarters, 1972-73), Thomas Schwartz, Michael Tooley (on leave spring quarter, 1973). By Courtesy: Robert McGinn (Humanities Special Programs)

PHILOSOPHY

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

Normally these are to be lecture courses of at least 3 units each.

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 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 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. Completion of a total of at least 36 units of graduate work in the Department with grades no lower than C and an average grade of B or better. Course work shall include one or two quarters in Philosophy 250.

2. Completion of a thesis acceptable to the Department. Credit will be allowed for the thesis to a maximum of 9 units toward the 36 units required for the degree.

3. Satisfactory performance on the preliminary examinations described below under “Doctor of Philosophy.”

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 pass one written preliminary examination (see item two under Proficiency Requirements below). The choice of courses and preliminary examination must be recommended by a faculty member who agrees to serve as the student’s adviser and 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 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
      2) The Rationalists
      3) The Empiricists
      4) 19th and 20th Century Philosophy
   b) Four sections:
      1) elementary logic (157A,B level)
      2) advanced logic
      3) philosophy of science
      4) formal theories of language

Thos examined will answer questions on one philosopher from each section.

b) Four sections:
   1) ethical 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 at least one other section.

3. Every student must take at least one preliminary examination during his first year of graduate study.

4. Every student must have passed at least two preliminary examinations by the end of his 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 has previously passed a preliminary examination, and fulfilling a special course requirement in the remaining area.

6. In addition to these programs a student may substitute a research paper for no more than one preliminary examination (excluding specialized examinations) or course requirement in any of the above options subject to the following conditions:
   a) the student submits a written request for this substitution, including a detailed sketch of the proposed paper,
to the faculty committee responsible for the preliminary examination in the relevant area no later than the second week of the autumn quarter of the student's second year of graduate study;
b) the faculty committee unanimously approves the request;
c) the final draft of the paper is submitted to the faculty committee no later than Friday of the second week in March of the student's second year of graduate study;
d) the faculty committee passes the paper.

7. Course requirements, general and special, in the areas are as follows:

a) History of Philosophy
   1) general: four courses 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, 168, 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 to demonstrate competence in one or more languages if his dissertation research makes this requirement appropriate.

Dissertation—Upon passing the preliminary examinations the candidate will submit a brief written statement of his 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 degree.

Dissertations must be completed and approved within five years from the date of application. A candidate taking more than five years will be required to reinstate his 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 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 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 de-
scription 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 will have certain teaching duties. Details of this program may be obtained from the Department. In any term in which he 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 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 his 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 humankind 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 (Gibbard) MTWTh 9

3. **Logic of Political Action** — An introduction to the conceptual tools of political argument and action: Facts and values; logic and consistency; evidence and probability; decision making under uncertainty; game theory; organization theory. A survey of formal methods supplemented by readings from Machiavelli, Clausewitz, Lenin, Saul Alinsky, Mao Tse-tung and others. Emphasis will not be on political philosophy, but rather on formal techniques with illustrations of their usefulness in the area of political advocacy.

   5 units, Aut (Sneed) MTWTh 3:15; Th or F section

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 1973-74
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

6A,B. Problems of Good and Evil — The course will consider various ways in which man, in different socio-political contexts, has tried to come to terms with the recurrent human problems of individual death, tragedy, suffering and injustice in his persistent effort to give meaning to his own existence. Readings in the first quarter will include the "Book of Job" and other selections from the Old Testament, several Greek tragedies, selections from classical and hellenistic philosophers, from the New Testament and Dante's Divine Comedy. In the second quarter readings will include selections from such writers as Montaigne, Descartes, Pascal, Hume, Kant, Dostoevsky, Marx, Mill, Nietzsche, Sartre and Camus. Attention will also be given to different concepts of "Human Nature," "The Human Condition" and their implications for morality and law. Reference also will be made to relevant developments in the social sciences and new trends in the philosophy of science.

6A. 4 units, Win (Rhinelander) MWF 10
6B. 4 units, Spr (Rhinelander) MWF 10

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 (Schwartz) MW 11; Th or F section
7B. 3 units, Spr (Schwartz) MW 11; Th or F section

9. Science and Society — An examination of the conceptual structure of scientific theories with emphasis on the following questions: Is there any value-neutral, social-context-independent criterion for assessing the truth and other intellectual merits of scientific theories? Does the answer to this question differ for the physical and the behavioral sciences? By what criteria should society make decisions about support of scientific research?

5 units, Win (Sneed) MTWTh 3:15

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, Win (——) MTWTh 1:15, given 1973–74

15A. Introduction to Logic — (Graduate students enroll in 157A.) Discussions of axioms and rules of inference of first order predicate logic. Natural deduction rules. Interpretation and validity, theory of description, theory of definition; axiomatic theories. Basic definitions and operation with sets.

5 units, Aut (Gabbay) MTWThF 1:15

(Undergraduate Seminars and Tutorials

See also 191, 196, 197, and 199.)

27. Sophomore Seminar in Philosophy of Religion — A critical examination of the fun-
damental 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 relationship between science and religion; (4) the relationship 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 1973–74

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


4 or 5 units, Win (Mothershead) 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 1973–74

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 1973–74

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 1973–74


3 units, Win (Nivison) MWF 2:15

136. Philosophy of Plato.

4 units, Win (Moravcsik) MTWTh 10

137. Philosophy of Aristotle—Prerequisite 100 or equivalent.

4 units, Win (Moravcsik) MTWTh 10, given 1973–74
142. Seminar in the Philosophy of Descartes—Prerequisite: 102 or equivalent. 3 units, Aut (Howell) T 4:15-6:05, given 1973-74

143. Rationalism—Epistemology and metaphysics in principal works of Descartes, Leibniz and Spinoza. 4 units, Spr (——) MTWTh 3:15, given 1973-74

144. Seminar in the Philosophy of Spinoza—A study of the basic works of Spinoza. 4 units, Spr (Rhinelander) MW 2:15-4:05, given 1973-74

145. Seminar in the Philosophy of David Hume—Prerequisite: 102 or equivalent. 3 units, Win (Howell) T 4:15-6:05, given 1974-75

146. British Empiricism—Epistemology and metaphysics in the principal works of Locke, Berkeley, and Hume. 4 units, Win (Howell) TTh 2:15-4:05, given 1973-74

147. The Philosophy of Kant—A selection of representative problems in Kant’s philosophy is discussed in the light of recent developments. 3 units, Spr (Howell) Th 4:15-6:05, given 1973-74

152A. The Philosophy of Heidegger—Study and discussion of selected works by Heidegger in English translation including Being and Time. Students who want to take this course, should preferably have taken course 178 or have comparable background in phenomenology. 3 units, Spr (Føllesdal) MWF 2:15, given 1973-74

152B. The Philosophy of Sartre—Study and discussion of selected works by Sartre in English translation, including Being and Nothingness, and several of Sartre’s novels and plays. 3 units, Sum (Føllesdal)

SYSTEMATIC PHILOSOPHY

157A. Introduction to Logic—Content same as Philosophy 2. Special section for graduate students. 4 units, Aut (Gibbard) MTWTh 9

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 (Gabbay) 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 (——) MW 11:00-12:15

160B. 3 units, Spr (——) 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 (Gabbay) 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 1973-74

163B,C. Intensional and Modal Logics—General intensional operators. Modal, deontic tense and counterfactual operators. Kripke semantics. Applications to natural languages. Decidability and the finite model
property. Propositional quantifiers, statability operators, identity.
163B. 3 units, Aut (Gabbay) MWF 12
163C. 3 units, Win (Gabbay) 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, Spr (Suppes) MW 1:15

165. Philosophy of Logic—Some or all of the following topics will be discussed from a semi-formal point of view: Platonism versus nominalism, relation between logic and mathematics, epistemological implications of Gödel’s and Church’s theorems, counterfactuals, necessity and possibility, extensional and intensional contexts, synonymy, intuitionism, constructivity.

3 units, Aut (Kreisel) TTh 4:15-5:30, given 1973-74

166. 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

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

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

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 “metaethics.” 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 (Schwartz) TTh 11:00-12:15, given 1973-74

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, Aut (Schwartz) MTWTh 1:15, given 1973-74

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 (Schwartz) TTh 11; section Th or F

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 (Schwartz) MW 11; Th or F section
175B. 3 units, Spr (Schwartz) MW 11; Th or F section

176. Philosophy of Education — (Same as Education 204.)

177. Foundations of Normative Economics — An analysis of some fundamental concepts of welfare economics: preference, utility, technological possibility, social welfare functions, externalities, public goods, etc. An examination of the ideological implications of this conceptual framework with particular emphasis on anarchist and Marxist criticism.

4 units, Spr (Sneed) MTTh 3:15


3 units, Win (——) MWF 2:15, given 1973-74

179. Philosophy of Law — The nature and function of law, the relation of law to ethics, and the judicial process.

3 units, Aut (Rhinelander) MWF 10

181. Philosophy of Language — A study of the concepts and techniques required for the syntactic and semantic analysis of natural languages, including elements of formal semantics and transformational grammar. Prerequisites: two courses in philosophy or linguistics.

4 units, Aut (Moravcsik) MTWTh 11

183. Logic and Language — A discussion of some of the main problems in the logical analysis of language — problems bordering on logic, the philosophy of language and ontology and often discussed under rubrics like “philosophy of logic” and “philosophical logic.” Sample topics: (1) Singular terms and definite descriptions; (2) Ontic commitment; (3) Intensionality, with special emphasis on referential opacity and quantification into intensional contexts; (4) The logical form of statements involving adverbs and attributives; (5) Time and tense; (6) The logical form of statements with non-designating accusatives; (7) Abstract reference and the abstract/concrete distinction. Attention will also be given to the nature of logical form, to the rationale behind the logical analysis of language, and to the criteria for successful analyses. Prerequisite: 157A or equivalent.

3 units, Win (Hintikka) MWF 2:15

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, Win (Sneed, Suppes) W 4:15–6:05
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, Win (Sneath) by arrangement

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 (Howell) 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

193A,B. 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 naïve set theory and axiomatic method. Consult instructor for details.

193A. 3 units, Aut (Schwartz) MW 2:15–3:30

193B. 3 units, Win (Schwartz) TTh 11:00–12:15

196. Tutorial—Senior year.

5 units, any quarter (Staff) by arrangement

197. Individual Work for Undergraduates.

Any quarter (Staff) by arrangement

199. Seminar in Recent Philosophical Literature—Open to junior and senior students with consent of instructor. Seminars on various topics will be announced from time to time. Topic: Utilitarianism.

3 units, Aut (Gibbard) 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 1973–74

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

204. Seminar in Moral and Political Obligation—A systematic study of social justice and its relation to social utility. A good part of the time will be devoted to John Rawls’ *Theory of Justice*, one of the most important recent contributions to political theory. This material should be of interest to students of law and political science as well as philosophy. Prerequisite: consent of instructor for undergraduates.

3 units, Spr (Schwartz) W 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 multi-valued logic. Various axiomatic formulations of classical quantum mechanics will also be discussed.

3 units, Spr (Sneath) by arrangement
206. Mathematical Models in Behavioral Sciences: Measurement and Utility Theory — After a general introduction to the theory of models in the empirical sciences, the course will concentrate on the general theory of measurement and scaling. The last part of the course will deal with utility theory and related topics like subjective probability and decision criteria.

3 units, Aut (Suppes) TTh 2:15,
given 1973–74

210, A, B, C. Seminar in Mathematical Models of Learning and Instruction—(Same as Education 483.)

210A. 1 to 3 units, Aut (Suppes, Elashoff)  
M 12 and by arrangement

210B. 1 to 3 units, Win (Suppes, Elashoff)  
M 12 and by arrangement

210C. 1 to 3 units, Spr (Suppes, Elashoff)  
M 12 and by arrangement

215. Philosophy, Education, and Society—  
(See as Education 405.)

4 units, Win (Hintikka) 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, Win (Hintikka) MTWTh 3:15,  
given 1973–74

222. Seminar in the Philosophy of Kant—  
Detailed analysis of the Critique of pure reason.

3 units, Win (Hintikka) T 2:15–4:05

236. Seminar in the Philosophy of Plato—A study of metaphysical and epistemological themes in the later Platonic dialogues.

3 units, Aut (Moravcsik) M 4:15–6:05,  
given 1973–74


3 units, Spr (Moravcsik, 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

241A, B. Seminar in the Philosophy of Language—This is a continuing 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.

241A. 1 to 6 units, Win (Bresnan, Cabbage, Moravcsik) W 4:15–6:05

241B. 1 to 6 units, Spr (Bresnan)  
W 4:15–6:05

242A, B, C. Seminar in the Philosophy of Science.

242A. 3 units, Aut (Suppes, Sneed)  
M 4:15–6:05

242B. 3 units, Win (Suppes, Sneed)  
M 4:15–6:05

242C. 3 units, Spr (Suppes, Sneed)  
M 4:15–6:05

244. Seminar in Metaphysics.

3 units, Spr (Moravcsik) T 4:15–6:05

245. Seminar in Foundations of Psycholinguistics—Theories of language learning will be examined with particular attention to current theories of performance and competence. Critique of stimulus-response theories and of purely linguistic theories of language learning. Implications of psycholinguistics for the philosophy of language.

3 units, Spr (Suppes) T 4:15–6:05

Any quarter (Staff) by arrangement

259. 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, Win (——) given 1973–74

290A, B, C. Mathematical Logic—(Enroll in Mathematics 290A, B, C.)

291A, B. Topics in Model Theory—(Enroll in Mathematics 291A, B.)

291A, B. Topics in Recursion Theory—(Enroll in Mathematics 291A, B.)

293A, B. Topics in Proof Theory—(Enroll in Mathematics 293A, B.)  
Given 1973–74

294A, B. Topics in Set Theory — (Enroll in Mathematics 294A, B.)  
Alternate years, given 1973–74
295. Advanced Automata Theory—(Enroll in Electrical Engineering 484.)

299. Advanced Seminar in Recent Philosophical Literature—Topic: Utilitarianism. 3 units, Aut (Gibbard) T 4:15–6:05


391A. Units by arrangement, Aut ( ) W 4:15–6:05, given 1973–74

391B. Units by arrangement, Spr (Kreisel) W 4:15–6:05

391C. Units by arrangement, Spr ( ) T 4:15–6:05, given 1973–74

PHYSICAL SCIENCES (GENERAL PROGRAM)

Professor: Claudio Alvarez-Tostado
Associate Professor: Julien A. Ripley, Jr.
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) MWF 11

75, 76, 77. History of Science—Origin and development of science from its inception to the present.

75. 3 units, Aut (Ripley) MWF 10

76. 3 units, Win (Ripley) MWF 10

77. 3 units, Spr (Ripley) MWF 10

99. Directed Reading.
Any quarter (Staff)

100. Physical Science and Modern Life—Review of important conclusions, theories of modern physical science; discussion of
PHYSICS

methods, values, limitations of scientific inquiry; survey of relations of science to technology, economics, sociology, philosophy, religion. Prerequisite: junior or senior standing.

3 units, Win (Ripley) MWF 9

150. Philosophical Problems in the Physical Sciences — Current issues and problems in the philosophy of science in the context of modern scientific and mathematical developments. Topics to be discussed will include: the meaning and verification of scientific theories and models; the nature, function, and interpretation of postulate systems; the role of explanation and prediction; problems of "causation," "probability," and "reality" in the light of quantum physics and relativity theory. Emphasis and selection of topics will be determined on the basis of student background and interest. Prerequisites: restricted to a maximum of 20 students of junior or senior standing, who have completed a minimum of 6 credit hours in a course in one of the physical sciences (chemistry, physics, geology, etc.) on the university level, and who have completed the equivalent of college algebra. Exceptions only with consent of instructor.

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

Any quarter (Staff)

PHYSICS

Emeriti: Felix Bloch, Paul H. Kirkpatrick, David L. Webster (Professors)
Chairman: Walter E. Meyerhof


Associate Professors: Alexander L. Fetter, Theodor W. Hansch, H. Alan Schwettman, Stanley G. Wojcicki


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.

Students who wish to specialize 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 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, 1973, for the following autumn. Graduate students may normally enter the Department only at the beginning of autumn quarter.

Programs of Study

The study of physics is undertaken by three principal classes of undergraduates: those including physics as part of a general education, those preparing for careers in professional fields that require a knowledge of physics, such as medicine or engineering, and those preparing for teaching or research careers in physics itself. In this Department the courses numbered below 200 are planned to serve all three of these groups. The courses numbered above 200 meet the needs mainly of the third group, but also of some students majoring in other branches of science and in engineering.

Bachelor of Science

Department requirements for the degree of Bachelor of Science are as follows: Physics 51, 53, 54, 100, 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, 43, and 45.

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 55, 56, 59, and 60. 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 the upper-class years. Students are urged to work out, in consultation with their advisers, a program which will best fulfill their individual aims. The Undergraduate Office of the Physics Department has more detailed information on how to obtain a Bachelor's degree in Physics. This should be carefully studied by prospective majors, especially if they intend to make use of Stanford's programs abroad. Under some circumstances the Department will permit, by petition, flexibility in the requirements so that the student may fit a period abroad into his program.

NORMAL SEQUENCE

First Year†

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 51, 53. Mechanics, Electricity</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 54. Electricity Laboratory</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 41, 42, 43. Analytic Geometry and Calculus</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Second Year†

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 55, 57. Light and Heat, Atomic Physics</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 56, 58. Light and Heat, and Atomic Physics Laboratory</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 110, 111. Int. Mechanics</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 44, 45, 46. Advanced Calculus</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
<td></td>
</tr>
<tr>
<td>Math. 130, 131, 132. Ordinary Differential Equations, Partial Differential Equations</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
<td></td>
</tr>
</tbody>
</table>

† Additional elective units must be added to bring the total number of units to 180 as required by the University. Students should consult their advisers about the course distribution requirements in areas outside of the sciences.

* Not required for degree in physics.
**ADVANCED SEQUENCE**

### Fourth Year†

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 200, 201, 202. Advanced Physics Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 220, 221, 222. Classical Electrodynamics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 230, 231, 232. Quantum Mechanics</td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

### Third Year†

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 130, 131, 132. Atomic and Nuclear Structure</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 170, 171, 172. Thermodynamics, Kinetic Theory and Introduction to Statistical Mechanics, Physics of Solids</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 210, 211. Introductory Theoretical Physics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 113, 114, or 120. Linear Algebra and Matrix Theory or Modern Algebra</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### Second Year†

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 100, 101. Int. Physics Laboratory</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 120, 121, 122. Int. Electricity and Magnetism</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics 161. Int. Optics</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 46. Advanced Calculus</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Math. 106. Complex Variables</td>
<td></td>
<td></td>
<td>(3)*</td>
<td></td>
</tr>
<tr>
<td>Math. 132. Partial Differential Equations</td>
<td></td>
<td></td>
<td>(3)*</td>
<td></td>
</tr>
</tbody>
</table>

### First Year†

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 55, 59, 60. Light and Heat, Advanced Fresh. Physics</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Physics 58. Light and Heat Laboratory</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 43, 44, 45. Analytic Geometry, Calculus, Advanced Calculus</td>
<td>5</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 130, 131. Ordinary and Partial Differential Equations</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Students who have not taken Physics 58 must also take Physics 101.**

### 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, 222, 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, will be expected to gain teaching experience as an integral part of their graduate training.

The student interested in applied physics and biophysics research should also be aware of the Ph.D. granted independently by the Applied Physics Department and by the Biophysics Program. Students interested in astronomy, astrophysics, or space science should consult the Astronomy Course Program. See elsewhere in this bulletin.

Minors in physics must take either Physics 210, 211, and one other course above 100, or Physics 130, 131, and 132, or Physics 170, 171, and 172, with the appropriate prerequisites. All prospective physics minors must receive approval of their physics course program (at least one year before the award of the Ph.D.) from the Physics Graduate Study Committee.

The office of the Physics Department has more detailed information on how to obtain an advanced degree in Physics. This should be consulted by prospective candidates for advanced degrees.

**Teaching Credentials and Master of Arts in Teaching**

In its capacity as agent for the State Board of Education, the University grants credentials for teaching in California in junior and senior high schools and junior colleges. Applicants for these credentials should consult the Credential Secretary of the School of Education for details of the requirements in connection with the teaching of physics.

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. 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, 1973.

**Courses**

There are four series of beginning courses. The Ten Series (10, 12, 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 thor-
oughly 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). Graduate courses in astronomy, astrophysics, biophysics, microwave physics, plasma physics, solid state physics, and space science are offered in the Applied Physics Department, the Astronomy Course Program, and the Biophysics Program.

10. Special Topics in Physics — This course proposes to familiarize the humanities or social science student with part of modern physics. In 1972–73 the subject will be The World of Physics: Nuclei and Particles. 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 mentioned. The relevance of nuclear physics in modern society will be emphasized. 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 (Meyerhof) M 2:15–4:05; discussion W 2:15 or 3:15

12. The Basis of the Physical Laws—In this course we will discuss the fundamental notions that enter into the formulation of physical laws. In particular we will consider the extent to which physical theories are constrained by symmetry principles such as “time reversal invariance,” “charge conjugation invariances,” “invariance under reflection,” “Gallilean and Lorentz invariance,” and “invariance under rotation and translation.” A number of recent experiments which investigate these points will be explained in detail. This is a course for the intelligent layman with an interest in comprehending a portion of the world around him. No prerequisite.

3 units, Win (Schwartz) M 2:15–4:05; discussion W 2:15

19. An Introduction to Physics—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) M 2:15–4:05; 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 (Wojcicki) lec. MWF 10 or 11 and lab.

23. Electricity and Optics—Electric charges and currents, magnetism, induced currents; wave motion, interference, diffraction, geometrical optics. Prerequisite: 21.

4 units, Win (Little) 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 10 or 11 and lab.

51. Mechanics — Vectors, particle kinematics and dynamics, work, energy, momentum, angular momentum; conservation laws; rigid bodies; oscillations. Discussions based on use of calculus. Prerequisites: Mathematics 41 or 11 and continuation in Mathematics 42, or consent of instructor.

4 units, Win (Schwettman) lec. MWF 9 or 10; discussions (Yearian)

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 (Schwartz) 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 (Schawlow) lec. MWF 9 or 10; discussions (Yearian)

56. Light and Heat Laboratory—Concurrent registration in 55 is required.
   1 unit, Aut (Yearian)

57. Atomic Physics — Experimental basis of quantum theory; atoms, atomic structure, X-rays, nuclei, radioactivity. 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—This course deals mainly with the subjects of mechanics and electricity at the level of the Berkeley physics course (McGraw-Hill, 1968) and the Feynman Lectures in Physics (Addison-Wesley, 1963 and 1964). A considerable amount of outside reading and homework will be required. A discussion period or fourth lecture may be added to the regular lectures, as needed. Prerequisites: 55, 56, and advanced placement in mathematics and in the Physics Fifty Series, concurrent registration in Mathematics 44 and consent of instructor.
   59. 4 units, Win (Hitlin) TTh 9:00-10:50
   60. 4 units, Spr (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 (Hitlin) by arrangement
   101. 2 units, Spr (Opfer, Wojcicki) by arrangement
holography, crystal optics, lasers and their modes, optical waveguides.

3 units, Spr (Schawlow) MWF 9


170. 3 units, Aut (Bloch) 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 (Turneaure) 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, Aut (Schwettman) W 3:15
Win (Meyerhof) W 3:15
Spr (Wojcicki) W 3:15

200, 201, 202, 203. Advanced Physics Laboratory—Experiments in atomic physics, nuclear physics, solid state physics, low temperature physics, particle physics, and cosmic rays, including 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 fundamental experiments chosen mainly from the field of atomic and nuclear physics. 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 (Walecka) MWF 10


3 units, Win (Walecka) MWF 10

220, 221, 222. Classical Electrodynamics — Electro- and magneto-statics (boundary value problems, Green's functions), Maxwell's equations, electromagnetic properties of matter, waves, dispersion relations. Relativity, covariant formulation of Maxwell's equations, Lienard-Wiechert potential, relativistic electrodynamics (energy-momentum and angular momentum tensors). Radiation theory, scattering and diffraction, crystal optics. Special topics, such as magnetohydrodynamics, applications to cosmological and astrophysical problems, and classical field
theory. 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
222. 3 units, Spr (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 scattering matrix, phase shifts, complex potentials, and dispersion relations are developed. The technique of second quantization is also introduced. Prerequisites: 132 and 211 and Mathematics 106 and 132, and preferably Physics 222.

230. 3 units, Aut (Glavish) TTh 9:00-10:50
231. 3 units, Win (Glavish) TTh 9:00-10:50
232. 3 units, Spr (Glavish) 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 (Hofstadter) MWF 11
241. 3 units, Win (Hanna) 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 (West) 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 (Yearian, Ritson, Schwartz, Wojcicki, Staff) MWF 1:15
261. 3 units, Win (Fairbank, Schwettman, Fetter, Walecka, Staff) MWF 1:15
262. 3 units, Spr (Hanna, Meyerhof, Hansch, Schawlow, Staff) MWF 1:15

270. Statistical Mechanics—Liouville theorem, Canonical Distribution, Thermodynamic Functions, Specific Heat, Magnetism, Quantum Statistics, Einstein-Bose and Fermi-Dirac distribution. Prerequisite: 171. Concurrent or prior enrollment in 232 and Mathematics 106 is required.

3 units, Spr (Bardeen) MWF 10

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 (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: 222 and 232.

330. 3 units, Aut (Peccei) TTh 1:15-3:05
331. 3 units, Win (Peccei) TTh 1:15–3:05
332. 3 units, Spr (Peccei) TTh 1:15–3:05


3 units, Spr, alternate years, given 1973–74

336. Advanced Topics in Theoretical Physics — Discussion of selected topics of current interest in theoretical physics. Prerequisite: 330.

3 units, Aut (Bardeen) MWF 2:15
Win (Bardeen) MWF 2:15
Spr (__) by arrangement


3 units, Aut (Donnelly) TTh 9:00–10:50
Spr (—) by arrangement

341, 342. Nuclear and Elementary Particle Theory — Nuclear matter, theory of angular momentum, group theory and nuclear spectroscopy. Nuclear models. Weak interactions, nuclear reactions, and special topics in elementary particle theory. Prerequisites: 222, 241, 251, 340, concurrent or prior registration in 331, 332 is recommended.

341. 3 units, Win, alternate years, given 1973–74
342. 3 units, Spr, alternate years, given 1973–74


370. 3 units, Win (Donnelly) TTh 9:00–10:50, alternate years, given 1972–73
371. 3 units, Spr (Donnelly) TTh 9:00–10:50, alternate years, given 1972–73

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

POLITICAL SCIENCE

Emeriti: Thomas S. Barclay, Philip W. Buck, Christina P. Harris, Anthony E. Sokol, Graham H. Stuart (Professors)

Chairman: Heinz Eulau


Assistant Professors: Jonathan D. Casper,
Lecturers: Robert M. Rosenzweig, Eric Vogelin. Visiting: James N. Danziger, Lawrence E. Rose

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 subject 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). He must declare his major no later than the winter quarter of his junior year. For the Bachelor's degree, a total of 50 units is required; 30 of these 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 students 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 Spring 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 have secured the agreement of a regular faculty member to be their thesis adviser. Students admitted to the program will be so advised before the end of Spring quarter.

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 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**

Applications from students who plan to terminate their graduate study at the Master's level are not accepted except in joint degree programs with certain other professional schools within Stanford University. The normal procedure in these instances is for the student to apply sometime during his first year in the professional school within the University.

The Master's degree may be awarded to Doctoral candidates who have completed the following requirements:

The faculty of the Department recommends a candidate for the Master's degree if he 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 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 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 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 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 his adviser a statement of purpose. This statement will indicate the student's proposed major fields of study, the courses he has already taken and those he proposes to take in order to cover his 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 by him, 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 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 a student and his 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 him, or to a member of the faculty designated by him as a minor advisor, 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 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, civil rights, social welfare, poverty, foreign policy. Political process; influence of cultural, economic, political factors on determination of public policy.

   5 units, Aut (Marshall) MTWThF 10
   Win (Marshall) 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 Congress, the Presidency, pressure groups, and national policy-making from the New Deal to the present.

   5 units, Win (Manley) MWF10
   Spr (Horn) MTWThF 11

15. **Introduction to Political Development**—Comparative analysis of the formation and development of political systems; special attention to participation, state-building, and resource allocation in Western and non-Western countries.

   5 units, Spr (Harding)
   lec. MW 10 and section

20. **Introduction to Comparative Government and Politics**—Political development, governmental institutions and political pro-
cesses in selected political systems, such as England, the Soviet Union, and Japan.

**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**

100. Introduction to Public Administration
—Introduction to the study of organization with particular reference to public administrative agencies. Includes the development of the study of public administration, organization theory, decision theory, and administration as a political phenomenon. Prerequisite: 10 or consent of instructor.

5 units, Aut (Fry) MTWThF 9

105. Seminar on the Budgetary Process — An overview of the budgetary process with an emphasis on bureaucratic politics and the relationship between the budget and the political system.

5 units, Spr (Fry), given 1973-74

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. Prerequisite: 100. Recommended: Economics 1. (Graduate students enroll in 207.)

5 units, Win (Marshall) M 2:15-4:05

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. Prerequisite: 100. (Graduate students enroll in 208.)

5 units, Spr (Marshall) M 2:15-4:05

109. Directed Reading in Administration—Advanced individual study in public administration. Prerequisite: 100.

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, Win (Walker) MTWThF 11

For graduate courses in Administration, see Graduate Courses.

**COMPARATIVE POLITICS**

111A. European Politics: The British Political System—Examination of the politics and processes of government in Britain; the operation of parliamentary government; the responses of the political system to the issues and problems in contemporary Britain.

4 to 5 units, Aut (Danziger) 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) given 1973-74

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, Aut (Steiner) MTW 9

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.

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, Aut (Ike) MTWTh 9

113A. Latin American Politics: Major Themes — Topics in Contemporary Latin
American politics: colonial legacies; social, economic, and cultural contexts; sociopolitical groups; political parties; the military; links to international environment; dependency relations; political institutions and decision-making.

4 to 5 units, Win (Packenham) given 1973–74

113B. Latin American Politics: Selected Country Analyses—Survey of political processes, institutions, and leaders, in their historical and socioeconomic contexts, in selected Latin American countries. Emphasis on Brazil, Mexico, Argentina, and Cuba.

4 to 5 units, Win (Packenham) MWF 1:15

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. Desirable prerequisite: 15, or 20, or 112.

4 to 5 units, Win (Ike) MTWTh 1:15

115. Government and Politics in China—Governmental institutions and the political process in the Chinese People's Republic; analysis of elites, policy formulation, techniques for eliciting mass response, and constraints upon the exercise of central power. Desirable prerequisite: 20 or equivalent or 112; History 190, 191, 192, or 193; or Anthropology 117.

4 to 5 units, Win (Harding) MTWTh 10

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) MWF 2:15–4:05

117. Government and Politics of Africa South of the Sahara—Focuses 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) given 1973–74

118L. Political Leadership.

5 units, Win (Lewis) MTWThF 9

119A. The Soviet Union: Politics and Society Since 1917—(Same as History 123A.)

5 units, Spr (Dallin) MTWTh 10

119B. International Communism: From the First International to the Present—(Same as History 123B.)

5 units, Aut (Dallin) MTWTh 10

120A. Seminar in Comparative Politics: Japan—(Graduate students enroll in 220A.)

5 units, Spr (Ike) W 2:15–4:05

123. Seminar in Comparative Politics: Latin America—(See 223.)

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 1973–74

126A. Seminar in Comparative Political Ideologies—The aim of the seminar is to develop some analytical guidelines for assessing ideologies and orienting ideological study and construction. The course will call attention to historical continuities in the issues and substantive difficulties in studying the "life histories" of ideologies. The substantive focus will be on a critical analysis of emergent ideologies of liberation in the U.S.—Black, Chicano, and Puerto Rican.

5 units, Aut (Bonilla) M 2:15–4:05

126B. Soviet Politics and Society Since 1917: Undergraduate Colloquium—(Same as History 219S.)

4 to 5 units, Aut (Dallin) T 2:15–4:05

126C. Recent Soviet History: Problems and Alternative Approaches.

5 units, Spr (Dallin) given 1973–74


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, Aut (Weiler) W 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, Spr (Weiler) M 2:15–4:05 and by arrangement

128A. Seminar in Comparative Politics: Problems of Industrial Democracies—Major issues of social-political organization confronting the countries of Western Europe and North America; political performance in view of the crisis of participation, social-cultural cleavages, and the changing international environment.

5 units, Win (Rose) Th 10–12

128B. Seminar in Comparative Politics: Crises of Modern Democracy — Principal issues and problems affecting the stability of American, British, French and German democracy: the crises of equality, the crises of post-industrial culture, the impact of the international environment on democratic politics.

5 units, Spr (Almond) given 1973–74

128C. Seminar in Comparative Survival Strategies—A systematic exploration of how different human societies go about meeting their basic survival and reproductive needs. The total configuration of survival strategies and behaviors will be considered, and students will be required to take a holistic approach, utilizing ecological, demographic, economic, anthropological, sociological, and political data. Particular emphasis will be given to the role of the political system and the relationship between the politics of different societies and the survival strategies adopted by each. (Graduate students enroll in 228C.)

5 units, Spr (Corning) M 4:15–6:05

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 1973–74

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 1973–74

131A,B. Case Studies and Theory Development in International Relations—(See 231A,B.)

132C. Human Aggression—An evolutionary and interdisciplinary approach to a major category of social behavior. Students will explore alternative theories of violence, the evolutionary origins of violent aggression, natural selection and aggression, the genetics, physiology, and biochemistry of aggression, socio-economic and other "environmental" factors in human aggression, the types of aggression and their functions, pathological aggression, collective or group aggression, aggression as a dimension or political behavior, and the problem of ameliorating violent aggression. (Graduate students enroll in 232C.)

5 units, Win (Corning) MTWTh 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

134. Seminar on Panafricanism 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 1973–74
135C. How Nations Deal With Each Other  
— (Same as History 135C.)  
5 units, Aut (George, Willis, Staff)  
MWF 1:15

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.)  
136A. Colloquium.  
5 units, Aut (Triska) Th 4:15-6:05  
136B. Seminar—Students research papers.  
5 units, Win (Triska) Th 4:15-6:05

4 to 5 units, Aut (Watkins) MTWTh 10

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 or History 135C.

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; consideration given to historical forces and domestic pressures which shape her policy.  
4 to 5 units, Spr (Harding) MTWTh 11

140. Seminar in International Relations.  
5 units, Aut (Watkins) Th 2:15-4:05  
Win (Watkins) Th 2:15-4:05  
Spr (Watkins) Th 2:15-4:05

140A,B. Seminar on Political Leadership—See 240A,B.

141. International Relations: An Introductory Seminar in Scope and Method. (Graduate students enroll in 241.)  
5 units, Win (Brody) given 1973-74  
Spr (Brody) T 2:15-4:05

142C. Spread of Nuclear Weapons.  
5 units, Spr (Brody) W 2:15-4:05

143. Seminar on Latin America and the United States—(See 243.)

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) T 4:15-6:05

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 1973–74

145B. Student research — Prerequisite: 145A or 245A. (Graduate students enroll in 245B.)

5 units, Spr (George) given 1973–74

146. Seminar in International Law: International Treaties. (Graduate students register for 246.)

5 units, Win (Triska) given 1973–74

146II. 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) T 2:15–4:05

147. Seminar on Soviet-Chinese Relations. (Graduate students register for 247.)

5 units, Win (North) T 4:15–6:05

147H. Seminar on the Political Development of the International System — See 247H.

148. Introductory Seminar in International Organization.

5 units, Win (Watkins) T 2:15–4:05

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) given 1973–74

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 1973–74

152. Political Thought: Modern Ideas and Doctrines—Philosophy and ideology of the Enlightenment, the nineteenth and early twentieth centuries, with particular attention to the critique of liberalism and the development of democratic and socialist theory.

5 units, Spr (Drekmeier) given 1973–74

153. 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) MTWThF 11

154. Political Theory of China and Japan—Leading thinkers and schools of thought from Confucius to Mao Tse-tung. Prerequisite: third-year standing or consent of the instructor.

4 to 5 units, Spr (Ike) MTWTh 1:15

155. Comparative Marxist Theory—A critical examination of the chief theories developed by Marx, Engels, Lenin, Stalin, Mao Tse-tung and certain revisionists. Special emphasis on Soviet and Chinese Communist ideologies. Prerequisite: third-year standing or consent of instructor. (Graduate students enroll in 255.)

4 to 5 units, Aut (North) MTWThF 3:15

156. Philosophy, Culture, and Society.

4 to 5 units, Win (Williams) MTWThF 11

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 Apocryph-
tic 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 1973-74

157V. Modernity and Its Discontents—An exploration of the personal, social, and political contradictions that pervade the lives of men and women in modern societies; of the new forms of freedom and repression, authenticity and alienation that modernization has opened up. Writers studied will include Marx, Toennies, Durkheim, Simmel, Weber, Dostoevsky, Freud, Kafka, Sartre, Genet.

5 units, Spr (Berman) MTWThF 11

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 (C. Drekmeier) given 1974-75

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, Michelis, 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) given 1974-75

159. Judeo-Christian Political Thought—A study of some of the political impulses and ideologies that have developed out of the Biblical image of the “Children of Israel,” the holy community. We will concentrate on the literature of the Old and New Testaments, but will also consider more recent militant social movements—both formally religious and ostensibly secular, in both the industrial West and the Third World—which draw on Biblical images and ideas.

5 units, Win (Berman) MTWThF 1:15

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) M 2:15-4:05
160B. 5 units, Win (Rogat) M 2:15-4:05

161. Seminar in Power, Authority, and Disobedience. (Graduate students enroll in 261.)

5 units, Spr (Drekmeier) given 1973-74

162. Seminar in Political Theory and Method: Lukács and Habermas.

5 units, Aut (Drekmeier) given 1973-74

166. Seminar: Radical Traditions in Political Thought.

5 units, Win (Berman) Th 2:15-4:05

167. Seminar: Sexual Politics.

5 units, Spr (Berman) Th 2:15-4:05

169. Directed Reading in Political Theory—Advanced individual study in political theory. Prerequisite: 150.

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) T 4:15-6:05

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, and war powers used to regulate property and the economy. Prerequisite: third-year standing. Recommended: 170. (Graduate students enroll in 272.)

5 units, Spr (Horn) MTWThF 1:15

173. Civil Liberties in the United States—Civil liberties in contemporary American culture; theory, history underlying them. Free speech, press in era of mass communications; freedom of association; religious liberties; rights of ethnic minorities. Prerequisite: third-year standing. (Graduate students enroll in 273.)

5 units, Win (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.

4 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

180M. Computer Models of Social Behavior—(Same as Education 218, Computer Science 127, Psychology 154, and Sociology 179.) Models of human behavior in social situations. Particular attention is given to the problems involved in specifying simulation models, determining their properties, and testing them.

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

181. Attitude Formation and Voting Behavior—The determinants of opinions and political beliefs, political participation, voting behavior; the significance for democratic government of findings in these areas. Prerequisites: third-year standing and 10 or equivalent.

5 units, Win (Sniderman) MTWThF 11

182A,B. Research on Racism and Law Enforcement—Individual and group research on aspects of law enforcement particularly as they affect the lives of black people, Chicanos and other minority groups. (Graduate students register for 282A,B.)

182A. 5 units, Aut (Bonilla) W 7:30-9:30 p.m.

182B. 5 units, Win (Bonilla) W 7:30-9:30 p.m.

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

184. Legislative Behavior—Congressional elections, constituent relations, policy making and leadership, relations between Congress and administrative and executive agencies; the committee system, seniority and procedure; Congress as an element in the party system. Prerequisites: third-year standing and 10 or equivalent.

5 units, Aut (Manley) MWF 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.

4 units, Aut (March) M 1:15-3:05; 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

186C. The Politics of Survival—Our crisis of the environment presents a significant opportunity to examine in depth the politics of the policy-making process and the problem of inducing social, economic, and political change in our society. The role of ideology and public opinion, interest groups, the Congress, the Executive, the Courts, parties and elections, the Federal system, and the larger economic and social system will be examined in relation to environmental issues. Particular attention will be given to air and water pollution, land, resource and energy policies, and population control. The politics of social change will also be considered in detail. (Graduate students enroll in 286C.)

5 units, Spr (Corning) MTWTh 10

186J. Crisis in The American Community—An analysis of the overlapping problems in the urban setting. The form and content of demands and needs; the attempt of the local political system to govern; the impact of local, state, and federal programs on the community.

5 units, Spr (Danziger) MTWTh 11


5 units, Aut (Brody) given 1973-74

191. Seminar on the Warren Court and Civil Rights—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, Win (Casper) M 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 1973-74


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 15 juniors and seniors. Desirable prerequisite: previous courses in American government, policy-making, organization theory, psychology. (Graduate students enroll in 296A.)

5 units, Aut (George) given 1974-75

196B. Student Research — Prerequisite: 196A or equivalent. (Graduate students enroll in 296B.)

5 units, Win (George) given 1974-75

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) given 1973-74

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-
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.

200. Graduate Seminar on Administrative Theory—General survey of the study of public administration. Concerned both with the theoretical premises and implications of the study and practice of public administration and empirical research concerning public agencies. Particular emphasis on administration as a political phenomenon.

5 units, Win (Fry) Th 4:15–6:05


5 units, Spr (Fry) Th 4:15–6:05

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. Prerequisite: 105 or equivalent.

5 units, Aut (Packenham) 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, Win (Packenham, Staff) T 4:15–6:05

220. Seminar in Comparative Political Socialization—Theories of political socialization; political socialization and political change. 4 to 7 units, Win (Weiler) TTh 2:15–4:05

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) Th 4:15–6:05

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 2:15–4:05

223. Seminar in Comparative Politics: Latin America—Problems in Latin American politics. Reading knowledge of Spanish or Portuguese recommended but not required. Prerequisite: 113A,B, History 177, or equivalent. (Undergraduates enroll in 123.)

5 units, Spr (Packenham) M 7:30–9:30 p.m.

224. Seminar in Comparative Local Politics—Theories of local government and politics; functions of the local community in the political system with emphasis on the relations between local government and democracy; comparative urbanism.

5 units, Spr (Steiner) T 4:15–6:05


225B. Seminar in Comparative Politics: Latin American Dependency—Review of dependency theory and the substantive aspects of social organization on which it focuses. Links of economic to political and cultural structures, institutional and elite configurations in dependency, especially external ties of elites and their relations with internal populations. Emphasis on Brazil, Venezuela, and Chile. Knowledge of Spanish or Portuguese highly useful.

5 units, Win (Bonilla) M 4:15–6:05

226A,B. Research Seminar in Comparative Political Behavior—A two quarter research seminar in which students will have the op-
portunity to undertake intra- or inter-nation comparative research involving secondary analysis of cross-section survey data. Data will be available from Great Britain, Germany, Italy, Mexico, Norway, and the U.S. (and possibly other countries). Desirable prerequisites: 290 and familiarity with the use of "pre-packaged" computer routines for data analysis, or consent of instructor.

226A. 5 units, Win (Rose) T 2:15-4:05
226B. 5 units, Spr (Rose) T 2:15-4:05

227. Seminar in Comparative Politics: Africa. Open to selected undergraduates who have taken an Africa-related course. (Undergraduates register for 127.)

5 units, Win (Abernethy) given 1973-74

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

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) given 1974-75

232C. Human Aggression—See 132C.

233. The International System and Comparable Systems—See 133.

234. Seminar on Panfricanism and Interstate Relations in Africa—See 134.

236A,B. Colloquium and Seminar in Soviet Foreign Policy—See 136A,B.

237C. Change and Legitimacy — East and West—This seminar will deal with the effects of domestic changes in the major countries of the world (USSR, Eastern Europe, China, USA) on the legitimacy of established political authority since World War II. Open to advanced graduate students, the seminar will center around research papers focusing on the factors that have contributed to the breakdown of domestic stability, the erosion of political institutions, and, in some cases, the legitimacy of existing regimes, as well as the international position of the countries in question. Seminar discussions, upon completion of the research, will also be concerned with the longer-term potentialities for decay or recovery in the countries under scrutiny.

5 units, Aut (Dallin, Labedz)

240A,B. Seminar on Political Leadership.

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, Win (George) given 1973-74

240B. Student research. (Undergraduates enroll with consent of instructor in 140B.)

Prerequisite: 240A (140A).

5 units, Win (George) given 1973-74


5 units, Spr (Ike, North, Triska)

Th 4:15-6:05

243. Seminar on the United States and Latin America—Critical analyses of liberal, radical, and other orientations in describing, explaining, and evaluating U.S. politics and activities in Latin America since 1945. Examination of selected relationships and episodes. Prerequisite: prior course work in U.S. foreign policy or Latin American politi-
cal and economic development. (Undergraduates enroll in 143.)

5 units, Win (Packenham) given 1973–74

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) Th 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—See 147.

247H. Seminar on the Political Development of the International System—An attempt to apply models of political development to recent changes in the international system. Topics to be discussed include: analogies between the international system and "primitive" political systems, the increasing number of international actors and issues, problems of inequality among nations, institutionalization of processes of conflict-resolution, etc. Prerequisite: consent of instructor. (Undergraduates enroll in 147H.)

5 units, Win (Harding) W 2:15–4:05


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 1973–74

248B. Student research. (Undergraduates enroll, with consent of instructor, in 148B.)

5 units, Spr (George) given 1973–74

249. Directed Reading in International Law and Relations.

Any quarter (Staff) by arrangement


5 units, Aut (Drekmeier) M 4:15–6:05

255. Comparative Marxist Theory—See 155.


258A,B. Theory, Power, and Social Science—See 158A, B.

260A,B. "Modernisms"—See 160A, B.

261. Seminar in Power, Authority, and Disobedience—See 161.

264. Problems in Contemporary Social and Political Theory.

5 units, Win (Williams) W 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, Win (Horn) given 1973–74

276. Seminar on the Constitutional Scope and Limits of "Free Speech"—The seminar will consider the historical origins and the major analytic problems of the laws regarding "free speech."

5 units, Spr (Rogat) M 2:15–4:05
279. Directed Reading in Public Law.  
   Any quarter (Staff) by arrangement

280A. Contemporary Problems in Social Institutions—(Same as Education 202 and Sociology 134.) The examination of a specific contemporary institution. (The institution to be considered varies each year.) How does the institution function? What are its problems? What are the alternatives? Ideology, social structure and process, institutionalization and professionalization, normative regulation. In 1973 the course will focus on the social institutions of leisure and play.  
   4 units, Win (March) MW 8:30-10:00

281A,B. Seminar in Empirical Political Theory—This is a two-quarter course.
   281A. 5 units, Aut (Eulau) given 1973-74
   281B. 5 units, Win (Eulau) given 1973-74

282A,B. Research on Racism and Law Enforcement—See 182A,B.

286C. The Politics of Survival—See 186C.

287A,B. Voting Behavior Seminar.
   287A. 5 units, Win (Brody) M 4:15-6:05
   287B. 5 units, Spr (Brody) M 4:15-6:05

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 labeling courts, and the impact of court decisions.  
   5 units, Spr (Casper) M 2:15-4:05

290. Introduction to Political Data Analysis.
   5 units, Aut (Brody) M 2:15-4:05

293A,B. Seminar in American National Government—See 193A,B.

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.

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 1973-74

322. Advanced Seminar in European Politics—Tendencies and problems in the politics of Britain, France, and Germany.  
   5 units, Win (Almond) given 1973-74

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 data from studies in different cultures and involves some secondary analysis of such data. Requires previous course work in the general area of political socialization, and facility in handling empirical data.  
   4 units, Spr (Weiler) W 2:15-4:05

325. Advanced Seminar in Reform and Revolution in Twentieth Century China and Japan.  
   5 units, Aut (Ike) given 1973-74

   5 units, Aut (Ike) Th 2:15-4:05

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 1973-74

365. Alienation and Detachment.  
   5 units, Spr (Drekmeier) given 1974-75

384A,B. 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. The second quarter is a research seminar. Joint sessions may be held with graduate students at Berkeley. Students should plan to take both A and B.

384A. 5 units, Win (Manley) given 1973-74
384B. 5 units, Spr (Manley) given 1973-74

387A,B. Research Seminar in American Politics: The Roots of Political Belief—Intensive review of major findings on the roots of belief and ideology. Examination of major psychological theories concerning conformity and deviation, ideological coherence, etc. Students must take both quarters.

387A. 5 units, Aut (Sniderman) F 2:15-4:05
387B. 5 units, Win (Sniderman) F 2:15-4:05

388. Research Seminar on Comparative Political Behavior — Research approaches to the study of elite structures and behaviors: social backgrounds, career lines, intra-elite communications, action in power roles, ideologies.

  5 units, Spr (Bonilla) M 2:15-4:05

PSYCHOLOGY

Emeriti: Paul R. Farnsworth, Ernest R. Hilgard, Maud Merrill James, Quinn McNe mar, Lois Meek Stolz (Professors)
Chairman: Richard C. Atkinson
Vice Chairman: Douglas H. Lawrence


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 research as a thesis.

**Advanced Degrees**

The Department does not have specific course requirements for admission to its doctoral program. However, applicants are expected to have the equivalent of an undergraduate major in psychology and to have had some research experience as an undergraduate. The Department does not have a clinical program. Students who are interested in the practice of clinical psychology should consider other universities that offer instruction and practicum training in the clinical area.

An applicant for admission must file a report of his scores (aptitude and advanced psychology) on the Graduate Record Examination as part of his application. This examination may be taken at most universities and colleges (see your registrar for further information).

Admission to the training program is strictly limited. 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 the degree of Master of Arts is optional. A Stanford graduate is ordinarily not accepted for an advanced degree in the Department unless he is also registered in the School of Medicine or the Graduate School of Business. It is contrary to the policy of the Department to accept candidates for an advanced degree who have reached the age of 40.

**Master of Arts**

For the degree of Master of Arts, at least 27 units in psychology beyond the equivalent of an undergraduate major are required as well as sufficient additional units outside of psychology to make up a program totaling 45 or more units. In partial fulfillment of this unit requirement Psychology 151 must be elected as well as two other courses from the content areas, one to be selected from 208, 209, 210, 214, and 215, and one to be selected from 211, 212, 213, and 254. The student is normally expected to spend one-half of his time in research and must present a thesis based on a portion of his research. He 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 must present evidence of his 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 his 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 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 he 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 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 adviser, that will permit him 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 behavior 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 his 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 a number of its students receiving 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, 1973.

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, Sec 1 (Ruch) MWF 10
Sec 2 (Zimbardo) MWF 2:15
(Primarily intended for entering freshmen)
Win, Sec 1 (Ruch) MWF 10
Sec 2 (Schmaltz) MWF 2:15
Spr (D. Bem) MWF 10
Sum (Staff) MTWTh 9

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 (Thomas) MTWThF 9
Win (Ross) MTWThF 11
Spr (McGee and C. Clark) MTWThF 11
4 to 5 units, Sum (Staff) MTWThF 8

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. Labora-
tory 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, Aut (Smith) TTh 1:30-3:05

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, Aut (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

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

112. Personality and Social Development — Motivation, emotion, and interpersonal action systems examined from birth through adolescence and adulthood, with emphasis on child rearing and other environmental or cultural influences. Recommended: 1.

3 to 4 units, Win (Sears) MWF 11

113. Adolescent Development — This course focuses on the cognitive and personality development that takes place during adolescence. Prerequisite: 111 or equivalent.

4 units, Spr (Feldman) MWF 11, alternate years, given 1973-74

114. Exceptional Children — The study of children with deviant patterns of development; includes gifted, retarded, sensory defects, emotional problems. Prerequisite: 111 or equivalent.

4 units, Spr (______) TTh 4:15-5:45

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.

3 to 5 units, Aut, Win, Spr (Dowley) T 2:15-4:05 and by arrangement

119. Cognitive and Language Development — The child's development in the areas of memory, language, and conceptual skills will be surveyed. Prerequisite: 111 or equivalent.

4 units, Aut (Nelson) WF 11
121. Social Psychology—The study of interpersonal behavior. A survey of relevant research concerning attitudes, groups, person perception, and selected topics in social psychology. Prerequisite: 1 or equivalent.
4 units, Aut (D. Bem) TTh 3:15-4:45

122. Social Psychology in Action—This course will explore some of the action consequences of social psychological research and theory. It will focus on issues of social and personal change. Our analysis will be supplemented with field observations and an appropriate level of social involvement on the part of each student. Enrollment limited to 100 students; preference given to senior and junior majors in psychology. Prerequisite: 121 or equivalent.
4 units, Win (Zimbardo) MW 2:15-3:45 and by arrangement

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 and by arrangement

124. Communication and Community Psychology II—(Same as Communication 124.) This is a continuation of 123. Prerequisite: 123.
4 units, Win (C. Clark, McGee) TTh 10 and by arrangement

126. Social Influence and Attitude Change—A survey and analysis of the social determinants of human behavior, with an emphasis on beliefs and attitudes. The course covers contemporaneous determinants like interpersonal persuasion and group influence; ontogenetic determinants like socialization, mass media, and family influences; and historical and socio-cultural determinants which have influenced the norms and practices of the society itself. The social-psychological aspects of current social issues such as the women's rights movement, race relations, and political action will also be treated. Prerequisite: 1 or equivalent.
4 units (D. Bem), given 1973-74

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, Spr (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 and by arrangement

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, Aut (S. Bem) MWF 10

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—(Same as Modern Thought and Literature 285.) Analysis of novelists' personalities through data from their life histories and creative writing. Lectures, reading, and exercises on analytic methods, including content analysis and relating of social behavior to fantasy and symbolic expressions of motivation. For 3 units: reading of brief psychobiographies, with final
exam. For 4 units: writing a 25-page psychological biography of a novelist of own choice. Recommended: 1 or 111 or 112.

3 to 4 units, Aut (Sears) TTh 11

134. Personality and Assessment—Theories and findings regarding the psychological causes, assessment, and modification of personality. Focuses on major approaches and findings in the analysis and modification of complex normal and deviant human behavior. Prerequisite: 1 and 60, or equivalents, and at least junior standing.

3 to 4 units, Spr (W. Mischel) MW 1:15–2:45

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

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, Spr (S. Bern) MWF 9

141. History of Psychology—Prerequisites: three courses in psychology and junior standing.

4 units, Spr (Hastorf) TTh 11:00–12:20, alternate years, given 1973–74

143. Experimental Psychology of Reading —Prerequisites: 1 and 60, or equivalents.

4 units, Spr (Smith) by arrangement

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

4 units, Aut (Gage) TTh 3:15–5:05
Spr (Shavelson) 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, or 109.

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, Spr (Wine and Pribram) by arrangement, given 1973–74

151. Statistical Methodology—Prerequisite: 60 or equivalent.

4 units, Win (Thomas) MWF 9

152. Analysis of Data—Prerequisite: 151 or consent of instructor.

4 units, Spr (Carlsnith) MWF 9

154. Computer Models of Social Behavior— (Same as Computer Science 127, Education 218, Political Science 180M, and Sociology 179.) Models of human behavior in social situations. Particular attention is given to the problems involved in specifying simulation models, determining their properties, and testing them. Prerequisites: knowledge of at least one standard programming language (Computer Science 105, Computer Science 106, or equivalent), advanced courses in social science, and consent of instructors.

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

155. Human Abilities—(Same as Education 255.) The nature, development, and measurement of intellectual abilities. Prerequisites: 1 and Statistics 160, or equivalent.

3 units, Spr (Cronbach) MWF 10

158. Introduction to Behavior Genetics — (Same as Biological Sciences 158.) Designed for students of anthropology, biology, and psychology. Principles and methods of ani-
mal and human behavior genetics research. Discussion of the social implications of gene-behavior relationships. Prerequisites: 1 and Genetics 201 or Human Biology 130 or their equivalents.

4 units, Win (Kessler) TTh 1:15

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 would be desirable, though not necessary.

4 units, Win (Atkinson) TTh 11:00-12:20

170. Hypnotic Phenomena—Lectures, readings, and discussions on hypnosis, with emphasis on experimental studies designed to study hypnosis as related to more familiar psychological phenomena. Limited to graduate students in psychology, and in other fields by special consent, and to senior majors in psychology.

3 units, Aut (Hilgard and Morgan) W 2:15-4:05

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

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

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

184. Individual Participation and Study in Paraprofessional Programs—Two programs within the broadly defined area of Community Mental Health will utilize a limited number of Stanford volunteers. Both programs provide training sessions as well as academic credit for participants. Mountain View High School has with our encouragement started a Drop-In Center manned by a professional coordinator with the help of college volunteers. Counseling in this racially and socioeconomically heterogeneous setting will concentrate upon personal, academic, and drug-related problems. Children’s Health Council has innovated an interesting paraprofessional program through which volunteers work with a family which has sought help from the Council because of education-re-
lated problems. In both programs the volunteers are some combination of caseworker, counselor, big brother or sister, tutor, and friend. Both demand a heavy commitment in terms of time and energy (8–10 hours per week) but offer an unusual opportunity for mature, responsible, and dedicated individuals. This program is particularly recommended for students who anticipate careers in counseling, clinical, community, or educational psychology.

3 to 5 units, Aut (Ross) by arrangement

186. Study of Social Issues—This research oriented seminar will be divided into groups, each of which will examine a particular social issue. Topics will be: public policy on heroin; the conception of citizen loyalty in relation to federal employment, draft obligations, etc.; jail reform; domestic security of intelligence operations; and the bureaucratic personality, i.e., the impact of service in large organizations on values, emotional control, interaction styles, and the like.

3 units, Aut (Blum) M 1:15–3:05

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

190. Undergraduate Seminar on Topics in Psycholinguistics—Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Spr (H. Clark) by arrangement

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 1972–73

190B. Undergraduate Seminar in Endocrines and Behavior—Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Win (Levine) T 8:00–9:50, alternate years, given 1973–74

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, given 1973–74

192. Undergraduate Seminar on Aggression—Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Spr (Bandura) M 2:15–4:15, given 1973–74

193. Undergraduate Seminar in Social Psychology—Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Spr (——) by arrangement

194. Undergraduate Seminars in Developmental Psychology—Including, but not limited to, topics listed below. Prerequisite: consent of instructor.

194A. Sex-Typing.

3 units, Spr (Sears)

194B. Moral Development.

3 units, Win (Lepper)

Topic to be selected.

3 units, Win (Nelson)

194C. Parent-Child Interaction.

3 units, Spr (Maccoby)

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. Undergraduate Seminar in Physiological Psychology—Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Win (Schmaltz) by arrangement

198. Undergraduate Seminar on Theories of Attention—Primarily intended for majors in psychology. Prerequisite: consent of instructor.

3 units, Aut (Lawrence) T 2:15–4:05

COURSES PRIMARILY FOR GRADUATE STUDENTS

Undergraduate students may be admitted only by consent of instructor.

207. Contemporary Viewpoints in Psychology—A survey of major issues in contemporary psychology with their historical back-
208. Physiological Psychology: Brain and Behavior—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, Aut (Atkinson and Staff) TTh 11:00-12:20

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 (Ganz) MWF 9

210. Memory and Learning: An Information Processing Approach — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (Bower) MWF 11, given 1973-74

211. Advanced Developmental Psychology — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Win (Nelson, Maccoby) by arrangement

212. Social Psychology—Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Spr (Lepper and Carlsmith) Th 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

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 and concept formation. Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Spr (Atkinson and Thomas) by arrangement

216. Information Processing Psychology—Survey of information processing models of cognitive behavior. Emphasis on logical problem solving and hypothesis formation; discrimination learning; association learning; memory levels, structures, and retrieval processes; and perceptual processes, especially visual form perception. Methodological considerations. Prerequisites: some familiarity with computer programming and experimental psychology.

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

220. Psychology of Speech — (Enroll in Hearing and Speech Sciences 220.) Origin, development of speech, semantics; relation of speech to thought, emotion, personality. Prerequisite: consent of instructor.

3 units, Aut (Eisenson) MWF 9

222. Mathematical Theories of Perception —Prerequisite: consent of instructor.

4 units, Spr (——) by arrangement

224. Models of Thought Processes—(Enroll in 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 2:15

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 — (Enroll in Hearing and Speech Sciences 390.) Prerequisite: consent of instructor.

4 units, Spr (Dewson) by arrangement

231. The Auditory Process — (Enroll in 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-
sory process. Prerequisite: consent of instructor.

3 to 4 units, Aut (Schubert) by arrangement

232. Selected Topics in Psychoacoustics — (Enroll in 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, Win (Schubert) by arrangement

233. Peripheral Auditory Mechanisms — (Enroll in 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 7–10 p.m.

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 (C. Clark, McGee) TTh 7–10 p.m.

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 7–10 p.m.

240. Child Language I — (Enroll in 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 — (Enroll in Linguistics 301.) Emphasis on the role played by meaning in first language acquisition. Critical survey of recent research. Of special interest to advanced linguistics and psychology students. Prerequisite: Linguistics 100 or 210.

4 units, Win (E. Clark) TTh 11:00–12:30

242. Theories of Child Development — Intensive coverage of selected theoretical issues in child psychology, approached through discussion of current research. Prerequisite: consent of instructors.

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

245. Socialization of Pre-Adults in Contemporary U.S. Society — (Same as Education 311.)

3 units, Spr (Hess) TTh 9

246. Methods in Developmental Research —Prerequisite: consent of instructors.

4 units, Aut (Sears, Maccoby) WF 2:15–4:05

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 1972–73

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 equivalent.

3 to 4 units, Aut (Shavelson) 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, given 1973-74

250. Prosocial and Moral Behavior—Prerequisite: consent of instructor.

3 units, Aut (Rosenhan) by arrangement

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 (Rosenhan) by arrangement, given 1973-74

254. Principles of Personality Change — Prerequisite: graduate standing in psychology or consent of instructor.

3 units, Aut (Bandura) M 1:15-3:05, given 1973-74

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


3 units, Win (Lepper, Ross) by arrangement

261. Seminar on Research Methods in Social Psychology—Prerequisite: consent of instructor.

3 units, Spr (Zimbardo) by arrangement

262. Special Topics in Memory—Prerequisite: consent of instructor.

3 units, Win (Horowitz) by arrangement, given 1973-74

263. Seminar in Perception — Prerequisite: consent of instructor.

3 units, Win (Ganz) by arrangement

264. Seminar in Learning Theory—Prerequisite: consent of instructor.

3 units, Spr (Bower) by arrangement, given 1973-74

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.) Including, but not limited to topics listed below. Prerequisite: consent of instructors.

266A. Seminar on Piaget.

4 units, Aut (Feldman) TTh 9-11

267. Seminar in Person Perception — Prerequisite: consent of instructor.

3 units, Spr (Hastorf) alternate years, given 1972-73

269. Seminar in Personality—Prerequisite: consent of instructor.

3 units, Win (W. Mischel) by arrangement

271. Seminar in the Mechanisms of Selective Attention—Prerequisite: consent of instructor.

3 units, Aut (Lawrence) by arrangement, given 1973-74

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

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, Win (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

291. Seminar on Information Processing Approach to Perception: Selected Topics—Prerequisite: consent of instructor.
   3 units, Win (Smith) by arrangement

300. On Becoming a Professional Psychologist—This course is in response to the requests of a number of graduate students who want some formal presentation of issues, skills, folklore, etc., involved in becoming a professional psychologist. We will consider for review any topic which the students feel might be important for their careers (e.g., how to give a colloquium, how to write a grant proposal, how to be interviewed and win, etc.). In addition, we will examine alternatives to academic psychology—administration, community work, consulting, etc. Hopefully, other colleagues will lend their expertise. Prerequisite: consent of instructor.
   2 units, Win (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 instructors.
   1 to 3 units, Aut, Win, Spr (E. Hilgard and 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 11–1

310. The Psychology of the Reading Process—Prerequisite: consent of instructors.
   3 units, Aut (Mackworth, Atkinson) Th 7:15–10:00

311. Research Seminar in Developmental Psychology—Can be repeated for credit. Prerequisite: consent of instructors.
sition, 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, 161, 162, 163, and 192, with the remainder to be selected from the following: 145, 146, 147, 148, 170, 182, 191, 193, 198, 201. In addition, candidates are required to produce a translation of such quality as to merit publication of a Russian book or article of monograph length not previously translated in 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.

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 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 his 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 allow him to handle successfully survey courses dealing with his 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 his 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 indi-
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 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 his 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 his University Oral Examination, i.e., before the end of the third year.

General Courses (A)

Courses in this category may be of interest to students in other literatures, in comparative literature and in Russian area studies. When registering, students are advised to prefix the identifying letter A to the course number. 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 concentrators will take this course in conjunction with 147.

3 units, Win (Todd) MWF 10

146. Russian Literature of the Twentieth Century—Selected works of Bely, Mayakovsky, Gorky, Zamiatin, Pasternak, Sholokhov, Olesha, Solzhenitsyn, and some others. Stylistic and thematic developments in the twentieth century will be emphasized. Readings in English. Undergraduate concentrators will take this course in conjunction with 148; graduate students will take the course in conjunction with 222.

3 units, Aut (Brown) MWF 11

149. Introduction to the Culture and Literature of the Slavic Peoples—No foreign language required.

3 units, Aut (Stahlberger) given 1973-74

151. Dostoevsky—Reading of major works in English translation with reference to related developments in European literatures. Open to all students except freshmen. Undergraduate concentrators and graduate students in Slavic will do assigned portions of the reading in Russian.

3 units, Spr (Todd) MWF 10

152. Gogol—Reading of major works in English translation with reference to related developments in European literatures. Open to all students except freshmen. Undergraduate concentrators and graduate students in Slavic will do assigned portions of the reading in Russian.

3 units, Aut (——) given 1973-74

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 concentrators and graduate students in Slavic will do assigned portions of the reading in Russian.

3 units, Win (Stahlberger) alternate years, given 1973–74

SLAVIC COURSES

UNDERGRADUATE COURSES

By special arrangement with the department, courses numbered 100–159 can be taken for graduate credit.

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

The Department urges students to take all three quarters of first-year, second-year, and third-year language series in the same academic year.

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

10. Elementary Russian—Intensive Russian morphology and elementary readings for beginners desiring to develop reading knowledge of the language and particularly for those seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to seniors and graduate students only. No auditors.
   4 units, Aut (Staff) given 1973–74
   Sum (Staff) MTWThF 8

11. Readings in Russian — Training in the reading and translation of texts, with emphasis on developing vocabulary resources. Prerequisite: 10 or equivalent. No auditors.
   3 units, Win (Staff) given 1973–74

12. Readings in Russian — Continuation of 11. Training in the reading and translation of texts with emphasis on the syntax of Russian. Prerequisite: Russian 11 or consent of instructor.
   3 units, Spr (Staff) given 1973–74

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, Staff)
   MTWThF 12 and 1:15

   5 units, Win (Van Campen, Staff)
   MTWThF 12 and 1:15

   5 units, Spr (Van Campen, Staff)
   MTWThF 12 and 1:15

111–113. Third-Year Russian — Reading, composition, and conversation. Prerequisite: 53 or equivalent.
   3 units, Aut, Win, Spr (Schupbach)
   MWF 9

118A,B. Russian Intellectual History  —  (Same as History 118A,B and Comparative Literature 118A,B.)
   8 units (Brown, Emmons) given 1973–74
given 1973–74

147. Russian Nineteenth-Century Prose — Discussion of selected problems, based on readings in Russian. This course must be taken concurrently with General Course 145.
   2 units, Win (Todd) by arrangement

148. Russian Twentieth-Century Prose — Discussion of selected problems, based on readings in Russian. This course must be taken concurrently with General Course 146.
   2 units, Aut (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 re-
quired to pass a qualifying examination
given at the beginning of the quarter.

SECOND-YEAR LEVEL

63. Second-Year Russian (for Translators)
—Systematic study of graded texts drawn
from a single field of scholarship. Course de-
dsigned to familiarize the student with both
English and Russian usage in the area in
question. Oral and written drills on transla-
tion of such materials, plus material from 53.
Prerequisite: 51 and 52, and concurrent en-
rollment in 53. Students who have already
completed the second year must take an ex-
amination before being allowed to enroll.
  3 units, Spr (Van Campen, Staff)
  MWF 2:15

THIRD-YEAR LEVEL

Students who have not had Slavic 63 or its
equivalent must demonstrate adequate com-
petence by an examination given at the be-
ginning of the autumn quarter.

161. Third-Year Russian (for Translators)
—Reading and translation of texts of moder-
ate difficulty drawn from several different
areas in the natural and social sciences. As
in 63, attention will be paid to both English
and Russian usage. Oral and written drills.
  3 units, Aut (Van Campen) MWF 2:15

162. Third-Year Russian (for Translators)—
Continuation of 161. Reading and translation
of more specialized texts in areas covered in
161 plus an introduction to less specialized
texts in at least two additional areas.
  3 units, Win (Van Campen) MWF 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 2:15

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 (——)
given 1973-74

ADVANCED AND GRADUATE
COURSES

165. Introduction to the Structure of Rus-
sian—(Same as Linguistics 165.) An outline
of the phonology, morphology, and syntax
of contemporary Russian. Prerequisite: Lin-
guistics 100 or Slavic 112 or its equivalent.
  3 units, Spr (Crockett) 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 in-
terested in interpreting. Emphasis on prep-
paration for work in news media and in cul-
tural exchange programs. During the au-
tumn quarter students needing additional
preparation will be required to supplement
class hours with two additional hours of in-
dividual work. For each hour of class, stu-
dents will have to spend no less than two
hours working at home or in the Language
Laboratory.
  12 units, Aut, Win, Spr (Pashin) TTh
   1:15–3:05

172. Pushkin.
  3 units, Win (Stahlberger) MWF 11

182. Solzhenitsyn—Conducted in Russian.
  3 units, Spr (Pashin) TTh 3:15–5:05

184. The Russian Short Story—Conducted
in Russian. Prerequisite: 113 or equivalent.
  3 units (Pashin) given 1973–74

186. The Russian Drama — Conducted in
Russian. Prerequisite: 113 or equivalent.
  3 units (Staff) given 1973–74

187. Russian Poetry of the Nineteenth Cen-
tury—Sentimentalism, Romanticism, “Real-
ism.”
  3 units, Win (Stahlberger) MWF 1:15

188. Russian Poetry of the Twentieth Cen-
tury — Futurism, Symbolism, Acmeism,
Imagism.
  3 units, Spr (Stahlberger) MWF 1:15

189. Russian Literature from the Eleventh
to the Eighteenth Century.
  3 units, Aut (Iodd) MWF 10

190. Russian Literature of the Eighteenth
Century — Emphasis on poetry: theory of
genres, the satire, the ode, the mock-epic.
  3 units, Aut (Stahlberger) MWF 1:15

191. Derivational Morphology.
  3 units, Win (Schupbach) given 1973–74

193. Advanced Conversation — Open to
third- and fourth-year students and graduate students.

3 units, Win (Pashin) by arrangement

196. Russian Pronunciation — Prerequisite: 53 or equivalent.

3 units, Win (Pashin) given 1973–74

197. Russian Lexicology and Phraseology.

3 units, Spr (Pashin) given 1973–74

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) TTh 11

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 4:15–6:30

201. Synchronic Morphology of Russian Conjugation and Declension.

3 units, Aut (Crockett) given 1973–74

211. Introduction to Old Church Slavonic and Early Russian Texts.

3 units, Win (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, Spr (Schupbach) MWF 3:15

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, Aut (Brown) given 1973–74

222. Studies in Russian Fiction: From Realism to Modernism — Continuation of 221.

The evolution of naturalist, symbolist, neorrealist, 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, Aut (Brown) by arrangement

228. Divergence of Slavic Languages.

3 units, Aut (Van Campen) given 1973–74

230. Aspects of Intrinsic Criticism—(Same as Comparative Literature 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) given 1973–74

277. Gogol—Also open to qualified undergraduate students.

3 units, Spr (Todd) by arrangement


3 units, Aut (Stahlberger) given 1973–74

299. Individual Work — Exclusively for graduate students in Slavic working on theses 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.

SOCIAL SCIENCES

(SPECIAL PROGRAM)

HONORS PROGRAM IN SOCIAL THOUGHT AND INSTITUTIONS

Charles Drekmeier (Chairman), Robert McA. Brown, Margot Drekmeier, John Flores, Harold Kahn, Mark Mancall, Wilfred Stone

STATEMENT OF PURPOSE

The Honors Program in Social Thought and Institutions is designed to meet the needs of students wishing special preparation in areas of study which draw on the
materials of two or more of the social science disciplines. It aims at a clearer understanding of the contributions the social sciences are able to make to one another and to a specific problem, an awareness of differences and agreements in their theoretical assumptions, and facilitation of communication among these disciplines. It seeks to combine rigorous training with the breadth of knowledge interdisciplinary study provides. The Program is administered by an interdepartmental committee.

**Admission to the Program**

Students wishing admission to the program should provide evidence of superior academic achievement (at least a 3.0 average). It is recommended that application be made in the last quarter of the sophomore year. Any member of the committee may be consulted regarding admission. (Mr. Drekmeier's office is in the Department of Political Science.)

**Requirements**

It is expected that most students will be able to fulfill the conditions of an undergraduate major; in some cases minor modifications of departmental requirements may be necessary. The student is required to take the interdisciplinary seminar series (Social Sciences 101, 102, 103) offered for 4 units each quarter, during his junior year. The seminar meets bi-weekly, at a professor's home, and is organized around a particular theme or concept each year. In past years topics have included responsibility, freedom, utopia, change, self and community, and false consciousness. Approximately fifteen students are admitted to the junior seminar each year.

Members of the Program submit an honors thesis toward the end of the senior year which demonstrates the ability to synthesize and criticize materials drawn from several disciplines. A credit of from 5 to 15 units will be allowed for the thesis, and no more than 5 units may be taken in any single quarter. The student may also be required to take a senior seminar which will offer the opportunity for the discussion of problems arising in the research projects.

After the student's plans for an honors thesis have been approved by the administrative committee, he will be assigned an adviser. In most cases the committee will arrange for the appointment of a second adviser in his major field.

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.

**Special Courses of Instruction**

101. Interdisciplinary Seminar — Designed to familiarize the student with philosophical and methodological problems of the social sciences.  
4 units, Aut (Staff) by arrangement

102. Interdisciplinary Seminar — Continuation of 101.  
4 units, Win (Staff) by arrangement

103. Interdisciplinary Seminar — Continuation of 102.  
4 units, Spr (Staff) by arrangement

193. Senior Thesis and Directed Reading.  
1 to 5 units, any quarter (—) by arrangement

**Sociology**

**Emeriti:** Richard T. LaPiere, Charles N. Reynolds (Professors)  
**Chairman:** W. Richard Scott  
**Professors:** Joseph Berger, Bernard P. Cohen, Sanford M. Dornbusch, St. Clair Drake, Alex Inkeles, Dudley Kirk, James C. March, W. Richard Scott, Morris Zelditch, Jr.  
**Associate Professor:** Elizabeth G. Cohen, John W. Meyer  
**Assistant Professors:** C. Norman Alexander, J. Victor Baldrige, Francesca M. Cancian, Michael T. Hannan, Jr., Anne M. McMahon, Stephen M. Olsen
Programs of Study

Bachelor of Arts

1. The Standard Major—Majors must take 45 units of sociology in addition to basic University requirements. However, with the approval of a departmental adviser, up to 15 of these units may be taken from related courses outside the Department. In addition to the 45 unit requirement, three courses are required of all majors: Sociology 80. Department Seminar for Undergraduates; Sociology 100. Introduction to Sociological Research; and Sociology 106. Introduction to Sociological Theory.

The Department Seminar for Undergraduates is designed to provide orientation to the field for new majors. The format for the seminar varies from year to year but normally attempts to rapidly acquaint students with course offerings and faculty interests, courses of interest available in other Departments, graduate and professional training possibilities, and alternative careers open to sociologists. Introduction to Sociological Research provides students with direct experience in data collection, analysis, and interpretation employing a variety of research methods. Introduction to Sociological Theory provides students with opportunities to examine some of the basic theoretical issues posed by the work of sociologists past and present. These two courses are viewed as providing students with methodological and conceptual tools of general value regardless of the specific substantive topics they may wish to pursue.

There are several alternative routes available to students who are considering a major in Sociology. One is to begin by taking Sociology 1. Principles of Sociology which is designed to provide a systematic overview of the concerns addressed by contemporary sociologists. This course may be followed by two courses which are designed to provide an in-depth introduction to sociological processes and structures at the micro and the macro levels. Sociology 2. Introduction to Social Psychology and Interpersonal Behavior focuses on such topics as the self, socialization, deviation and conformity, leadership and attitude change. Sociology 3. Introduction to Social Organizations and Institutions examines the inter-relations and development of major social institutions, the institutional organization and definition of actors and actions in modern societies, and the growing importance of organizations as arrangements for carrying out work in complex societies. The student taking this introductory three course sequence (1, 2, and 3) will be well equipped to move into some of the more specialized courses at the 100 level where somewhat more advanced and specialized topics are pursued.

A second route into sociology is provided by Sociology 1A. Social Problems: A Sociological Approach. This course is designed to introduce students to some of the basic sociological concepts and theories by showing their applicability to a selected set of social problems. The problems to be considered vary from year to year but might include social inequality, crime, over-conformity, and the malfunctioning of organizations or institutions. Students taking Sociology 1A may choose to take Sociology 1 as well or may move directly to Sociology 2 and/or Sociology 3.

A third route into the department is available for those students who have some previous work in the social sciences and sufficiently clear interests that they are able to move directly into courses at the 100 level. Most introductory courses at the 100 level are open to students with no prerequisites or by consent of the instructor.

The Department offers substantive undergraduate courses in many areas. In order to assist the student, these courses can be grouped in three areas, though the student is not expected to concentrate his courses in one of them.

a) Comparative Sociology: organization and change in societies and institutions. Students may begin their study of Comparative Sociology with Sociology 3. Introduction to Social Organizations and Institutions; Sociology 102, Introduction to Comparative Sociology; or Sociology 112, Social Change; or they may begin with more specialized though still elementary courses in the family, stratification, population, political sociology, and so on. A number of courses offered outside the Department are relevant for students interested in Comparative Sociology and, in working out their programs, interested
students should consult with the Department Adviser in Comparative Sociology. In the Department of Anthropology, several courses are offered which provide models for the analysis of total social systems and also provide a number of surveys of substantive and institutional fields which may be seen as supplementing and extending the range of data and approaches presented in Sociology courses. The Department of Political Science has a program in Comparative Politics, and the student may enter these courses either by way of a particular substantive interest or with particular regional interests. The problem of economic development is one which is relevant in many ways to the field of Comparative Sociology. The Department of Economics offers a number of courses which deal with this on a general level and also in the context of specific national and regional economic histories.

Among specific areas of concentration which have a substantial comparative focus is the study of systems of social inequality or stratification. The student may begin study with Sociology 8, Social Inequality; Sociology 60, Racism and Prejudice; or Sociology 108, Class, Status and Power. Other departments also offer relevant courses. Anthropology 104, Race and Culture Contact in the Caribbean; Political Science 186G, Urban Politics; Political Science 182A,B, Research on Racism and Law Enforcement; and Economics 150, Urban Poverty and Social Policy, are concerned with structural antecedents and consequences of social inequality.

b) Formal Organizations: Resources for enabling the student to pursue his interests in organizations in all their guises and manifestations are spread throughout the University, but are particularly concentrated in the Departments of Sociology and Political Science and the Schools of Business and Education. Students may begin with Sociology 3, Introduction to Social Organizations and Institutions and move to Sociology 105A or 105B. These two courses, either or both of which may be taken, provide a basic introduction to the subject area. Sociology 105A concentrates attention on the structural characteristics of organizations, their determinants and consequences; Sociology 105B emphasizes individual and group phenomena within organizations as well as change and conflict. Another introductory course on organizations which emphasizes the special characteristics and problems of educational organizations; Sociology 203. Fundamentals of Organization Theory, is also open to undergraduates. Other introductory level courses bearing on the general topic of organizations include: Sociology 110, Religious Institutions and Behavior; Sociology 117, Education and Society; Sociology 123, Political Institutions and Behavior; and Sociology 127, The Community. Typically, the Department also offers at least one course per year on survey, field, or experimental approaches to the study of organizations.

Related courses outside the Department include: Anthropology 279, The Hospital as a Socio-Cultural System; Political Science 100, Introduction to Public Administration; Political Science 110, Administrative Behavior; and Economics 158, Organization and Social Control of Industry.

c) Social Psychology and Interpersonal Behavior: The Department offers many courses dealing with the social organization of individual identity, beliefs, and behavior, and with the organization of behavior in interpersonal interaction. The general introductory course, Sociology 2, Introduction to Social Psychology and Interpersonal Behavior has already been described. Students may also begin their work in this area with Sociology 63, Social Identities and Interaction which focuses on the processes by which people come to define “self” and “other” in social situations and the consequences of these identities for interpersonal relations. Students with previous course work in sociology will find Sociology 103, Advanced Social Psychology; Sociology 104, Interpersonal Behavior; or Sociology 113, Social Identity Transactions appropriate starting points for a concentration in this area. Many other relevant courses are offered in the Departments of Psychology, Anthropology, Political Science, and Communication. Students who are interested in concentrating their work in this area should consult with the Department Adviser in Small Groups and Social Psychology.
d) In addition to their investigation of substantive fields, undergraduates may also wish to pursue their study of sociological theory and methodology beyond the two courses which are the requirements for a major. The Department offers courses on formal models of analysis, Sociology 119 and Sociology 173, and courses on methods of research. Interested undergraduates should also consider training outside the Department in mathematics, statistics, and logic. In addition to a basic calculus sequence, the following courses would be useful: Mathematics 113, Linear Algebra and Matrix Theory; Statistics 116, Theory of Probability; Philosophy 3, Introduction to Logic; and Philosophy 164A,B, Philosophy of Science.

HONORS PROGRAM IN SOCIOLOGY

This program provides research experience for qualified students who wish to engage in independent sociological research supervised by a member of the Department.

Application for admission to the Honors Program should be made in the Winter Quarter of the junior year. No specific grade point average is required for admission to the program—either for university work in general or departmental work in particular. Instead, applicants are evaluated in terms of their overall performance as an undergraduate student and their interest in and capacity to carry out an individual research project.

Honors students are not required to take a fixed number of units in Sociology. However, each student must take the Departmental Seminar, Introduction to Sociological Research, and Introduction to Sociological Theory. In addition, each student is required to complete one course in statistics or some other collateral field (e.g., logic, mathematics, computer science) appropriate to his specific interests or to his Honors Thesis research. Each student will plan his academic program with the help of an adviser whose approval must be obtained in the selection of a course to satisfy the collateral field requirement described above. Honors students are exempt from prerequisites attached to courses at the discretion of the adviser and the course instructor, and may be admitted to graduate level courses.

Intensive honors work begins in the Spring Quarter of the junior year, with participation in an Honors seminar. At the end of the year, each student will be expected to have selected a sociological problem for intensive study under the direction of a Department member. This study proceeds through the senior year, and leads to the preparation of an Honors Thesis. Two units of credit are granted for participation in the Honors Seminar and ten units for the satisfactory completion of the Honors Thesis.

Thus, to be eligible for Honors in the Department, the student must: 1) be admitted to the Honors Program; 2) satisfactorily complete Sociology 80, 100, and 106; 3) satisfactorily complete at least one course in statistics or some other collateral field; 4) participate in the Honors Seminar; and 5) prepare an Honors Thesis which is acceptable to his Departmental adviser.

The Department does not distinguish between highest honors, high honors, and honors, but simply recognizes honors.

MAJOR IN SOCIAL SCIENCES (SOCIOLOGY)

The Major in Sociology who is interested in pursuing a program of interdisciplinary study in the social sciences may wish to declare for the Bachelor's degree in "Social Sciences (Sociology)". To do so, he must declare for this program not later than the beginning of the Winter Quarter of his junior year.

For the Bachelor's degree in Social Sciences (Sociology), 45 units of course work are required. Thirty units must be in Sociology and must include Sociology 80, 100, and 106. The remaining fifteen units must be selected "in consultation with the adviser" from the course offerings of other departments in the social sciences (Communication, Economics, Political Science, Psychology, Anthropology, and Linguistics).

Students wishing to combine concentration in Anthropology with an interdisciplinary interest not represented by a field in the social sciences (e.g., History) are advised to arrange for a special major in the University's Interdepartmental Major Program.

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 ob-
tained 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. At least 30 of these units must be in courses at or above the 100 level.

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 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, six graduate courses are required: Basic Problems in Sociological Theory, Theory Construction, Statistics for Sociological Analysis, Research Design, Logic of Social Research, 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 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.

THE 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.

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 (Zelditch) MTWThF 11; sections by arrangement

5 units, Sum (— —) MTWTh 9; 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) MTWThF 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 10
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 (Scott, Staff) MTWThF 10

5. Introduction to Statistical Methods I—(Same as Statistics 60.) Especially designed as a non-mathematical study of statistical methods used in the social 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 (Switzer) MTWThF 3:15

4 units, Sum (——)

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, given 1973-74

60. Racism and Prejudice—An historical and comparative analysis of ethnic group relations in this and other countries. Attention is given to the social-psychological and structural sources of racism and prejudice.

5 units, Win (Drake) MTWTh 9

63. Social Identities and Interaction—How do people come to define “self” and “other” in social situations, and what are the consequences of identity formations for interpersonal relations? The course will deal with the effects of person perception on interaction, and it will cover role-taking, role-playing, and role-conflict. Social norms and cultural values will be treated in terms of the possibilities they offer and the prerogatives they prescribe on the identity-potentials of people in interaction. Primarily for non-major undergraduates.

5 units, Spr (Alexander) MWF 1:15

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 (Staff) T 4:15-6:05

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, Aut (Olsen) MWF 10

103. Advanced 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, Aut (McMahon) MTWThF 1:15

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) MTWTh 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) MTWThF 11

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, Win (——) MWF 11

110. Religious Institutions and Behavior—A sociological approach to organized religion, emphasizing the interaction between the church and its social setting.

5 units, Win (Dornbusch) MWF 11

112. Social Change — Evolutionary theories of societal change, with emphasis on comparative research.

5 units, given 1973-74

113. Social Identity Transactions—Historical and contemporary perspectives on the formation, maintenance, and change of social identities. Exploration of contemporary research concerns in the areas of attribution theory and dispositional inference processes. Consideration will be given to integrating these issues with other major theoretical ideas in social psychology. Primarily for majors with some background in social psychology.

5 units, Win (Alexander) W 2:15-5:05

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, given 1973-74

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.

4 units, Aut (March) M 1:15-3:05; sections M 10 or 11

120. Human Ecology: A Materialist Approach to Social Structure—Introduction to human ecology—the study of social structure viewed as man’s collective adaptation to the environment through technology. Topics covered include: a brief survey of the origins of the continuing idealist-materialist debate in the social sciences; Marxian and neo-Marxian approaches; survey of current theory and empirical research in human ecology in several social sciences.

5 units, Aut (Hannan) TTh 2:15-3:45

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, Spr (Meyer) MTWThF 9

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) MT 12:50-2:05

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, Win (Olsen) MWF 11

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, Spr (Olsen and Cancian) TTh 2:15-4:05

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, Spr (Cancian and Olsen) MWF 2:15


5 units, Win (Kirk) MTWTh 9

132. Black Communities in the United States—A description and analysis of some of the various types of black communities in this country.

5 units, Aut (Drake) MTWTh 10

134. Contemporary Problems in Social Institutions—(Same as Education 202 and Political Science 280A.) The examination of a specific contemporary institution. (The institution to be considered varies each year.)

How does the institution function? What are its problems? What are the alternatives? Ideology, social structure and process, institutionalization and professionalization, normative regulation. In 1973 the course will focus on the social institutions of leisure and play.

4 units, Win (March) MW 8:30-10:00

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 (Olsen and Cancian) given 1973-74

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, Staff) Wed 7-10 p.m. and by arrangement

144. Sociology of Urban Growth—(Same as History 233.) Undergraduate colloquium on the socio-economic aspects of urban growth in Europe during the first decades of modern industrialization.

5 units, Win (Thienel) Th 2:15-4:05

ADVANCED LEVEL COURSES—OPEN TO ADVANCED UNDERGRADUATES AND TO GRADUATES

Note—Students can usually obtain more detailed descriptions of the following courses from the Department Office on registration days.

153. Undergraduate Colloquium: The Professions—Analysis of the individual professional, the organizational professional, and the professional organization and the professional association in contemporary society. Among the topics to be considered: colleague control; the revolt of the client; the professionalization of everyone. Limited enrollment; preference given to undergraduate majors.

3 units, Win (Scott) T 2:15-4:05
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, Spr (Zelditch) W 2:15-5:05

155. Research Seminar on Expectation-States Theories—This research seminar will concern itself with the analysis of some recently developed expectation-states theories and the results of experiments carried on in connection with these theories. In addition to a lecture and discussion session, students will participate in working on on-going experimental research. Research activities by arrangement.

3 to 5 units, Win (Berger) M 2:15-4:05

156. 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 in 1973-74

157. 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) TTh 7-9

158. 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 1973-74

159. 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 macrosociology.

5 units, given 1973-74

160. 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 topics treated will be deviant behavior, occupations, schools and other organizations, national character, and political participation. Undergraduates who have some background in personality theory or sociological analysis will be admitted. Enrollment limited to fifty, some of whom may be invited to join the advanced seminar for which this course is a prerequisite.

3 to 5 units, Win (Inkeles) TTh 4:15

161. Norms, Values, and Behavior—This research seminar will investigate the conditions under which people conform to the norms and values of their community. The main activity will be doing research. Reading will focus on studies of how norms, values and attitudes affect behavior. Open to advanced undergraduates and graduates in the social sciences.

5 units, given 1973-74

162. Urbanization and Status Systems — A reexamination of sociological theory and research on social stratification from the point of view of ecological bases of status systems. Prerequisite: consent of instructor.

5 units, given 1973-74

163. Computer Models of Social Behavior—(Same as Computer Science 127, Education 218, Political Science 180M, and Psychology 154.) Models of human behavior in social situations. Particular attention is given to the problems involved in specifying simulation models, determining their properties, and testing them. Enrollment limited to 20. Prerequisites: knowledge of at least one programming language; advanced courses in social science; consent of instructor.

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

164. 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) by arrangement
2 units, Win (Staff) by arrangement
2 units, Spr (Staff) by arrangement

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 (Cohen) MWF 11; labs by arrangement

204. Field Methods in the Study of Organizations — Field research on a selected organizational problem will be carried out with the student gaining experience in data collection and analysis.
4 units, given 1973–74

213. Research Seminar on Organizations — (Same as Education 327.) Concerned with research design and/or data analysis problems in on-going organizational research. Basic purpose is to give students a taste of data collection and analysis problems in the context of a real research project on organizations. Each student will write papers dealing with specific problems within the context of the larger research activity. Prerequisite: Fundamentals of Organization Theory (204 or 105 or Education 329). Recommended: Research methods course and elementary statistics.
4 units, Aut (Baldridge) T 7–10 p.m.

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. Enrollment will be limited to fifteen; the selection, if necessary, to be made at the first meeting.
3 to 5 units, Spr (Inkeles) W 3:30–5:30

217. Problems in Theoretical Analysis — Prerequisites: 253 and consent of instructor.
5 units, given 1973–74

219. Policy Research in the Social Sciences — (Same as Education 328.) An analysis of the ways social science can be used to aid in policy decisions, especially in complex organizations and educational areas. Students will work in teams to select and define problems, gather data, and offer alternative policy recommendations based on their analysis.
4 units, Spr (Baldridge) T 7–10 p.m.

220. Research Problems in the Sociology of Education — (Same as Education 310.) 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 285.) The demographic situation of each of the major regions—Latin America, tropical Africa, Islam, India, and East Asia—in relation to economic and social development. Population forecasts and prospects. Present and possible policies for restricting population growth. Each student will be required to lead a seminar and prepare a paper based on a term project. Prerequisite: 230 or consent of instructor.
5 units, Spr (Kirk) M 2:15–5:05

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 (Newby) 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, given 1973–74

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) W 2:15–5:05

253. Theory Construction — Prerequisite: consent of instructor.

5 units, Spr (Berger) T 2:15–5:05

255. Logic of Social Research — Practicum in the formulation and critical evaluation of research designs for the study of sociological problems. Prerequisites: 149 and 260.

5 units, given 1973–74

267A,B. Seminar on Research Design, Measurement, and Data Analysis.

5 units each quarter, given 1973–74

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) Th 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 (Adlakha) 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. Prerequisite: 105, 203 or equivalent.

4 units per quarter, Aut, Win, Spr (March, 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

(Staff) by arrangement

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. Visiting: Juan M. Lope Blanch

Senior Lecturer: Phillip Petersen


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.

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 23 units

Literature: Chosen from courses in Hispanic Literature or Civilization numbered from 180 up 6 units

Language Laboratory 215 2 units

Methods: Spanish 210 2 units

Courses in Education 12 units

45 units

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.

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Language Laboratory 215 2 units

Methods: Spanish 210 2 units

Courses in Education 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.

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 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 continues his 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 from the following courses: Spanish 181, 190, 204, 205, 260, 263, 264, 266. Portuguese 185. No more than three units of similar work done elsewhere will be accepted as partial fulfillment of this requirement.
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 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 two other foreign languages. This knowledge must be demonstrated by examination.
2. Nine units to be chosen from the following courses: Spanish 181, 190, 204, 205, 260, 263, 264, 266. Portuguese 185. 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 are open to all students. When registering, students are advised to prefix the identifying letter A to the course number.

### 75. Don Quixote in Translation — Open to non-Spanish majors only.

3 units

### 150. Unamuno and Ortega — Present-day conflicts in literary works of Unamuno, Ortega y Gasset. Not open to Spanish majors.

3 units


3 units


3 units

### 153. Lorca and Other Contemporary Spanish Dramatists in Translation — Modern trends, tensions as reflected in significant Spanish dramatists of present day. Not open to Spanish majors.

3 units

### 156. Luso-Brazilian Literature in Translation—Analysis, discussion of representative works. Open to Spanish majors.

3 units, Spr (Staff) MWF 9

### 171, 172, 173. 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, Aut, Win, Spr (Hilton) MWF 10

**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) MTWThF

2. **First-Year Spanish—Continuation of 1.**
   - 5 units, Aut, Win, Spr (Staff) MTWThF

3. **First-Year Spanish—Continuation of 2.**
   - 5 units, Aut, Win, Spr (Staff) MTWThF

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 and one hour daily in 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. degree. 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

23. **Second-Year Spanish — Continuation of 22.**
   - 3 units, Aut, Win, Spr (Staff) MWF

24. **Second-Year Spanish — Continuation of 23.**
   - 3 units, Aut, Win, Spr (Staff) MWF
9 units, Sum (Staff) MTWThF 8 and 11

52. Intensive Second-Year Spanish.  
5 units, Aut (Staff) MTWThF

52BL. Intensive Second-Year Spanish—Especially designed for bilingual students.  
5 units, Aut (Staff) MTWThF

53. Intensive Second-Year Spanish—Continuation of 52.  
5 units, Win (Staff) MTWThF

53BL. Intensive Second-Year Spanish—Especially designed for bilingual students. Continuation of 52BL.  
5 units, Win (Staff) MTWThF

54. Intensive Second-Year Spanish—Continuation of 53.  
5 units, Spr (Staff) MTWThF

54BL. Intensive Second-Year Spanish—Especially designed for bilingual students. Continuation of 53BL.  
5 units, Spr (Staff) MTWThF

99. Individual Reading — Enrollment only by special consent. Prerequisite: 23.  
1 to 4 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 or 10

113BL. Third-Year Spanish — Continuation of 112BL.  
3 units, Spr (Staff) MW 10

121. Hispanic American Cultural Readings —Prerequisite: 23 or equivalent.-  
3 to 4 units

125. Spanish Cultural Readings—Training in careful reading of books with significant cultural content. Prerequisite: 23 or equivalent.  
3 to 4 units, Aut (Staff) MWF 1:15

130. Cervantes—Don Quixote. Prerequisite: 23 or equivalent.  
3 to 4 units

131. Masterworks of Spanish Literature I—Selected readings of Golden-Age authors. Prerequisite: 23 or equivalent.  
3 to 4 units

132. Masterworks of Spanish Literature II—Selected readings of modern Spanish authors. Prerequisite: 23 or equivalent.  
3 to 4 units

142. The Spanish Novel of the Nineteenth Century.  
3 to 4 units

151. Masterworks of Spanish American Literature I—Prerequisite: 23 or equivalent.  
3 to 4 units

152. Masterworks of Spanish American Literature II—Prerequisite: 23 or equivalent.  
3 to 4 units, Spr (Gamboa) MWFTh 10

164. Spanish Conversation — Discussion in Spanish of present day problems. Enrollment limited to 15. Students in the short-term program should enroll in 164A for 2 units.  
4 units, Sum (Staff) MTWThF 9

165. Spanish Conversation — Discussion in Spanish of present-day problems. Enrollment limited to 15. Students in the short-term program should enroll in 165A for 2 units.  
4 units, Sum (Staff) MTWThF 9

166. Spanish Conversation. Enrollment limited to 15. Students in the short-term program should enroll in 166A for 2 units.  
4 units, Sum (Staff) MTWThF 1:15

ADVANCED AND GRADUATE

184. Spanish Speech and Drama—Reading and rehearsing of Spanish plays. May be repeated for credit. Prerequisites: 100 and 112 or consent of instructor.  
3 units
185. Spanish Phonetics.
   2 to 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 4 units

187L. Spanish American Literature II — Romanticism. Open only to graduate and advanced undergraduate students.
   3 to 4 units

188L. Spanish American Literature III — Modernismo. Open only to graduate and advanced undergraduate students.
   3 to 4 units

186S. Spanish Literature I — From its origins to end of fifteenth century.
   3 to 4 units

187S. Spanish Literature II — Sixteenth and early seventeenth centuries.
   3 to 4 units

188S. Spanish Literature III — From 1650 to 1898.
   3 to 4 units, Spr (Alfaro) MWF 10

189S. Spanish Literature IV — Twentieth century.
   3 to 4 units

190. Spanish Linguistics — (Same as Education 283.)
   3 units

193. The Problems of Spain in the Literature of the Nineteenth and Twentieth Centuries.
   3 to 4 units

195. Chilean Literature of the Twentieth Century.
   3 to 4 units

195A. Argentine Literature of the Twentieth Century.
   3 to 4 units

195B. Mexican Literature of the Twentieth Century.
   3 to 4 units

195C. Peruvian Literature of the Twentieth Century.
   3 to 4 units

196. Poesía tradicional española.
   3 to 4 units, Aut (Lope-Blanch)
   MW 4:15–5:30

   3 to 4 units

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

201. Advanced Grammar and Stylistics — Intensive review of structural syntax. Prerequisite: qualifying examination.
   3 units, Aut (Staff) MWF 3:15
   Sum (Staff) MTWF 2:15

202. Advanced Grammar and Stylistics — 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 3:15

203. Advanced Grammar and Stylistics — Prerequisite: 202 with grade of B or equivalent.
   3 units, Spr (Staff) MWF 3:15

204. Modern Spanish I — The phonology of modern Spanish.
   3 units

205. Modern Spanish II — The syntax of modern Spanish.
   3 units

210. Methods of Teaching Spanish — (Same as Education 292.) See also Language Laboratory 215.
   2 units, Win (Staff) TTh 11
   Sum (Petersen) MTWThF 11

211. Spanish Literature from its Origins to 1500.
   4 units

212. Spanish Literature of the Sixteenth Century.
   4 units

213. Spanish Literature of the Seventeenth Century.
   4 units

214. Spanish Literature from 1700 to 1850.
   4 units
215. Spanish Literature from 1850 to 1905.
4 units
216. Spanish Literature from 1905 to the Present.
4 units
217. Spanish Theater of the Golden Age.
3 to 4 units
218. Spanish Renaissance Prose.
3 units
220. Cervantes.
3 to 4 units
223. The Modern Spanish Novel.
3 to 4 units
3 units
3 units
228. Contemporary Spanish Poetry.
3 to 4 units, Win (Gicovate)
230. Hispanic Folklore.
3 to 4 units
232. The Spanish Epic Tradition.
3 units
240. Spanish Versification.
3 units
248. Proseminar: Problems and Methods of Research in Hispanic Literatures I.
3 units
249. Proseminar: Problems and Methods of Research in Hispanic Literatures II.
3 units
250. Graduate Seminar in Spanish Literature—Subject to be announced in Time Schedule.
3 units, Aut (Gicovate) M 2:15–4:05
Win (Staff)
251. Graduate Seminar in Spanish American Literature
3 units
255. Contemporary Novelists of Spanish America.
3 units
257. The “New Novel” in Europe and Latin America—(Same as Comparative Literature 257.)
4 units, Spr (Franco)
258. Modern European and Latin American Poetry: Avant Garde and Vanguard—(Same as Comparative Literature 258.) Studies in the relationship of European movements such as Symbolism, Dada, and Surrealism with contemporary Latin American poets.
4 units, Win (Franco)
260. History of the Spanish Language—Readings in Old Spanish. Prerequisite: elementary knowledge of Latin and consent of instructor.
3 units
261. Old Spanish—Elements of phonology, morphology; reading of Old Spanish texts. Prerequisite: elementary knowledge of Latin and consent of instructor.
3 to 4 units
263. Historical Spanish Linguistics I—Prerequisite: 260.
3 units, Aut (Lope-Blanch)
264. Historical Spanish Linguistics II.
3 units
266. Hispanic Dialectology.
3 units
3 units, Aut, Win, Spr (Hilton) MWF 10
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) MWThF 1:15
2. First-Year Portuguese—Continuation of 1.
5 units, Win (Staff) MWThF 1:15
3. First-Year Portuguese—Continuation of 2.
5 units, Spr (Staff) MWThF 1:15
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
35. Intensive Portuguese — Intensive work on pronunciation and drill problems, conversation, and a minimum of composition and grammar. Prerequisite: one year of Portuguese.
   12 units, Sum (Staff) MTWThF 11 and 1:15 and lab.
99. Individual Reading — Enrollment only by special permission. Prerequisite: 23.
   1 to 2 units, any quarter (Staff) by arrangement
107. Conversations on Contemporary Brazil.
   5 units, Sum (Staff) MTWThF 8
115. Advanced Intensive Portuguese — Intensive work on oral expression, correction of pronunciation and grammar.
   12 units, Sum (Staff) MTWThF 8
131. Masterworks of Portuguese and Brazilian Literature.
   3 to 4 units

ADVANCED UNDERGRADUATE AND GRADUATE

181. Advanced Portuguese.
   3 units, Aut (Coelho) MWF 1:15
182. Advanced Portuguese — Continuation of 181.
   3 units, Win (Staff) MW 2:15
183. Advanced Portuguese — Continuation of 182.
   3 units, Spr (Staff) MW 2:15
185. Portuguese Linguistics.
   3 to 4 units, Win
186. Portuguese Phonetics.
   3 to 4 units
191. Portuguese Literature I.
   3 to 4 units
192. Portuguese Literature II.
   3 to 4 units
195. Brazilian Literature I.
   3 to 4 units, Aut (Coelho) Th 2:15–4:05
196. Brazilian Literature II.
   3 to 4 units, Win (Coelho) MW 12
199. Individual Work—May be repeated for credit.
   1 to 12 units, any quarter (Staff) by arrangement
207. Advanced Conversations on Contemporary Brazil.
   5 units, Sum (Staff) MTWThF 11
250. Graduate Seminar—Subject to be announced in Time Schedule.
   3 units, Spr (Staff)
299. Individual Work.
   1 to 12 units, any quarter (Staff) by arrangement

SPEECH and DRAMA

(See Department of Drama, found on page 266.)

STATISTICS

Emeritus: Quinn McNemar (Professor)
Chairman: Herman Chernoff
Professor of Biostatistics: Byron W. Brown, Jr.
Visiting Professor: Christopher C. Heyde
Associate Professors: Thomas M. Cover, Bradley Efron, Paul Switzer
Assistant Professors: Louis Gordon, Sidney Resnick. Acting: Mayer Alvo, Ramesh M. Korwar
Assistant Professor of Educational Statistics: Janet D. Elashoff

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, Computer 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 536 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 mathematical 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. Four 200-level quarter courses in Mathematics including Mathematics 205A and 206A (or equivalent).

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 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, combinatorial 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 (Resnick) MWF 2:15
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 (Korwar) MTWThF 9
Win (Alvo) MTWThF 3:15

60. Introduction to Statistical Methods I—(Same as Sociology 7.) 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 (Switzer) MTWThF 3:15
4 units, Sum (Alvo) MTWThF 1

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 (Switzer) MTWF 10
62. 3 units, Spr (Olkin) MWF 10

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, Spr (Madow) TTh 1:15-2:30

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 (Alvo) TTh 10 and MW 4:15
Spr (Korwar) MTWF 9
Sum (——) MTWThF 9


4 units, Aut (Resnick) MTWF 11
Spr (Moses) MTWF 8
Sum (——) MTWThF 11

116E. Theory of Probability — A course similar to 116 for engineering students. Prerequisite: Mathematics 45.

3 units, Aut (Alvo) MWF 11


4 units, Aut (Gordon) MTWF 11

119. Elementary Statistical Inference — Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. Prerequisite: 116.

4 units, Win (Lieberman) MWF 11
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 (Lieberman) MWF 11
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 (Cover) MWF 10

140. Introduction to Probability and Its Applications — For graduate students. Lectures same as 40.

3 units, Aut (Resnick) MWF 2:15
Sum (——) by arrangement

150. Elementary Statistics — For graduate students. Lectures same as 50.

4 units, Aut (Korwar) MTWThF 9
Win (Alvo) MTWThF 3:15

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 gradu-
ate students. See 252. Prerequisite: Mathematics 43.

3 units, Win (Cottle) MW 4:15–5:30


3 units, Spr (Jacobs) MW 4:15–5:30

160. Introduction to Statistical Methods I — For graduate students. Lectures same as 60.

4 units, Aut (Switzer) MTWThF 3:15
Spr (Alvo) MTWThF 1:15
Sum ( ) by arrangement

161, 162. Introduction to Statistical Methods II, III — For graduate students. Lectures as 61, 62.

161. 4 units, Win (Switzer) MTWF 10
162. 3 units, Spr (Olkin) MWF 10

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, given 1973–74

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 1973–74


3 units, given 1973–74

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 (Korwar) MWF 2:15
Win (Resnick) MWF 3:15
218. 3 units, Win (Korwar) MWF 2:15
Spr (Resnick) 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 (Lieberman) MWF 11
Sum (Haley) MTWThF 8:00–9:50

220. Statistical Inference — For graduate students. Lectures same as 120.

3 units, Spr (Lieberman) MWF 11
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 (Gordon) MWF 11

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 (Gordon) MWF 11

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, given 1973–74

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 (Heyde) MWF 1:15
230B. 3 units, Win (Heyde) MWF 1:15
230C. 3 units, Spr (Heyde) 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 (Gordon) MWF 2:15
236B. 3 units, Win (Johns) MWF 2:15
236C. 3 units, Spr (Johns) MWF 2:15

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 (——) TTh 4:15-5:30


3 units, Spr (Lieberman) MW 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 (Jacobs) MW 3:15-5:05
Win (Eaves) MW 4:15-6:05
Sum (——) TTh 3:15-5:30


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

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) Th 1:15-3:05
260B. 2 to 5 units, Win (Brown) Th 1:15-3:05
260C. 2 to 5 units, Spr (Brown) 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)
261B. 2 to 3 units, Win (Olkin)
261C. 2 to 3 units, Spr (Olkin)

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, Win (Cottle, Olkin)
314B. 3 units, Spr (Cottle, Olkin)

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.

324A. 3 units, Aut (Stein) MWF 10
324B. 3 units, Win (Stein) MWF 10
324C. 3 units, Spr (Stein) MWF 10

324A. 3 units, Aut (Stein) MWF 10
324B. 3 units, Win (Stein) MWF 10
324C. 3 units, Spr (Stein) MWF 10

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, Aut (Chernoff) TTh 11

326B. Sequential Analysis—General theory of optimal stopping with applications to sequential statistical decision problems.

3 units, Win (Chernoff) TTh 11

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, Aut (Chernoff) TTh 11

326B. Sequential Analysis—General theory of optimal stopping with applications to sequential statistical decision problems.

3 units, Win (Chernoff) TTh 11

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, Aut (Chernoff) TTh 11

326B. Sequential Analysis—General theory of optimal stopping with applications to sequential statistical decision problems.

3 units, Win (Chernoff) TTh 11

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, given 1973-74
328B. 3 units, given 1973-74

330. Stochastic Processes—Topics in stochastic processes to be announced later. Prerequisites: 230A, B, C.

3 units, Spr (Heyde) MWF 11


3 units, Aut (Johns) TTh 11:00-12:15

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, Win (Johns) TTh 11:00-12:15

336A, B. Decision Theory and Statistical Inference — Minimax theorem, admissibility and complete class theorem, formulation of statistical decision problems, sufficient statistics, testing hypotheses, estimation, comparison of experiments, and sequential problems.

336A. 3 units, Aut (Stein) MWF 2:15
336B. 3 units, Win (Stein) MWF 2:15


343A. 3 units, given 1973-74
343B. 3 units, given 1973-74

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 1973-74
351B. 3 units, given 1973-74


3 units, Win (Cover)

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)

399. Research — Research work as distinguished from independent study of nonresearch 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
Associate Professors: John H. Barton, Paul A. Brest, Robert L. Rabin
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 (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 6, 1972, and classes for spring term will terminate on June 11, 1973.

COURSES

GRADUATE

The following courses are open to qualified graduate students of other departments of the University upon permission of the instructor:

296. Legal Aspects of International Control of Armed Conflict — A seminar on the legal problems of international arrangements for the control and prevention of armed conflict. The seminar will focus on a series of examples of such arrangements: the international law of neutrality, neutralization of an area, the informal activities of the United Nations Secretary General, United Nations peacekeeping forces, and the concept of war criminality.

2 term units, Aut (Barton)

300. Education and Law—(Same as Education 300.) This course will examine issues in the financing, control, and operation of elementary and secondary schools, including: 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, equal educational opportunity. Enrollment limited to ten students each from the School of Education and the School of Law.

2 term units, Aut (Brest, Levin)

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.

2 to 3 term units, Aut (Friedman)

323. Legal Systems of Western Europe and Latin America—A study of the legal systems of major West European and Latin American nations—the so-called civil law nations—and of some of the important ways in which they differ from American law. The emphasis is on context, structure, and process, with less attention to mastery of rules of substantive law.

3 term units, Aut (Merryman, Cappelletti)

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 (Franklin), given 1973-74

107. The Criminal Law and the Criminal System—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.

4 units, Spr (Kaplan) by arrangement

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) MTW 10
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 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, with the assistance of curricular consultants from the faculty and student body. 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. Selected students accepted into the M.D. Program, upon invitation by the faculty, are eligible for appointment as predoctoral fellows in the Medical Scientist Training Program in the School of Medicine. Students interested in medical research should consult the Medical School Bulletin for details of this Program.

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.
The School of Nursing has offered a five-academic-year curriculum since 1957. Students presently enrolled will complete this program although no new students will be admitted. A comprehensive study leading to a new, four-year program will be undertaken during 1972-73 and it is anticipated that the first class will be admitted in Autumn 1974.

DIVISION OF PHYSICAL THERAPY
Emeritus: Sarah Semans (Associate Professor)
Director: Helen Blood
Associate Professors: Lucille Daniels. Clinical: Catharine Graham
Assistant Professors: Helen Blood, Barbara Kent. Clinical: Ruth Cook
Lecturers: Katharine Robertson, Susan Fitch

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 years, a total of six quarters, and includes basic courses required for state licensure and one of the following specialty areas: Administration, Community Health, Curriculum and Teaching, or Pediatrics, and the satisfactory completion of the 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, 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

100. Introduction to Physical Therapy—General survey of history of field, common physical disabilities, and current therapeutic procedures; observation of treatment. For undergraduate students interested in a future career in the field.

3 units, Aut (Daniels, Staff) T 3:15-5:05 and one hour by arrangement

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 physiological 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 diagnostic 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.)

3 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 part-time to health care facilities for 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

258. Seminar: Evaluation of Physical Therapy—Comparative analysis of physical ther-
apeutic 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—260 and 261
Pediatrics—265 and 266
Community Health—270 and 271
Curriculum and Teaching—280 and 281

260. Administration in Physical Therapy I — Program planning; cost analysis; supervising and consulting techniques; interprofessional and interdepartmental relationships. Includes projects and field work.
4 units, Aut (Daniels) by arrangement

4 units, Win (Daniels) by arrangement

4 units, Aut (Houser) by arrangement

266. Pediatric Physical Therapy II — Continuation of 265.
4 units, Win (Houser) by arrangement

4 units, Aut (Blood) by arrangement

271. Community Health and Physical Therapy II — Continuation of 270.
4 units, Win (Blood) by arrangement

280. Curriculum Development and Directed Teaching I — Objectives, organization, content of curricula and courses in physical therapy; directed teaching in selected areas of the field.
3 to 5 units, Aut (Daniels, Staff) by arrangement

281. Curriculum Development and Directed Teaching II — Continuation of 280.
3 to 5 units, Win (Daniels, Staff) by arrangement

282. Directed Teaching.
1 to 5 units, any quarter (Staff) by arrangement

1 to 8 units, any quarter (Staff) by arrangement

RESEARCH COURSES

Research requirements of the Division must be satisfied by completing either 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

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

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

ANATOMY

Emeriti: William W. Greulich, Hadley Kirkman (Professors)
Chairman: Donald J. Gray
Professors: Donald J. Gray, Robert S. Turner. Visiting: Otto A. Mortensen
Associate Professor: Donald L. Stilwell, Jr.
Assistant Professors: Ferrell R. Campbell, Gerald R. Cunha, Lawrence H. Mathers
Instructor: Acting: Ian H. Leverton
Lecturer: Myrna B. Miller
Clinical Lecturers: Dean T. Clark, Burt L. Davis, Jr., Mitchell S. Madison, Robert W. Meyer, Reuben Stutch, Bernard O. A. Thomas

PROGRAMS OF STUDY

Instruction in the Department of Anatomy is planned primarily to meet the needs
of students in medicine, but, insofar as facilities permit, all of the courses are open to other properly qualified third- and fourth-year undergraduate and graduate students. Those who are not registered in medicine but wish to take work in the Department should make arrangements in advance with the instructors concerned.

Facilities are available for a limited number of doctors of medicine, or others with equivalent training, who may wish to do special dissections or pursue work on problems within the scope of the Department. Graduate study may be undertaken in such aspects of anatomy as are indicated by the courses listed. Programs combining work in anatomy and other fields of biology or medicine may be arranged.

ADVANCED DEGREES

Students desiring to become candidates for advanced degrees in anatomy should consult the general University regulations regarding such degrees, which are summarized in the section "Degrees" in this bulletin. It is to be noted that this Department requires the Graduate Record Examination, plus the advanced test in Biology. Candidates for the degree of Doctor of Philosophy will be expected to have done the equivalent of at least the basic work offered in the Department. All programs leading to an advanced degree in anatomy must be worked out individually and approved by the Department faculty. It is expected that an average grade of B will be maintained. Approval must also be obtained by graduate students in other departments who wish to elect anatomy as a minor.

COURSES

101. Practical Anatomy — Brief survey of 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) TThF 1:15-4:05

201. Human Gross Anatomy—Embryology, dissection, demonstrations, and clinical correlations. Enrollment ordinarily limited to medical students.
5 units, Aut (Gray, Leverton, Mortensen) MWF 8:00-10:50

5 units, Win (Gray, Leverton, Mortensen) MWF 8:00-10:50

3 units, Spr (Turner, Leverton, Mortensen) TTh 8:00-10:50

204. Histology — Structural and functional organization of cells, tissues, and organs, as seen with the light and electron microscopes.
3 units, Aut (Campbell, Kirkman, Mathers, Miller) TTh 8:00-10:50

205. Histology — Continuation of 204.
3 units, Win (Campbell, Kirkman, Mathers, Miller) T 9:00-10:50; Th 8:00-10:50

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

3 units, Aut (Turner, Mathers, Miller, Stilwell) MWF 10:00-10:50

214. Neuroanatomy Laboratory — A study of prepared slides and dissections of central nervous systems of man and other mammals. Prerequisite: previous or concurrent enrollment in 209.
1 unit, Aut (Turner, Mathers, Miller, Stilwell) MWF 11:00-11:50

216. Concise Human Anatomy — Lectures, dissection, demonstrations, clinical correlations, embryology.
5 units, Win (Stilwell, Leverton, Mortensen) MWF 8:00-10:50

217. Concise Human Anatomy — Continuation of 216. Prerequisite: 216.
5 units, Spr (Stilwell, Leverton, Mortensen) TTh 8:00-10:50; F 10:00-11:50

299. Research — By individual arrangement, approved by Department faculty.
Any quarter (Staff) by arrangement

BIOCHEMISTRY

Chairman: Paul Berg
Professors: Robert L. Baldwin, Paul Berg, David S. Hogness, A. Dale Kaiser (on
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 1:15
201. 5 units, Win (Staff) MTWThF 1:15

203. Mechanisms of Biochemical Reactions — Detailed examination of a few selected topics; examples will be taken from processes such as enzyme-catalyzed hydrolyses and group transfer reactions, participation of coenzymes in enzymatic reactions, modification of enzyme structure and activity. Prerequisite: 200, 201, and 3 quarters of organic chemistry are recommended.

2 units, Spr (Stark) given 1972–73

204. Membrane Biochemistry.

2 units (Kornberg) given 1973–74

211. Subject to be announced.

2 units (Kaiser) given 1973–74

212. Enzymology of Nucleic Acids — Recent advances in the enzymology of nucleotide and nucleic acid synthesis and degradation will be discussed. Special attention will be given to virus-induced enzymes. Prerequisites: Biochemistry 200 and 201.

2 units, Win (Lehman) given 1972–73

213. The Arrangement of Information in Chromosomes.

2 units (Hogness) given 1973–74

214. Physical Chemistry of Proteins and Nucleic Acids — Laboratory work and discussion on the measurement of conformational changes and binding reactions (protein-ligand, protein-protein, and protein-nucleic acid). Prerequisites: first-year physical chemistry and consent of instructor. Limited enrollment.

3 units, Aut (Baldwin) given 1972–73

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; research training for medical students in the Medical Scientist Training Program; and research training to holders of the Ph.D. or M.D. The Department also participates in an interdepartmental program leading to a Ph.D. in Neurological 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.

Financial support for predoctoral and postdoctoral trainees is available including full tuition and personal stipend at current national levels. Support opportunities exist through appointments as part-time research assistants. However, applicants are also strongly encouraged to apply independently for National Institutes of Health, National Science Foundation, or other fellowships. Predoctoral applicants are encouraged to take the Graduate Record Examination in Biology, Chemistry, or Physics. Further inquiries should be directed to the Graduate Student adviser (predoctoral applicants) or the appropriate faculty member (postdoctoral applicants).

For further information on the availability of the following courses, consult the quarterly Time Schedule, or inquire at the Department Office. Additional courses in genetics are included in the listings of the Department of Biological Sciences and the Program in Human Biology.

COURSES

201. Medical Genetics—Case presentations and lectures on applications of genetics to human disease and the more important genetic polymorphisms of man. Prerequisite: consent of instructor for nonmedical students. 2 units, Spr (Cann, Staff) TTh 11

208. Human Cytogenetics and Its Clinical Applications—After a review of normal human chromosome structure and normal chromosome segregation in mitotic and mi-
totic 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 1971-72

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) MWF 10

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

PROGRAM IN HEARING AND SPEECH SCIENCES

Emeritus: Virgil A. Anderson (Professor)
Director: James H. Dewson III
Professors: Jon Eisenson, Earl D. Schubert
Associate Professors: James H. Dewson III, Dorothy A. Huntington
Assistant Professors: Theodore J. Glattke. Clinical: Kathryn R. Beadle
Clinical Instructor: Robert H. Gottsleben

Cooperating in the offerings of the Program is Clara N. Bush, Associate Professor of Linguistics (on leave 1972-73)

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. The Scottish Rite Institute for Childhood Aphasia has a close connection with the program; this affiliation plus 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.)

A limited number of postdoctoral research fellows will be accepted each year. 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 200.) Theory and practice of phonetic transcription of speech, including consideration of distinctive features, sound types and units and the effects of context on sound patterns (both segmental and prosodic). Phonetic characteristics associated with speech registers and dialects.

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

220. Psychology of Speech—Origin, development of speech, semantics; relation of speech to thought, emotion, personality.

3 units, Aut (Eisenson) MWF 9

230. Physiology of Speech Production—Study of the structure of the speech mechanism and its function. Special attention will be given to recent research in respiratory control, the nature of phonation, and the articulatory adjustments characteristic of spoken language.

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

252. Organic Language Disorders—Impairments in reception and production of language correlated with disfunction of central nervous system. Aphasic disorders in children and adults will receive special emphasis.

3 units, Spr (Eisenson) MWF 9

260. Clinical Aspects of Communication Disorders—An overview of speech and language disorders with special emphasis on diagnostic techniques. Prerequisite: consent of instructor.

3 units, Win (Beadle) 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 Audiometry—Detailed consideration of current tests of auditory function with special reference to psychological 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 cur-
rent 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. Schwertd, 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 D. Fenster

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 Arts to undergraduates. Requirements include: Biological Sciences, 15 quarter units; Chemistry, 24 quarter units; Physics, 12 quarter units. The following courses in the Department are required and normally covered during the senior year: Medical Microbiology 101, 200, 202, 204, 206, and 270. In addition, Biochemistry 200 and 201 are required.

ADVANCED DEGREES

MASTER OF ARTS

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 Arts. They will be expected to have completed the premedi-
cal requirements (see above) and Quantitative Analysis (Chemistry 111, 112), and to complete the following courses: Medical Microbiology 101, 200, 202, 204, 206, 270, and Biochemistry 200 and 201. In addition, at least 15 units of research bearing on the thesis subject must be completed. The candidate is expected to pass an oral examination of two hours’ duration covering the fundamentals of medical microbiology, bacterial genetics, immunology, and virology at the end of the first year of work.

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 (Psychology 60 or Statistics 50), principles of computer science (e.g., Computer Science 106, 156; Genetics 217), and molecular biology (e.g., Biological Sciences 21, 22, 23, 250). These general recommendations should be discussed with faculty advisors. 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 211, 212, 213, 214); physical chemistry (e.g., Chemistry 171, 173); calculus (Mathematics 10, 11, 21, 22, 23). The choice among these (or other) formal courses should be discussed with an advisor.

The student is expected to pass qualifying examinations at the end of his 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 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 1, 2, and 3.

5 units, Aut (Hayflick) MWF 1:15; lab. MWF 2:15–4:05

102. Diseases of Laboratory Animals — Discussion and observations of diseases of laboratory animals, their effects on experiments, treatment, control, prevention. Autumn: Diseases and care of rats and mice. Winter: Diseases and care of rabbits, guinea pigs, exotic species. Spring: Diseases and care of primates. Open to graduate students only. Prerequisite: consent of instructor.

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

103. Readings in Molecular Biology—Gene structure and function introduced through discussion of the most significant published papers, beginning with Darwin and Mendel, but concentrating on knowledge gained in the last twenty years. Intended for students with no previous college biology.

3 units, Spr (Fenster) MWF 1:15

200. Immunology—An introduction to the principles of immunology and bacteriology.

3 units, Win (Amkraut, Raffel, Rosenberg) MWF 3:15

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 the essential aspects of immunology, of laboratory diagnosis, and of preventive measures.

4 units, Spr (Staff) M 2:15–4:05; TTh 1:15; F 2:15–4:05

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 1:15, 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, Steward, Stocker) Th 1:15, given 1973-74

211. Immunologic Techniques — Antibody preparation and purification by physicochemical 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, Steward) by arrangement

212. Topics in Microbial Physiology—Lectures on special topics (regulation, differentiation, extreme environments, etc.) and concurrent readings on comparative metabolism. Prerequisite: Biochemistry 201, or equivalent.

2 units, Aut (Fenster) TTh 1:15

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

PATHOLOGY

Chairman: David Korn

Professors: Klaus G. Bensch, David Glick, David Korn, Lelland J. Rather, Lucien J. Rubinstein

Associate Professors: Amico Bignami, Ronald F. Dorfman, Luis J. Fajardo, Richard L. Kempson, Jon Kosek, Paul L. Wolf


Instructors: Acting: Sharon DeWit, Hun Kim. Visiting: Ranchod Mahendra

Senior Scientist: Lawrence F. Eng

PROGRAM OF STUDY

200. General Pathology — Lectures and demonstrations providing an introduction to general pathology. Prerequisites: anatomy, histology, and biochemistry, or consent of instructor.

4 units, Spr (Korn, Staff) TTh 2:15-4:05

The Department offers a basic course in general pathology which is open to medical students, qualified graduate students, and senior level undergraduates. In addition, the Department offers advanced courses which are open to medical and graduate students who have completed the basic course. Additional qualifications are necessary for certain courses.

The degree of Doctor of Philosophy is given by the Department through an arrangement with the Division of Biological Sciences. Applicants are expected to fulfill all the requirements for admission to candidacy and completion of the Ph.D. degree as summarized in this bulletin. Also, the candidate must meet all the specific requirements for the Ph.D. degree in Biological Sciences as outlined in this bulletin. Further information may be obtained by writing to Dr. D. A. Clayton.
Postdoctoral research training is available to graduates holding a Ph.D. or M.D. degree. Qualified graduates may apply to the Department Chairman for further information. At present, the chief research interests of the Department are in studies of nucleic acids and proteins (structure and function) in both prokaryotes and eukaryotes, mammalian cell structure and function in normal and pathologic states, immunology and tissue transplantation, tumor viruses and organ culture of a variety of neuropathological disorders.

PHARMACOLOGY

Emeritus: Robert H. Dreisbach (Professor), Leon Kolb (Clinical Associate Professor)
Chairman: Robert T. Schimke
Professors: Lewis Aronow, Avram Goldstein, Oleg Jardetzky, Sumner M. Kalman, Tag E. Mansour, Robert T. Schimke
Associate Professor: Daniel W. Nebert
Visiting Professors: Ralph I. Dorfman, Richard K. Richards
Assistant Professors: Tatiana A. Assaykeen, Leslie Wilson
Lecturer: Dora B. 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. Financial support for predoctoral and postdoctoral trainees includes full tuition and stipends at current national levels.

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, regulation of hormone secretion, cell regulatory mechanisms in carbohydrate metabolism, regulation of macromolecular synthesis in mammalian cells, mechanism of action of antimitotic agents, 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

Principles of Pharmacology (201) is considered basic to the understanding of drug action, and will generally be taken by second-year medical students in conjunction with the course in systematic pharmacology (202) which deals with the major classes of drugs used in man. Pharmacology 203 (Pharmacology of the 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 students will choose to take the entire sequence in their second year, others will defer or omit entirely certain of these courses.

201. Principles of Pharmacology—a lecture course on the principles of drug action. Topics to be considered will include kinetic aspects of drug absorption and distribution, drug metabolism, and drug-receptor interaction. Other topics will include drug resistance, tolerance, pharmacogenetics, toxicity, carcinogenesis, mutagenesis, and teratogenesis. This course is considered necessary for further study in pharmacology and therapeutics. Prerequisites: mammalian physiology and biochemistry, or consent of the instructor.

3 units, Aut (Staff) MWF 1:15

202. Systematic Pharmacology—a lecture and demonstration course in systematic pharmacology and elementary aspects of therapeutics. The major drug groups will be discussed with emphasis on their use in man. Prerequisite: 201 or consent of instructor.

4 units, Win (Staff) MWF 1:15

203. Pharmacology of the Nervous System—a lecture course on mechanisms of action and therapeutic uses of drugs affecting the central nervous system. Drugs discussed include convulsants, anti-convulsants, sedatives, analgesics, tranquilizers, and other psychoactive drugs. Problems of drug abuse are also considered.

3 units, Spr (Staff) MWF 1:15

**ADVANCED COURSES**

Advanced courses are open to students in all parts of the University, but the instructor's consent is required prior to registration. In general, these courses require as a prerequisite a good knowledge of physiology and biochemistry and sometimes of microbiology or genetics. *Previous or concurrent registration in Principles of Pharmacology (201) will usually be assumed by the instructor.* Students are advised to consult with the instructor about the adequacy of their preparation.

213. Cellular Regulatory Mechanisms in Carbohydrate Metabolism—Lectures and discussions on the different regulatory processes that keep carbohydrate catabolic reactions in the cell in pace with its energy requirement and the effect of different hormones on carbohydrate metabolism at the cellular and subcellular level.

1 unit, Win (Mansour) 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 (A. Goldstein) T 4:15,

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

217. Problems of Population Growth—Lectures and seminar discussion on population growth and its control through the use of pharmacologic agents.

2 units, Aut (Kalman) T 4:15–6:05, given 1973–74

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 1972–73

220. Topics in Molecular Pharmacology.

1 unit, Spr (Jardetzky) T 4:15


1 unit, any quarter (Staff) Th 4:15–6:05

280. Tutorial Program—Guided readings in the literature of any area of pharmacology. A critical review paper may be required. Primarily for graduate students in pharmacology.

Any quarter (Staff) by arrangement

299. Research.

Any quarter (Staff) by arrangement
PHYSIOLOGY

Emeritus: James P. Baumberger (Professor)
Chairman: Maurice E. Krahl
Professors: Jefferson M. Crismon, George A. Feigen, Ronald Grant, Maurice E. Krahl, Eugene D. Robin
Visiting Professor: F. Eugene Yates
Associate Professor: Julian M. Davidson
Visiting Associate Professor: 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 file a report of his scores (aptitude and advanced biology) on the Graduate Record Examination as part of his 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 his 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 knowledge of any one of the following languages is required: French, Russian, or German.

Dissertation and University Oral Examination — The results of independent, original work by the students are to be presented in a dissertation. The oral examination will be largely a defense of the dissertation.

FINANCIAL AID

Research assistantships are occasionally available to postdoctoral fellows, or graduate students who have completed substantial work toward the Ph.D. degree in Physiology. Tuition aid may be awarded to students holding research assistantships. Graduate students who are also medical students are eligible for financial aid from the Office of Student Affairs, Stanford Medical School.

In general, graduate students must expect to find the majority of their financial support outside the University.

COURSES

(Commencing autumn quarter, 1972, the course order in Clinical Physiology will be: Clinical Physiology 200, autumn; 202, winter; 201, spring.)

200. Clinical Physiology (Physiology and Medicine) — (Formerly 150.) Cardiovascular

6 units, Aut (Krahl, Crismon, 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 (Krahl, Crismon, Robin, Fletcher, Maffly) MW 8-11; F 8-10


7 units, Win (Krahl, Davidson, Reaven, Luetscher, Gray) MWF 9; TTh 9-11

203. Neurophysiology — (Formerly 350.) Lectures on the basic physiology of the mammalian central nervous system. Prerequisite: neuroanatomy must be taken previously or concurrently.

3 units, Aut (Grant) MWF 9-10

204. Peripheral Circulation — (Formerly 301.) Lectures and discussions on regulation of the peripheral circulation with emphasis on special features of the circulation in man. Prerequisite: 200 or equivalent.

3 units, Aut (Crismon) T 4:15-6:05 and Th 4:15-5:05, alternate years, given 1971-72

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 1971–72

207. Immunophysiology Laboratory—(Formerly 304.) A laboratory course in quantitative immunophysiology emphasizing basic immunoochemical phenomena such as isolation and preparation of purified antigens and antibodies, quantitative analysis of specific precipitates, immunoelectrophoresis, immunone 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 1972–73

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 neurophysiology, neuroanatomy and endocrinology; consent of instructor.

2 units, Spr (Davidson) T 7:30–9:30 p.m., alternate years, given 1971–72

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 biologic phenomena. Restricted to Ph.D. candidates in Physiology, or consent of instructor.

2 units, Win (Feigen) TTh 2:15–5:05, given 1972–73

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, Kralh, 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

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, 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), Kennell Jackson, Jr. (History), Tetteh Kofi (Food Research Institute), William Leben (Linguistics), Scott R. Pearson (Food Research Institute). Acting: Bridget O’Laughlin (Anthropology)

Acting Instructor: Mohamed Hassan (Linguistics)

Lecturer: Elaine Kaufman (Linguistics)

Senior Fellows: Peter Duignan (Hoover Institution), Lewis Gann (Hoover Institution)

Curator: George S. Rentz (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 acephalous and state societies.
   5 units, Aut (O’Laughlin) MWF 9

2. Urbanization in African Societies—(Enroll in Anthropology 110.) Ancient centers for urbanism; types of cities arising from contact with Europeans; social problems incident to rapid urbanization; city planning and theoretical issues.
   5 units, Spr (Drake) MWF 1:15

3. 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, Win (O’Laughlin) MWF 9

4. 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, Spr (Jackson)

5. 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 romanticists and the realists.
   5 units, Aut (Jackson)

6. 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 his-
torian, phases of field research, and language materials in field work.
5 units, Win (Jackson)

7. 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) given 1973-74

8. 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) given 1973-74

5 units, Spr (Weiler) given 1973-74

5 units, Aut, Win, Spr (Kaufman) by arrangement

11. Intermediate Swahili — (Enroll in Linguistics 263A,B,C.)
5 units, Aut, Win, Spr (Hassan) by arrangement

12. Beginning Hausa — (Enroll in Linguistics 260A,B,C.)
5 units, Aut, Win, Spr (Leben) by arrangement

5 units, Aut, Win, Spr (Kaufman) by arrangement
(Other African languages may occasionally be taught on a tutorial basis if facilities are available.)

14. 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)

17. 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) given 1973-74

18. 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.
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). 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 50 is 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, but may also be taken by undergraduate 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, 350, 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, and 366.

COURSES

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 and Planetary Astronomy—Properties of the sun, the planetary system, planetary surfaces and atmospheres. Methods of astronomical observation with emphasis on radio and radar astronomy. Space probe experiments and results. Theories of planetary formation. The interplanetary medium. Prerequisites: two years of college physics, chemistry, or engineering.

3 units, Aut (Eshleman) MWF 1:15

102A,B,C. Astronomy Laboratory—Theory and use of an optical telescope. During 1972-73 the work will consist mainly of the construction of an optical observatory for a 16 inch telescope. One experiment on a radio telescope will be available.

102A. 1 unit, Aut (Wilcox) by arrangement

102B. 1 unit, Win (Wilcox) by arrangement
102C.  1 unit, Spr (Wilcox) 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, origin of the planetary system. 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 nonthermal phenomena of astrophysics: radio and X-ray radiation and the production of high-energy particles by the sun, neutron stars (pulsars), galaxies, and quasars. Discussion of cosmic rays, microwave background, and cosmology. 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 Interiors—(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)


367. Physical Processes in the Galaxy—(Enroll in Applied Physics 367)

COMPUTATION CENTER

Director: Charles Dickens
Deputy Director: T. David Phillips
Associate Director for Business and Finance: William H. Yundt
Associate Director for Interfacility Services: M. D. Ray
Assistant Director: Susan H. Kolasa
Affiliated Faculty: Norman R. Nielsen
ACME Facility Director: Ron Jantgaard
Campus Facility Director: T. David Phillips
SLAC Facility Director: Charles Dickens
Ballots Project Director: Hank Epstein

The Stanford Computation Center operates three computing facilities: the ACME Medical Center Computing Facility, the Campus Computing Facility, and the Stanford Linear Accelerator Center (SLAC) Computing Facility. The Computation Center is also responsible for Ballots, a library automation project.

ACME Computing Facility

The ACME Medical Center Computing Facility operates an IBM System/360 Model 50 that is used for medical research which includes on-line data acquisition and experiment control. Those interested in the following courses offered by ACME may register by calling Ext. 6121.

1. PL/ACME — This course teaches programming using the subset of PL/I implemented at the Medical Center Computing Facility. 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, bimonthly

2. Advanced PL/ACME — This course includes instruction in the following subjects: PL/ACME ON conditions for error control, the acquisition and output of analog and
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

**CAMPUS COMPUTING FACILITY**

The Campus Facility of the Stanford Computation Center is responsible for providing computing services to the University faculty, staff members and students in connection with their research work and their course requirements.

The Campus Facility is located in Pine and Polya Halls on the Jordan Quadrangle. The equipment currently operated by the Facility 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 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 Facility's 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. In the near future, a generalized on-line information retrieval system (SPIRES II) will be made available to the University community. In addition, the library automation and management information system, BALLOTS, will be implemented in the course of the next two years.

The Facility maintains a comprehensive library of analysis programs and statistical routines to assist users in solving their data processing problems. Programming languages available on the Facility's 360 include ALGOL, BASIC, COBOL, FORTRAN, 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 the Campus Facility stands ready to provide advice in program development and problem solving to present and potential users of the Facility's 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 the Campus Facility offers short courses in the use of the data processing and time-sharing equipment at the Facility 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 Campus Facility Bulletin. In addition, with at least one quarter advance notice, special sections or courses can be arranged through the User Services Group (ext. 4400).

1. **Introduction to the Campus Computer Facility** — This one-session course is designed for faculty, staff and students who will be using the Campus Facility for the first time. Topics to be covered include language and program availability, computer charges, keyword protection, use of keypunches and use of the Pine Hall lobby terminal. A tour of the Campus Facility will be given. Normally this course meets only 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 Campus Facility 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, Spr

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 simu-
late 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 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

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 Facility. 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 at the Campus Facility. 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, Win, Spr

SLAC COMPUTING FACILITY

The SLAC Computing Facility of the Stanford Computation Center 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 Facility are centered on an IBM System/360 Model 91 designed to handle scientific calculations rapidly. Because the SLAC computing system is devoted to support of the research program of the laboratory, its use is restricted to members of the SLAC staff.

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: Tetteh A. Kofi, Paul I. Mandell (Geography), Scott R. Pearson, C. Peter Timmer. Acting: Frank W. Oechsli (Demography)
Research Demographer: Arjun Adlakha
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 his 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) and Economics 170, 171 (Introduction to Econometrics I and II) are required. Elective courses may be selected from Institute offerings and other University courses upon the approval of the student’s adviser.

2. During the second year of the Ph.D. program the student prepares himself 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; Economics of Tropical Agriculture; 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 doctoral dissertation, which is subject to committee approval, and to defend this in a University-administered oral examination. The completed dissertation is subject to faculty approval, but no further formal defense is required.

4. To meet the foreign language requirement, a candidate must demonstrate a reading knowledge of one language other than English. The requirement may be satisfied in either of two ways: (a) by completion with passing grade of an approved reading course for the language concerned or, (b) by passing a special reading examination, to be given by a qualified member of the Food Research Institute or in the relevant language department.

5. At least two years (6 quarters) of graduate registration in the Institute program satisfactorily completed is required for each candidate.

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 (Mandell) MTWTh 10

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 (Mandell) TTh 10-12

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.

3 units, Win (Gray) W 4:15-6:05

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 monocoeononies, 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 (Kofi) 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—(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 (Kofi) TTh 1:15

150, 151. Undergraduate Workshop in 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 11

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 (Mandell) TTh 2:15–4:05

160. Trade and Development Problems of Tropical Africa—(Same as Economics 160.) (May be taken as 260 by graduate students.) Analysis of selected international aspects of tropical African economic development. Topics include African–non-African international trade and economic relations (theoretical background, historical perspective, case studies of export-led growth and the impacts of international capital flows) and intra-African trade and economic integration (customs union theory, historical perspective, case studies of African economic integration).

3 to 5 units, Win (Pearson) MW 4:15–6:05

COURSES PRIMARILY FOR GRADUATE STUDENTS

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—(Open to advanced undergraduate students, with the consent of the instructor.) An examination of the historical process of Latin American economic growth and structural change. Emphasis is placed on problems of regional, functional, and personal income distribution as they relate to changes in the structure of production, trade, and finance.

5 units, Spr (Reynolds) by arrangement

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) by arrangement

221. Economics of Production—The theory of production with special emphasis on agriculture. Production functions, profit functions and input demand functions; supply re-
sponsiveness; economic efficiency and technological change in the process of agricultural development. Prerequisite: one course in microeconomic theory and econometrics.

5 units, Aut (Yotopoulos) by arrangement

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) by arrangement

225, 226. Agricultural Development and Economic Growth I and II—A theoretical-historical approach with emphasis on open economies and agriculture's role in the development process. Attention will be given to Mexico, Japan, and Taiwan as case studies and to selected issues; intersectoral relationships and resource flows, dualism, economic rationality and labor-leisure allocations, technical change, land tenure and taxation, and criteria relevant to the choice of strategies for agricultural development. Research papers initiated early in the first quarter will emphasize empirical analysis of historical experience.

5 units each quarter, Win, Spr (Johnston, Reynolds) MW 10-12


253. Location Theory and Spatial Analysis—See 153.


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 the consent of the instructor.

3 units, Win (Pearson) by arrangement

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) M 2:15-5:05

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 (Adlakha) by arrangement

305. Seminar: Spatial Aspects of the Growth of Metropolitan Areas—Topics to be covered will be drawn from the following: economic aspects of rural-urban migration; economics of rural-urban land conversion; the location of economic activities in a metropolitan area; the market for residential land; racial segregation and discrimination in housing markets; externalities and neighborhood effects. Much of the material will be related to the Bay Area and in particular to Santa Clara County. Lectures and discussions. Opportunity for individual student projects. Open to graduate students only. Prerequisites: graduate course in microeconomic theory and some knowledge of econometrics (preferably) or statistics.

3 to 5 units, Spr (Massell) by arrangement, given 1973-74

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 agri-
cultural topics are highlighted. Prerequisite: 220.

3 units, Win (Timmer) by arrangement

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) by arrangement

365. Seminar: Economics of Tropical Agriculture—Selected topics in organization of production and marketing of agricultural products for home consumption and for export. Prerequisite: consent of instructor.

5 units, Win (Jones) T 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 Dean: J. Merrill Carlsmith
Assistant Deans: Karlene N. Dickey, Florine H. McIntosh, Thomas A. Rhue

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 guidance. The professor, if he 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. Enrollment required of and limited to Public Affairs Fel-
OTHER DEPARTMENTS, INSTITUTES, AND PROGRAMS

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laws. 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

339. Europe as Seen Through Literature—Under the direction of the instructor, students select and analyze books which give a vision of Europe as a whole, of one country, or of one phase of its culture or society. The students may select for analysis a book in English or in a foreign language, from any period down to the present, in any field of the humanities or social sciences. May be repeated for credit.

3 to 5 units, Aut, Win, Spr (Hilton) 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 technological 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
202. The Geography of Latin America.
260. Trade and Development Problems of Tropical Africa.

GEOLOGY
100. Environmental Earth Sciences I.
101. Environmental Earth Sciences II.
102. 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)

HUMANITIES

251. Basic Humanistic Problems.
253. The Idea of a University.

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 prereq-
uisite 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 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 must petition the Registrar to change his major from his 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 1.
HOOVER INSTITUTION
ON WAR, REVOLUTION AND PEACE

Emeriti: Harold H. Fisher (Chairman), Joseph S. Davis, Edgar E. Robinson, Graham H. Stuart (Councilors), Witold S. Sworakowski (Professor)

Director: W. Glenn Campbell
Associate Director: Richard F. Staar
Associate Director for Administration: Alan H. Belmont
Consultant to Office of Director: Witold S. Sworakowski
Information Officer: James R. Hobson
Senior Fellows: Martin Anderson, William C. Bark, Rita R. Campbell, Milorad M. Drachkovitch, Peter Duignan, Roger A. Freeman, Lewis H. Gann, Stefan T. Possoney, Richard F. Staar
Consultants: Ching-wen Kwang, Yuan-li Wu
Senior Research Fellows: Karl Brandt, Kiangau Chang, Alexander Dallin, Theodore Draper, John K. Emmerson, Dimitri von Mohrenschildt, Dan T. Smith, Eric Vogelin, Bertram D. Wolfe
Head, Publications Department: Brien G. Benson
Editor: Carole Norton
Curators: Joseph W. Bingaman (Latin American Collection), Anna M. Bourguina (Nicolaevsky Collection), Dennis J. Doolin (on leave for government service) (East Asia Collection), Peter Duignan (Africa Collection), Richard W. Lyman (Honorary Curator, British Labor Collection), John T. Ma (East Asia Collection), Karol Maichel (East European Collection), Agnes F. Peterson (Western European Collection), George S. Rentz (Middle East Collection). Deputy Curators: Lewis H. Gann (Africa Collection), David H. L. Tseng (East Asia Collection)
Archivist: Franz G. Lassner

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.

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. Since 1919 some 225 volumes have been
published by the Institution. Aided by several substantial grants, the Institution is focusing anew on an area traditional to its interests—the problems of peaceful change. Public conferences on “Peaceful Change in Modern Society” (November 1969) and “The United Nations at Twenty-Five” (January 1971) brought to the campus as speakers internationally recognized statesmen and scholars, whose papers have been or will be published in book form by Hoover Institution Press. Other 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.

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 newly established 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.

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 1972-73, 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; Brian R. Fry, Public Administration, Political Science Department; Michel Nabti, Current Middle Eastern History, Undergraduate Special; 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, John W. Harbaugh, 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 covers a wide range of the Hydrologic Sciences, emphasizing surface hydrology and groundwater hydrology together with those parts of meteorology and oceanography that are related to the hydrologic cycle. Studies involving the impact of the nuclear age on hydrology are also available.

**MASTER OF SCIENCE**

This program is available to students having the Bachelor's degree in Civil Engineering, Chemical Engineering, Chemistry, Geology, Geophysics, Agronomy, Forestry, Meteorology, Nuclear Science or Engineering, and related fields. In order to earn the M.S. degree in one year, the student should have completed basic courses in physics, chemistry, mathematics through an introduction to differential equations, geology, and elementary fluid mechanics.

The M.S. program will include 45 or more units of which at least 35 will normally come from the following list of courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<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></td>
</tr>
<tr>
<td>Civil Engr. 203</td>
<td>Ocean and Coastal Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Civil Engr. 205</td>
<td>Fluid Mechanics of Subsurface Flow</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></td>
</tr>
<tr>
<td>Civil Engr. 236</td>
<td>Stochastic Processes and Decision Statistics for Civil Engineers</td>
<td>4</td>
</tr>
</tbody>
</table>
Civil Engr. 266. Engineering Hydrology 4
Civil Engr. 267. Hydrologic Simulation 4
Civil Engr. 268. Advanced Hydrology 4
Civil Engr. 269. Water Resources Seminar 1
Civil Engr. 270. Water Quality in Water Resources Development 3
Civil Engr. 273. Water Chemistry 3
Civil Engr. 273A. Water Chemistry Laboratory 1
Civil Engr. 274. Water Microbiology 3
Civil Engr. 276. Nuclear Methods in Environmental Sciences 3
Civil Engr. 277. Nuclear Explosion Engineering 3
Civil Engr. 278. Environmental Radioactivity 3
Elec. Engr. 292A. Environmental Systems Analysis 3
Engr. 174. Nuclear Science 3
Engr. 176. Radiation Measurements Laboratory 3
Engr. 177. Nuclear Energy 3
Engr. 178. Radioactivation Analysis 3
Geol. 107. Introduction to Probability and Statistics in Geology 3
Geol. 115. Introduction to Biological Oceanography 3
Geol. 205. Applications of Probability and Statistics in Geology 3
Geol. 210. Introduction to Marine Geology 4
Geol. 235. Geomorphology and Photogeology 5
Geol. 284. Engineering Geology 3
Geol. 285. Hydrogeology 5
Geol. 286. Development of Groundwater Resources 3
Geol. 487. Seminar in Hydrogeology 2
Pet.E. 151A,B. Reservoir Fluids 6
Pet.E. 151E. Core Analysis Laboratory 3
Pet.E. 172. Natural Gas Engineering 3
Comp.Sci. 106. Introduction to Computing 4
Indus. Engr. 141A. Utilization of Computers 4
Sta. 110. Statistical Methods in Engineering and the Physical Sciences 4
Sta. 116. Theory of Probability 4

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. 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. At the present time there are, among others, projects in such areas as laboratory studies of wind-wave generation; fluid mechanics of groundwater flow and unsaturated flow in soils; measurements of environmental radioactivity; hydromechanics of water waves; transport processes at the air-sea interface; simulation of shallow-water marine processes on the digital computer; effect of geology, hydrology, and pollution on ground and surface water quality; water quality control in water resource development. 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.

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 admin-
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 (a) he is a student in good standing, and is a degree candidate at an accredited university or college; (b) he will have successfully completed prior to attendance a minimum of two years of Japanese or its equivalent at the college level; and (c) he 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

LIBRARIES

Emeriti: Minna Stillman (Associate Librarian); Alice Charlton (Chief Catalog Librarian); Jeannette M. Hitchock (Chief of Division of Special Collections); Margaret Wells (Education Librarian); Grace E. Stillson (Assistant Chief Catalog Librarian); Ruth Scibird (Curator of the Stanford Collection)

University Libraries
Director: David C. Weber
Associate Director of University Libraries: 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. Goltter
Assistant Director for Bibliographic Operations: Allen B. Veaner
Building Services: Philip D. Leighton
Financial and Planning Officer: John Heyeck
Department Chiefs: Julius P. Barclay (Spec-
cial Collections); Jennette E. Hitchcock (Catalog); Jack Plotkin (Central Circulation and General Reference); B. Jack Pooler (Science); Ralph W. Hansen (Acquisition)

University Archivist: Ralph W. Hansen

Curators — Resources Development Program: James Breedlove (Latin America); 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 Zachringer; Head, Technical Service and Acquisitions Librarian: Charles T. Pfingsten

Lane Medical Library
Chief Librarian: Peter Stangl
Reference Librarian: Paul S. Hanson

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
Department Head: George E. Owens
Head Librarian: Robert Gex
Assistant 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 about 3,550,000 volumes, 1,520,000 manuscripts, 109,000 sheet maps, 659,000 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 catalog.

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 Saturday, and from noon to midnight on 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 Library facilities on the first floor are available for classroom or individual use and include a general listening room as well as three 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, Great Britain, Canada, Australia, and the United Nations.

The Department of Special Collections services 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. Braseh 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 70,000 volumes devoted to the comprehensive coverage of the history of art, architecture, classical archeology, drawing, painting, and sculpture. There are extensive peri-
odical runs and over 8,500 exhibition catalogs. 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, 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 Chemistry Library, 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 collection 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 157,000 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 Build-
The Overseas Campuses Program offers to undergraduate students the opportunity of spending six months of their four undergraduate years studying in a foreign country. Partaking of the human and cultural riches 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 certain of the University distribution requirements in the field of Humanities (H) and the Social Sciences (SS), and all courses completed overseas count fully toward graduation.

Participating students complete two quarters of the language (or three courses relevant to the country, for Britain) before attendance at the two-quarter session. Applications are open autumn, winter, and spring quarters, at least six months in advance of the sessions. Students are invited to consult the Overseas Campuses Office, 112 Old Union, for admission and help in planning their program.

**STANFORD IN AUSTRIA**

**Director of Studies:** Siegfried Korninger  
**Director of Administration:** Dietmar Straub  
**Associate Director of Cultural and Academic Affairs:** Hedwig Thimig  
**Professors:** Edward J. Brown (Slavic Languages and Literature), Heinz Eulau (Political Science), Edgar Lohner (German Studies), Sandor Salgo (Music)  
**Instructors:** Ingeborg Bernhart, Anny Eder, Margaret Mehrl  
**Lecturers:** Gerda Maria Bansleben, Herbert Hausmaninger, Hans Georg Heinrich, Herbert Hymans, Beatrice Ottersböck, Heinz Schäffer

**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 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 or Spr, Sum (Staff) by arrangement

LECTURE COURSES

4 units, Spr (Salgo)

Overseas Campuses — Austria 111A. Introduction to Opera in Vienna (H).
4 units, Aut (——)

German 125A. From Realism to the Theater of the Absurd (H).
4 units, Sum (Lohner)

History 137A. Europe 1914–1939 (SS).
4 units, Aut (Hymans)

4 units, Sum (Hymans)

Slavic 155. Masterpieces of Twentieth Century Prose in Russia, Czechoslovakia, Poland, and Yugoslavia (H).
4 units, Win, Spr (Brown)

Political Science 188. Technology and Political Order (SS).
4 units, Aut (Euliu)

COLLOQUIA

Overseas Campuses — Austria 106. Vienna's Social and Political Culture (SS) — Enrollment limited to 15.
4 units, Aut (Eulau)

Overseas Campuses — Austria 111. Music in Vienna (H).
3 units, Win, Sum (Bansleben)

Overseas Campuses — Austria 114. Eastern European Governments (SS).
3 units, Win, Spr (Hausmaninger)

Overseas Campuses — Austria 117. Government and Politics in Austria (SS).
3 units, Sum (Heinrich)

Overseas Campuses — Austria 117A. Austrian Government and Constitution (SS).
3 units, Aut (Schäffer)

Art 121. Austrian Art (H).
3 units, Aut, Spr (Ottersböck)

German 142A. Poetry and Drama in Hugo Von Hofmannsthal (H) — Enrollment limited to 15.
4 units, Sum (Lohner)

Music 142B. Mozart Operas (H).
4 units, Spr (Salgo)

Slavic 151. The Major Works of Dostoevsky in English Translation (H).
4 units, Win, Spr (Brown)

History 235. European International Relations Since 1914 (SS).
4 units, Aut (Hymans)

History 235F. The Contemporary European Scene: Politics and Society Today (SS).
4 units, Win (Hymans)

STANFORD IN BRITAIN

Academic Director: Paul K. Ledger
Director of Administration: George A.B. Docker
Professor: Don E. Fehrenbacher (American History)
Associate Professors: Albert J. Gelpi (English), John W. Meyer (Sociology)
Assistant Professor: David W. Williams (English—Acting)
Lecturers: Barbara A. Gelpi (English), H.D. Johnstone, C.P. McCorquodale, V.C.D. Vowles
Tutors: Barrie Axford, Rodney Shewan, Geoffrey C. Tyack

LECTURE COURSES

Sociology 1E. Introduction to Sociology: English Society (SS).
4 to 5 units, Aut, Win (Meyer)

English 158. Twentieth Century British Poetry (H).
4 to 5 units, Spr, Sum (A. Gelpi)

History 166. British-American Relations from the Revolution to World War I (SS).
4 to 5 units, Spr, Sum (Fehrenbacher)

4 to 5 units, Aut, Win (Williams)

COLLOQUIA

Overseas Campuses — Britain 122. English Architecture 1550 to the Present Day (H).
4 to 5 units, Spr, Sum (Tyack)

Overseas Campuses — Britain 124. The English Town, Past and Present (H).
4 to 5 units, Spr, Sum (Tyack)
OVERSEAS CAMPUSES

Overseas Campuses—Britain 126A. English Music 1500–1650 (H)—Enrollment limited to 20.
4 to 5 units, Win (Johnstone)

Overseas Campuses 126B. Twentieth Century English Composers (H)—Enrollment limited to 20.
4 to 5 units, Aut (Aprahamian)

Overseas Campuses 128A. British (Political) Institutions (SS).
4 to 5 units, Win, Sum (Axford)

Overseas Campuses—Britain 128B. Political Sociology (SS)—Enrollment limited to 10–20.
4 to 5 units, Aut, Spr (Axford)

Overseas Campuses—Britain 129. English Society in the Nineteenth Century (H).
4 to 5 units, Aut, Win (Tyack)

Overseas Campuses—Britain 130. Modern British Drama (H)—Enrollment limited to 20.
4 to 5 units, Aut, Win (Shewan)

Overseas Campuses—Britain 130D. Practical Literary Criticism (H)—Enrollment limited to 20.
4 to 5 units, Spr, Sum (Shewan)

Overseas Campuses—Britain 133. Britain and European Unity (SS)—Enrollment limited to 10–15.
4 to 5 units, Win, Sum (Shewan)

Overseas Campuses—Britain 134. The Left in Britain (SS)—Enrollment limited to 10–20.
4 to 5 units, Aut, Spr (Axford)

Overseas Campuses—Britain 135. The Grand Tour (H)—Enrollment limited to 20.
4 to 5 units, Aut, Win (McCorquodale)

4 to 5 units, Win, Sum (Shewan)

Overseas Campuses—Britain 136B. The Nineteenth Century Avant-Garde and the Victorian Counter-Culture, Part II (H)—Enrollment limited to 20.
4 to 5 units, Aut, Spr (Shewan)

Overseas Campuses—Britain 137. Education in England and Wales (SS).
4 to 5 units, Spr (Vowles)

English 137A. The Interaction of Arts and Letters in Nineteenth Century England (H).
4 to 5 units, Spr, Sum (B. Gelpi)

English 139. The Literary Conventions of Baroque Opera and Oratorio (H)—Enrollment limited to 8.
4 to 5 units, Win (Williams)

English 145A. Jacobean and Caroline Drama (H)—Enrollment limited to 12.
4 to 5 units, Aut (Williams)

Sociology 157. Undergraduate Seminar: Comparative Educational Systems (SS)—Prerequisite: some previous background in social sciences.
4 to 5 units, Aut, Win (Meyer)

History 260. The English Revolutions as an American Heritage (SS).
4 to 5 units, Spr, Sum (Fehrenbacher)

STANFORD IN FRANCE

Director: Paul LeMoal (Professeur à l'Université de Tours)
Associate Directors: Henriette Bordenave, René Borius (Professeur à l'Université de Tours)
Professors: Donald Davie (English), Albert Guerard (English), John Lapp (French Literature)
Associate Professor: Ralph Hester (French and Italian)
Assistant Professor: Michael Hannan (Sociology)
Instructors: Pierre Gault, Roger Girod, Michèle Jomaron, Jean Yves LeGouil, Guy Lenoir, Françoise Ferdoux, Jeanne Perrin, René Perrin
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)

LANGUAGE COURSES

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 or Spr, Sum (Staff) by arrangement

LECTURE COURSES

French 56. The French Renaissance Short Story and Novel: Marguerite de Navarre and Rabelais (H).
4 units, Win (Hester)

French 75. Types of the French Novel: Balzac to Camus (Part I) (H).
4 units, Spr (Lapp)

French 76. Types of the French Novel: Balzac to Camus (Part II) (H).
4 units, Sum (Lapp)

Sociology 108. Class, Status, and Power (SS).
4 units, Spr (Hannan)

Sociology 120. Comparative Social Structure (SS).
4 units, Sum (Hannan)

French 128. Theories of Language Learning with Specific Reference to French (H).
4 units, Aut (Hester)

English 147A. The Age of the Enlightenment (H).
4 units, Aut (Davie)

Modern Thought and Literature 172. Forms of the Modern French Novel (H).
4 units, Win (Guerard)

COLLOQUIA

French 55. Rabelais: Gargantua and Pantagruel (H)—Open to students with 2 years college French, or by consent of instructor. Enrollment limited to 10.
4 units, Spr (Lapp)

French 56A. Montaigne: Selected Essays (H)—Open to students with 2 years college French or by consent of instructor. Enrollment limited to 10.
4 units, Sum (Lapp)

3 units, Win, Sum (Borius)

Overseas Campuses—France 132A. Balzac, Flaubert, et le Nouveau Roman.
3 units, Sum (Lajond)

Overseas Campuses—France 134C. La Pensée de Jean-Jacques Rousseau (H).
3 units, Spr (Roger)

3 units, Aut (Chevalier)

Overseas Campuses—France 136A. La France et L’Europe de 1919 à 1939 (SS).
3 units, Aut, Spr (Borius)

Overseas Campuses 136B. La Vie Politique en France de 1939 à 1969 (SS).
3 units, Win, Sum (Borius)

Overseas Campuses—France 140A. Debussy et la Rénovation de la Musique Française au Début de XXe Siècle (H).
3 units, Aut (Vaccaro)

Overseas Campuses—France 140B. Debussy—Pelléas et Mélisande ou la Musique et le Symbolisme (H).
4 units, Win (Vaccaro)

French 141. Les Poètes de la Renaissance (H)—Enrollment limited to 15. Prerequisite: reading competence in French equal to second-year college level.
4 units, Win (Hester)

Overseas Campuses—France 141A. Du Mai du Siècle à L’Espirit Fin du Siècle (H).
3 units, Win (Waldner)

Overseas Campuses—France 142. Les Ballets Russes à Paris au Début du XXe—Stravinsky (H).
3 units, Spr (Vaccaro)

French 144. L’Essai Philosophique de la Renaissance: Montaigne (H)—Enrollment limited to 15. Prerequisite: reading competence in French equal to second-year college level.
4 units, Aut (Hester)

Overseas Campuses—France 146A. Methods of Field Research (SS)—(Open to students with some social science background.)
4 units, Spr (Hannan)
Sociology 146B. Practicum in Field Research: Community Study (SS)—Prerequisite: Sociology 146A.
4 units, Sum (Hannan)

Modern Thought and Literature 202. Writing Seminar (H)—Enrollment limited to 12.
4 units, Win (Guerard)

English 257. The Expatriate Artist in the Twentieth Century (H)—Enrollment limited to 15.
4 units, Aut (Davie)

STANFORD IN GERMANY

Director of Studies: H. Ruudiger Hipp
Director of Administration: Alfred Schmid
Emeritus: George Knoles (Professor of American History)

Professors: Walter Lohnes (German), W. Richard Scott (Sociology), George Spindler (Anthropology and Education)

Assistant Professor: Jerry Irish (Religion)
Instructor: Gabriele von Radecki
Lecturers: Wieland Raatz, Michael von Poser, 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 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)

LECTURE COURSES

5 units, Aut, Win (Irish)

History 67. European and American Social Thought (SS).
5 units, Aut, Win (Knoles)

German 103. An Introduction to the Contemporary German Language (H).
5 units, Spr, Sum (Lohnes)

Anthropology 126. Cultural Dynamics: Studies of Urbanization of Remsh Communities (Germany) (SS).
5 units, Spr (Spindler)

Sociology 140. German Politics and Social Structure (SS).
5 units, Sum (Scott)

COLLOQUIA

Overseas Campuses—Germany 143A. Modern Germany (SS) — Enrollment recommended for those who want to enroll in Overseas Campuses — Germany 143B, second quarter.
3 units, Win, Sum (Wasser)

Overseas Campuses—Germany 143B. Modern Germany (SS) — Enrollment in Overseas Campuses — Germany 143A not necessary but recommended. Enrollment limited to 30.
3 units, Aut, Spr (Wasser)

Overseas Campuses—Germany 145. Drama Workshop (H)—Enrollment limited to 15.
3 units, Aut, Sum (Raatz)

Overseas Campuses—Germany 146. The Writer and His Environment (H)—Enrollment limited to 20.
3 units, Win, Sum (Hipp)

Overseas Campuses—Germany 147. The Novels of Franz Kafka and Kurt Vonnegut (H)—Enrollment limited to 15.
3 units, Win (Raatz)

Overseas Campuses—Germany 148. Thomas Mann: Short Novels, and Novels (H)—Enrollment limited to 15.
3 units, Aut (Schmid)

Overseas Campuses—Germany 149. Contemporary German Drama (H)—Enrollment limited to 15.
3 units, Win (Schmid)

Overseas Campuses—Germany 150. Heinrich Böll, Novels and Tales (H)—Enrollment limited to 15.
3 units, Spr (Schmid)

Overseas Campuses—Germany 152. America in German Literature (H)—Enrollment limited to 10–15.
3 units, Spr (Schmid)

Overseas Campuses—Germany 155. Hitler, Goebbels, and the Language of the “Third Reich” (H)—Enrollment limited to 20.
3 units, Spr (Hipp)

Overseas Campuses—Germany 159. War in
Other Departments, Institutes, and Programs

German Literature (H)—Enrollment limited to 15.

3 units, Aut (Hipp)

Overseas Campuses—Germany 160A. Goethe Seminar: Goethe's Life and His Age (H)—Enrollment limited to 15.

3 units, Aut (von Radecki)

Overseas Campuses—Germany 162. Twentieth Century Black Humor (H).

3 units, Sum (Raatz)

Religious Studies 164C. Modern Protestant Theologians (H).

3 units, Aut, Win (Irish)

Overseas Campuses—Germany 167. Märchen, Balladen, und Volkslieder (H).

3 units, Sum (von Radecki)

Overseas Campuses—Germany 169. Fiction and Reality in the Contemporary Literature of the DDR (H)—Enrollment limited to 15.

3 units, Spr (Raatz)

Overseas Campuses—Germany 170. The Modern German Novel (H).

3 units, Sum (Schmid)

Overseas Campuses—Germany 171. Humor in Nineteenth and Twentieth Century German Literature (H)—Enrollment limited to 15.

3 units, Spr (von Poser)

Sociology 172. The Social Democratic Party of Germany (SS) — Enrollment limited to 15-20.

3 units, Sum (Scott)

Overseas Campuses—Germany 172A. Brecht’s Dreigroschenoper (H) — Enrollment limited to 15.

3 units, Win, Sum (von Poser)

Overseas Campuses—Germany 173. Problems of Translation (H)—Enrollment limited to 15.

3 units, Aut (von Poser)

German 190. Thomas Mann and Politics (H)—Enrollment limited to 15.

3 units, Spr, Sum (Lohnes)

Anthropology 190A. Studies of Urbanization (SS)—Enrollment limited to 15.

3 units, Spr (Spindler)

History 266. Undergraduate Colloquium: Intellectuals and the Problem of War (SS) —Enrollment limited to 15.

3 units, Aut, Win (Knoles)

Stanford in Italy

Director of Studies: Guelfo Frulla

Director of Administration: Giuseppe Mammarella

Professor: Dwight Miller (Art History)

Associate Professors: J. Martin Evans (English), David Kennedy (History), Mark Mancall (History)

Instructors: Lucia Benini, Francesca Celli, Anna Kaiser

Lecturers: Sidney Alexander, Giovanni Scichilone, Maria Todorow

Language Courses

Italian (H)—Conversation courses and colloquia 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 or more, Aut, Win or Spr, Sum (Staff) by arrangement

Lecture Courses

Art 110. Florence During the Renaissance: The City and Its Art (H).

4 units, Spr (Miller)

Art 115A. Baroque Art in Italy (H).

4 units, Sum (Miller)

History 133F. Contemporary Italian Social Thought (SS).

4 units, Sum (Mancall)

History 137F. Modern European Social Thought (SS).

4 units, Spr (Mancall)

History 154. America and Europe in the Twentieth Century (SS).

4 units, Aut (Kennedy)

History 155. Social Thought in America and Europe (SS).

4 units, Win (Kennedy)

Humanities 162A. Christian Humanism—Medieval (H).

4 units, Aut (Evans)
PHYSICAL EDUCATION FOR MEN

Emeriti: Allen Elward, Edward M. Twiggs, (Directors); C. Myron Sprague (Associate Director); Ernest P. Hunt (Associate Professor)

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 Fehring (Intramurals and Club Sports), Charles E. Finger (Golf), James Fehr (Track), Poster Kmetovic (Rugby), Dan J. Millman (Gymnastics), Fred J. Priddle (Soccer), J. Ray Young (Baseball)

Assistant Directors: Clayton Bowling (Basketball), Marshall Clark (Track), Dave Currey (Football), Clyde D. Devine (Diving), Thomas Dunton (Baseball), Jeff Hammett (Aquatics), Ray Handley (Football), Norb Hecker (Football), Hudson Houck (Football), Bob Jones (Football), 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 men 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 competitive program, listed above, and others are included in the instructional 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.

Women's activities are conducted by the Department of Physical Education for Women. Activity courses such as equitation, folk and square dancing, bowling, badminton, scuba, karate, judo, volleyball, and archery are offered coeducationally.

Academic Degrees and Teaching Credentials in Physical Education for Men

The Department of Physical Education and Athletics for Men cooperates with the School of Education by providing faculty, facilities, and equipment necessary to the conduct of the Professional Physical Education Program for Men which leads to academic degrees and valid teaching credentials in the State of California. See the "School of Education" section of this bulletin for details of requirements leading to:

Degrees—Students majoring in physical education may become candidates for the A.M., Ed.D., and the Ph.D. degrees in Education, with concentration in physical education. At the present time there is no A.B. degree with concentration in physical education.

Teaching Credentials—Students desiring to teach physical education classes and coach athletic teams at the secondary and junior college levels should enter the physical education credential program in the junior year. The candidate takes a sequence of courses in the junior and senior years. The student then enters the Stanford Secondary Intern Program in the School of Education. Nor-
mally, the student completes this program at the end of the first graduate year.

See Dr. John Nixon or Dr. Wesley Ruff 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.

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.

Facilities used jointly by men and women 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.

**Fees**

Fees are charged for enrollment in bowling, equestrian, golf, and scuba diving. Club sports organizations may also assess themselves membership fees and dues.

**Credit**

Unless otherwise noted courses may be taken for one unit of credit or on a non-credit basis. If taken for credit the credit will count toward graduation and in the student’s grade point average, like any other college credit. A maximum of two courses are allowed per quarter and a maximum of twelve (12) units will be counted toward graduation. Graduate students are encouraged to register for classes but graduate credit is not available for these practicum classes.

**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**

02. Individual Programs—Individually prescribed exercise programs adapted to meet special needs.

*Aut, Win, Spr (Ruff) three periods weekly by arrangement*

08. Club Sports.

*Aut, Win, Spr (Staff) 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 (Millman) MW or TTh 1:15*
16B. Trampoline and Tumbling.
   Aut, Win, Spr (Millman) 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 11

20A. Swimming, Advanced.
   Aut, Win, Spr (Hammett) MWF 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 (Gould) TTh or MW

29. Water Polo.
   Aut, Win (Hammett) TTh 2:15
   Spr TTh 10 or 2:15

33. Soccer.
   Aut, Win, Spr (Priddle) MWF 3:15 or 4:15

41. Physical Conditioning.
   Aut, Win, Spr (Staff) MWF 4:15

42. Skin and Scuba Diving.
   2 units, Aut, Win, Spr (Gaughran) MWF 2:15

45. Life Saving and Water Safety.
   Aut, Win, Spr (Hammett) TTh 11

   2 units, Spr (Gaughran, Staff) MWF 3:15
   and by arrangement

53. Weight Training.
   1 unit, Aut, Win, Spr (Staff) MWF 11, 1:15, 2:15, 3:15, or 4:15

92. Techniques of Athletic Management.
   Aut, Win, Spr (Staff) by arrangement

INTERCOLLEGIATE SPORTS

FROSH, VARSITY, AND JUNIOR

VARSITY SPORTS

111F. Frosh Basketball.
   Aut, Win (Bowling) MTWThF 2–4 p.m.

111I. Basketball.
   Aut, Win (Dallmar) MTWThF 4–6 p.m.

114F. Frosh Football.
   Aut (Houck) MTWThF 2–4 p.m.

114I. Football.
   Aut, Spr (Christensen, Staff) MTWThF 4–6 p.m.

115I. Golf.
   Aut, Win, Spr (Finger) by arrangement

116I. Gymnastics.
   Aut, Win, Spr (Millman) MTWThF 3–5 p.m.

120I. Swimming and Diving.
   Aut, Win, Spr (Gaughran) MTWThF 3:15

121I. Tennis.
   Aut, Win, Spr (Gould) MTWThF 3:15

122I. Track.
   Aut, Win, Spr (Jordan, Clark) MTWThF 3:15

123I. Wrestling.
   Aut, Win (DeMeo) MTWThF 3:15

129I. Water Polo.
   Aut (Gaughran) MTWThF 3:15
   Spr (Gaughran) MWF 4:15

130I. Baseball.
   Aut, Win, Spr (Young) MTWThF 3:15

139I. Soccer.
   Aut, Win, Spr (Priddle) MTWThF 3:15

140I. 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.

171A. Theory and Technique: Baseball.
   2 units, Aut (Young) by arrangement

* Consent of instructor required.
171B. Theory and Technique: Basketball.  
2 units, Aut (Dallmar) Th 10 and by arrangement

171C. Theory and Technique: Football.  
2 units, Spr (Christiansen) alternate years, given 1971-72

171D. Theory and Technique: Track and Field.  
2 units, Win (Jordan) MW 10

171E. Theory and Technique: Adapted Physical Education.  
2 units, Spr (Ruff) M 1:15, alternate years, given 1971-72

2 units, Spr (Blanchard) by arrangement

171I. Theory and Technique: Aquatics—Prerequisite: Water Safety Instructor's Certificate, ARC.  
2 units, Spr (Gaughran) TTh 11

171J. Theory and Technique: Gymnastics—Prerequisite: 16.  
2 units, Win (Millman) 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 1971-72

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 currently 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—119C-La Gress—145C Karate (Kenpo)—135C Sailing—139C Volleyball—117C

CO-ED ACTIVITIES OFFERED IN THE WOMEN'S DEPARTMENT

Badminton  Folk Dance
Dance Appreciation  Leadership and Recreation
Dance and Society  Modern Dance
Elementary Games  Sports Officiating
Ethnic Dance  Techniques and Rhythm for Dance
Equitation  Folk Dance
Fencing  Leadership and Recreation
Golf  Modern Dance

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
Instructors: Mary Margaret Neal, Inga Weiss
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 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.

The Riding School, 18-hole championship Stanford Golf Course, and Tresidder Bowling Lanes are also available for student use.

All equipment, except badminton and tennis rackets and golf clubs, is provided for students enrolled in courses. Golf clubs may be rented. Gym suits, leotards and tights, swim suits, and towels are furnished and laundered.

**Courses of Study**

The variety of course offerings 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 which is part of the department’s curriculum.

In addition to the Basic and Advanced Courses, Practicums, Individual Study, and additional courses within the discipline of physical education and dance round out the department’s curriculum. Although most courses are for “women only,” many are coeducational as indicated by course descriptions. Additional coeducational courses are offered by the Department of Physical Education and Athletics.

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 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.

**Basic Courses**

**Individual Activities**

1. **Posture**—Figure control and posture improvement with individual conditioning.

   *1 unit, Aut, Win, Spr (Diaz, Weeks)*

   **MWF 10 or 11**
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, Win, Spr (Newell) MW 12 and by arrangement


1 unit, Aut, Spr (Diaz) TTh 1–2

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) by arrangement


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. Coeducational.

1 unit, Aut, Win, Spr (Melville) MTTh 10 or 4:30

SPORTS


1 unit, Aut, Spr (Newell, Staff) TTh 2:15–3:30 or 3:15–4:30

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, Spr (Staff) MW 3:15–4:30 Win (Staff) MW 1–2

10. Badminton: Elementary — This course covers basic strokes (serves, clears, drops, smashes, and drives), rules and scoring and practice in game playing. Coeducational.

1 unit, Aut, Spr (Schoof) MW 2:15 and by arrangement


1 unit, Aut, Win, Spr (Schoof) MW 11–12


1 unit, Aut, Win, Spr (Helliwell) MWF 10


1 unit, Aut, Win, Spr (Helliwell) MWF 9 or 11

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 (Schoof) TTh 9 and by arrangement (Neal, Staff) MW or TTh 1–2 Win (Newell) TTh 10 and by arrangement; (Staff) MW 1–2 Spr (Schoof) TTh 9 and by arrangement or TTh 1–2; (Neal) MW 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 (Neal) MW 9 or 10 each with an additional hour; (Schoof) TTh 1–2; (Newell) TTh 11–12 Win (Neal) MW 10 or 2:15 each with an additional hour or TTh 1–2; (Newell) TTh 11–12 Spr (Neal, Staff) MW 9 or 2:15 each with an additional hour; (Schoof) MW or Th 10 and by arrangement

20. Basketball: Elementary — This course focuses upon conditioning, ball handling,
and goal shooting skills, individual tactics, team play, strategy, and rules.
1 unit, Win (Schoof) TTh 2:15-3:30

1 unit, Win (Schoof) TTh 3:15-4:30

23. Field Hockey—This course focuses upon 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

AQUATICS

30. Swimming: Elementary—For those unable to swim safely in deep water. Basic understanding of buoyancy, balance, propulsion, coordination, water safety, and introduction to basic swimming strokes and survival skills.
1 unit, Aut (Weeks) MWF 1:15
Spr (Weeks) MWF 3:15

31. Swimming: Intermediate — Review of basic swimming skills, refinement of strokes, development of endurance and introduction of additional strokes and skills. Prerequisite: promoted from 30 or average ability and strength in basic strokes.
1 unit, Aut, Spr (Staff) MWF 2:15
Win (Weeks) MWF 1:15 or 2:15

32. Swimming: Beginning Competitive — Conditioning, training and learning, and refining of racing strokes, starts, and turns as preparation for intercollegiate meets. No prior racing experience is necessary. Prerequisite: strong swimmer in at least one of the racing strokes.
2 units, Aut (Weeks) MTWTh 3:15-5:00

35. Water Safety: Basic — This course focuses upon increasing awareness of water hazards, the avoidance of accidents, prevention of accidents to self and others, and utilization of appropriate rescue techniques. The American Red Cross Senior Lifesaving Certificate may be earned as a supplement to course work.
2 units, Aut (Strathairn) TTh 1-2
Win (Weeks) TTh 11-12 or 1-2
Spr (Weeks) TTh 11-12;
(Strathairn) MW 1-2

36. Aquatic Art—The utilization of swimming skills, body control, and creativity in stunts and figures, synchronized swimming, and water ballet. Prerequisite: above average ability in performing the crawlstroke, backstroke, breaststroke, and sidestroke.
1 unit, Spr (Newell) TTh 1-2

DANCE

60. Principles and Techniques of Rhythm and Movement — Analysis and performance of basic movements applicable to all dance. Development of simple rhythms and musical form with practical experience in simple drumming. Coeducational.
1 unit, Aut (Lidster) TTh 1-2 and by arrangement
Win (Cashion) MWF 2:15
Spr (Lidster) TTh 1-2

1 unit, Aut (Cashion) MWF 9

1 unit, Aut (Staff) MWF 10;
Win, Spr (Cashion) MWF 9 or 10

63. Modern Dance Technique: Intermediate—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. Coeducational.
1 unit, Aut, Win, Spr (Weiss)
TTh 2:15-3:15

64. Ballet Technique for Contemporary Dance—Principles of body alignment and style, terminology of traditional steps and positions (French). Coeducational.
1 unit, Aut, Win, Spr (Weiss)
W 11:00-12:30
   1 unit, Aut, Win, Spr (Cashion) TTh 9
   and by arrangement

72. Folk Dance: Elementary—Introduction of 25 or more dances from many countries with emphasis on traditional and foundation folk dance steps. Coeducational.
   1 unit, Aut, Win, Spr (Lidster, Cashion) MWF 1:15

73. Folk Dance: Intermediate—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. Coeducational.
   1 unit, Aut, Spr (Lidster, Cashion) MWF 2:15
   Win (Lidster) TTh 1-2

74. Ethnic Dance, Techniques and Styles: Couple Dances — A concentration on the dance, music, and dancelore of the British Isles, Central Europe, Scandinavia, or Spanish-speaking countries. Coeducational.
   1 unit, Aut (Cashion) TTh 11-12

   1 unit, Win (Lidster) TTh 11-12

   1 unit, Spr (Lidster) TTh 11-12

**ADVANCED COURSES**

**INDIVIDUAL ACTIVITIES**

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

148. Equitation: Jumping—Introduction to and development of jumping skill using low single fences, higher fences, combinations, and courses. Prerequisite: completion of intermediate equitation or equivalent. Coeducational.
   1 unit, Aut, Win, Spr (Melville) MTTh 3:15

**SPORTS**

104. Apparatus Gymnastics: Advanced —
   Prerequisite: promoted from 5 or equivalent.
   1 unit, Aut, Spr (Staff) MW 4:15-5:30
   Win (Staff) MW 2:15-3:15

110. Badminton: Advanced—Refinement of strokes and utilization of strategy in game playing. Competitive experience is scheduled with club and college teams. Prerequisite: promoted from 11 or extensive experience which has resulted in above average ability or consent of instructor. Coeducational.
   1 unit, Aut, Spr (Schoof) MW 1–2
   Win (Schoof) TTh 1–2

112. Fencing: Advanced — Concentration on practice of attacks. Regular lessons and some competition. Prerequisite: promoted from 13 or equivalent. Coeducational.
   1 unit, Aut, Win, Spr (Helliwell) TTh 10 and T 7 p.m.

113. Fencing: Tournament—Practice of all moves with special attention to the psychology of competition. Regular lessons and increased competition in class. Prerequisite: promoted from 112 or consent of instructor. Coeducational, undergraduates.
   2 units, Aut, Win, Spr (Helliwell) TTh 9 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

116. Tennis: Tournament — Emphasis is placed upon building endurance and skill through drills and practice with others who have strong strokes and good knowledge of strategy. Competitive experience is scheduled with club and college teams as well as intercollegiate tournaments. Prerequisite: promoted from 115 or equivalent experience including USLTA tournaments or school team participation.
   1 unit, Aut (Neal) MW or TTh 2:15–4:00
   Win (Neal) TTh 2:15–4:00
   Spr (Neal) MW or TTh 3:15–5:00
120. Basketball: Advanced — Prerequisite: promoted from 21 or the equivalent.
   1 unit, Win (Schoof) MW 3:15–4:15

121. Basketball: Tournament—Emphasis is upon developing a high level of ability in preparation for intercollegiate games. Prerequisites: above average ability and two seasons of playing experience.
   2 units, Win (Schoof) MTWTh 4:15–5:30

124. Field Hockey: Tournament—Emphasis is upon developing a high level of ability in preparation for intercollegiate games. Prerequisite: above average ability or one season playing experience.
   2 units, Aut (Schoof) MTWTh 3:15–4:30

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.
   1 unit, Aut, Spr (Diaz) MW 1:15
   and by arrangement
   Win (Diaz) TTh 1:15 and by arrangement

145. Golf: Tournament—Individualized instruction for the well-skilled who wants to specialize in golf for team and tournament participation. Prerequisite: average scores under 100 for a regulation length 18-hole course.
   1 unit, Aut, Spr (Diaz) MW 1:15
   and by arrangement
   Win (Diaz) TTh 1:15 and by arrangement

213. Fencing: Tournament—This course is for graduate students only. Prerequisite: promoted from 112 or consent of instructor. Coeducational.
   2 units, Aut, Win, Spr (Helliwell) TTh 11:00–12:30 and T 7 p.m.

130. Swimming: Advanced — Emphasis is placed upon analysis of all ten strokes, principles underlying swimming skills, and increased endurance. Prerequisite: promoted from 31 or above average ability in performing the crawlstroke, backstroke, breaststroke, sidestroke, and elementary backstroke.
   1 unit, Aut, Win (Newell, Weeks) TTh 2:15–3:15
   Spr (Newell) TTh 2:15–3:15
   (Weeks) TTh 3:15–4:15

132. Swimming: Advanced Competitive — Refinement of skills and training in preparation for intercollegiate meets. For the experienced competitive swimmer.
   2 units, Aut (Weeks) MTWTh 3:15–5:00

135. Water Safety: Advanced — The analysis and evaluation of swimming fundaments and strokes and lifesaving techniques for the primary purpose of teaching water safety. Students who fulfill course requirements will receive the American Red Cross WSI Course Completion Certificate. Prerequisites: current American Red Cross Senior Lifesaving Certificate and above average swimming skills.
   3 units, Aut, Win, Spr (Strathairn) MWF 11–12

DANCE

160. Modern Dance Technique: Advanced — This course focuses upon the development of disciplined movement in order to gain the tools for strong control and expressive use of movement. Coeducational. Prerequisites: promoted from 63 or 65 and consent of instructor.
   1 to 3 units, Aut (Weiss) MF 4:15–5:45

161A,B. Contemporary Dance Forms — Sequences for manipulation of movement and advanced techniques. Coeducational. Prerequisite: consent of instructor.
   161A. 1 to 3 units, Win (Weiss) MF 4:15–5:45
   161B. 1 to 3 units, Spr (Weiss) MF 4:15–5:45

163. Choreography Workshop — Coeducational. Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Cashion) T 7:30–10:00 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. Coeducational. Prerequisite: consent of instructor.
   2 to 4 units, Aut (Weiss) W 4:15–5:45
   and by arrangement

166. Contemporary Dance Workshop—Coeducational. Prerequisite: Consent of instructor.
   2 to 4 units, Win (Weiss) W 4:15–5:45
   and by arrangement
167. Contemporary Dance Workshop—Coeducational. Prerequisite: consent of instructor.
   2 to 4 units, Spr (Weiss) W 4:15-5:45 and by arrangement

172. Folk Dance: Advanced—Presentation of dances with complex combinations and intricate step patterns. Emphasis on styling and footwork. Prerequisites: ability to perform more complex step patterns; promoted from 73 or equivalent. Coeducational.
   1 to 3 units, Aut (Lidster) Th 4:30-5:45 and M 7:30 p.m.

173. Folk Dance: Advanced—Coeducational. Prerequisite: promoted from 73 or equivalent.
   1 to 3 units, Win (Lidster) Th 4:30-5:45 and M 7:30 p.m.

174. Folk Dance: Advanced—Coeducational. Prerequisite: promoted from 73 or equivalent.
   1 to 3 units, Spr (Lidster) Th 4:30-5:45 and M 7:30 p.m.

175. Folk Dance: Exhibition — Advanced and exhibition dances mastered in order to participate in dance demonstrations, exhibitions, and festivals. Coeducational. Prerequisite: consent of instructor.
   1 to 3 units, Aut (Cashion) Th 7:30 p.m. and by arrangement

176. Folk Dance: Exhibition — Coeducational. Prerequisite: consent of instructor.
   1 to 3 units, Win (Lidster) Th 7:30 p.m. and by arrangement

177. Folk Dance: Exhibition — Coeducational. Prerequisite: consent of instructor.
   1 to 3 units, Spr (Lidster) Th 7:30 p.m. and by arrangement

262. Seminar in Contemporary Dance Styles —Master lessons and lecture/demonstrations by guest artists representing various styles in Contemporary Dance. Coeducational. Prerequisite: consent of instructor.
   3 units, Aut (Staff) W 8-10 p.m.
   1 unit, Win, Spr (Weiss, Staff) by arrangement

263. Creative Project: Contemporary Dance —Coeducational. Prerequisite: consent of instructor.
   4 to 5 units, Aut, Win, Spr (Weiss) by arrangement

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. Coeducational. Prerequisites: advanced level students and consent of instructor.
   1 to 3 units, Aut (Weiss) F 11:00-12:30 and by arrangement

266. Dance Repertory: Advanced — Dance sequences, phrases and contrasting progressions emphasizing fluency of movement, accuracy of timing, and clarity of form. Study of theme and variations. Coeducational. Prerequisite: consent of instructor.
   1 to 3 units, Win, Spr (Weiss) F 11:00-12:30 and by arrangement

272. Seminar in Folk Dance Styles—Master lessons and lecture/demonstrations by guest artists. Coeducational. Prerequisite: consent of instructor.
   5 units, Win (Lidster) M 7:30 and by arrangement

273. Creative Project: Folk-Ethnic Dance—Coeducational. Prerequisite: consent of instructor.
   4 to 5 units, Win, Spr (Lidster) by arrangement

ADDITIONAL COURSES

To supplement the following courses, students may 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—The study of skeletal anatomy and mechanical principles applicable to sports and dance movement.
   3 units, Aut (Weeks) MWF 9
   Spr (Weeks) MWF 1:15
164. Notation—The Laban method of notating, with symbols, dance, and other forms of movement such as aquatic art.

2 to 4 units, Win (Cashion) M 11 and by arrangement

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 and by arrangement

170. Dance and Its Relationship to Society —The development of dance in its historical perspective.

4 units, Aut (Lidster) TTh 11

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.

2 units, Spr (Weeks) by arrangement

187. Field Hockey Officiating—The principles and techniques of officiating field hockey games.

2 units, Spr (Schoof) by arrangement

190. Games, Sport, and Society—An introductory survey of the Sociology of Sport designed to stimulate interest in the relationships that are typically associated with sport and games, to take sport out of the context of the acquisition of skill and fitness for its own sake and to place games and sport firmly in the context of their societal functions.

3 units, Aut (Staff) by arrangement

210. Badminton Theory and Technique—Prerequisite: consent of instructor.

2 units (Schoof) 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, Win (Neal) 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, Win (Neal) by arrangement

230. Aquatics Theory and Technique — In depth analysis of aquatic skills and exploration of various teaching methods, class organization patterns, evaluative techniques and pool management. This course satisfies requirements for review or re-training in the American Red Cross WSI program. Prerequisites: current WSI certification and consent of instructor.

3 units, Aut, Win, Spr (Strathairn) 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

369. Individual Study in Dance Research—Prerequisite: consent of instructor.

3 to 5 units, Aut, Win, Spr (Lidster, Weiss) by arrangement

PRACTICUM PROGRAM

The courses listed below provide selected students an opportunity to work individually or with other students toward relating their own interest, knowledge, and performance ability in dance and sports activities to leadership experiences. Enrollment is limited to
advanced level students by consent of the respective faculty.

   2 units, Win, Spr (Helliwell) by arrangement

216. Tennis Practicum.
   2 units, Win, Spr (Neal) by arrangement

245. Golf Practicum.
   2 units, Win, Spr (Diaz) by arrangement

260. Contemporary Dance Practicum—Coeducational.
   2 units, Aut, Win (Weiss) MW 3:15
   and by arrangement

261. Contemporary Dance Practicum—Coeducational.
   2 units, Win, Spr (Weiss) MW 3:15
   and by arrangement

270A. Folk Dance Practicum — Coeducational.
   2 units, Aut, Win (Lidster) by arrangement

270B. Folk Dance Practicum — Coeducational.
   2 units, Aut, Win, Spr (Lidster)
   by arrangement
THE INSTITUTE FOR PLASMA RESEARCH

Executive Committee: Peter A. Sturrock (Chairman), Daniel Bershadler, Oscar Buneman, I-Dee Chang, Marvin Chodorow, Frederick W. Crawford, Von R. Eshleman, Robert H. Eustis, Krishnamurty Karamcheti, Charles H. Kruger, Morton Mitchell, Sidney A. Self, 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, Bershadler, 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 Gas Dynamics Group (Eustis, Kruger, Mitchell) concentrates on experimental and theoretical research related to magnetohydrodynamic energy conversion, such as nonequilibrium thermodynamics, transport processes, spectroscopy and plasma diagnostics.

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 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.

SPACEx SCIENCE AND RELATED PROGRAMS

Committee in Charge: Von R. Eshleman (Chairman), Daniel Bershadler, Ronald N. Bracewell, Frederick W. Crawford, Robert A. Helliwell, Robert L. Kovach, 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 Radio Science 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 cis-lunar 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.

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.

**STANFORD LINEAR ACCELERATOR CENTER**

*Director:* Wolfgang K. H. Panofsky
*Deputy Director:* Sidney D. Drell
*Associate Directors:* Joseph Ballam (Research Division); Robert H. Moulton, Jr. (Administrative Services Division); Richard B. Neal (Technical Division); Frederick V. L. Pindar (Business Services Division)


**Associate Professors:** Frederick J. Gilman

**Assistant Professors:** Elliot Bloom, Michel Davier

**Senior Research Associates:** Karl L. Brown, Herbert DeStaebler, Jean V. Lebacqz, Gregory A. Loew, Joseph J. Murray, Richard B. Neal, John R. Rees, Perry B. Wilson

The Stanford Linear Accelerator Center (SLAC) is devoted to experimental and theoretical research in elementary particle physics and to the development of new techniques in high energy accelerators and elementary particle detectors. The Center is located on 480 acres of Stanford property west of the main campus, parallel to and south of Sand Hill Road and is operated under a contract with the United States Atomic Energy Commission. The major experimental facility of the Center is a two-mile-long linear electron accelerator.

The accelerator, which began operations for physics research during 1966, can provide an electron beam at energies up to 22 BeV and at beam intensities up to 30 microamperes average current. Positrons can also be accelerated to a maximum energy of about 14 BeV, at average beam currents up to about one microampere. A “switchyard” of magnetic elements at the end of the accelerator can direct the beams to any of several experimental areas. A large number of secondary beams of special character, including pion, kaon, muon, and photon beams, are available. A complement of large research instruments available for use with the accelerator includes three magnetic spectrometers capable of analyzing momenta up to 1.6, 8, and 20 BeV/c; two bubble chambers, a 40-inch diameter, cylindrical chamber built at SLAC, and a 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 1971, physicists from 35 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 catalogue.) 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 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. 7. Energy, From Nature to Man
  - Engr. 10. Aeronautics and Astronautics
  - Engr. 101. Writing Creatively
  - Chem.E. 20. Introduction to Chemical Engineering
  - C.E. 40. Elementary Surveying
  - C.E. 130. Transportation
  - C.E. 144. Construction Estimates and Costs
  - C.E. 170. Man and His Environment
  - C.E. 171. Environmental Planning
  - I.E. 50. Human Values in a Technological Society
  - I.E. 100. Organizations: Theory and Management
  - I.E. 133. Industrial Accounting
  - I.E. 140. Introduction to Computer Utilization
  - M.E. 42. Introduction to Architecture
  - M.E. 101. Visual Thinking
  - M.E. 103. Manufacturing Technology
  - M.E. 137. Air Pollution
Students interested in the broader relations between human values, technology, and society should also consult the Values, Technology, and Society (VTS) section of this bulletin.

**Human Biology (Program in)**

**Committee in Charge:** Robert R. Sears (Psychology), Chairman; Sanford M. Dornbusch (Sociology); Paul R. Ehrlich (Biological Sciences—on leave 1972-73); David A. Hamburg (Psychiatry); Albert Hastorf (Psychology); Donald Kennedy (Biological Sciences—on leave 1972-73); 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); Carl Djerassi (Chemistry); Shirley Feldman (Psychology); Jane van Lawick-Goodall (Psychiatry); John G. Gurley (Economics); Nicholas J. Hoogenraad (Pediatrics); Herant Katchadourian (Psychiatry); Sidney Liebes, Jr. (Genetics); William V. Robertson (Pediatrics); A. Thomas Schwartz (Philosophy); Alberta E. Siegel (Psychiatry)

**Student Members:** Joanne Godley, LuAnn Hall, Daniel J. McFarland, Marilyn J. Sigman, Elizabeth G. Stone, Rodney E. Utley, Margaret C. Walker

**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.

**Admission to Program**

Undergraduate students can elect Human Biology as a major. The Committee may have to limit enrollment in the Program if the number of students overburdens the resources of the Program.
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 32 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 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. It is advised that the sequence be initiated in Spring Quarter of the Freshman year. Courses 1 through 4 are open to non-majors; however, the A and B Series must be taken concurrently and in sequence by all students.

FUNDAMENTAL PROGRAM

1. Man and Nature—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 are 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.

   4 units, Spr (Pittendrigh) MWF 11

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 mechanisms of intercellular communication in multicellular organisms, leading to the central nervous organization underlying behavior, are emphasized. Finally the evolution of familial (insect) and associative (primate) societies will be used to illustrate the concept of societies as self-reproducing units. Prerequisite: 1 or Biological Sciences 1; must be taken concurrently with 2B.

   4 units, Aut (Pittendrigh, 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. In each evolutionary era, 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 (Goodall, Hamburg) 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 (Kretchmer) MWF 9

3B. Contemporary Psychobiology — This course will examine psychological and biological roots of behavior development in the contemporary human species. Research on cognitive and social development in infancy, childhood, and adolescence will be considered. Genetic influences on behavior development and their biochemical substrates will be presented, as will physiological correlates of behavior change. The utilization of this information in several medical and social contexts will be considered.

4 units, Win (Sears, 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 (Staff) MWF 10

4B. Contemporary Sociobiology — 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 (Gurley, Dornbusch, Adams) 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.

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 units, Win (Katchadourian, Lunde, Staff) MWF 11

ADVANCED COURSES

Note: A major in Human Biology is expected to take 30 units of upper division credits in fields related to the natural or physical and the social or behavioral aspects of Human Biology. The courses may be selected from the upper division offerings of the Program, or any appropriate department on the campus. The student must balance the advanced courses so that 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. 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.

101. The Environment of Man: The Plant World — The fundamental role of green plants in the ecology of man—as esthetic resource and indispensable foundation of the food chain. The course will include a discussion of those aspects of plant physiology essential to understanding agricul-
tural problems; the diversity of agricultural economies throughout the world; the nature and adequacy of the "green revolution" as a solution to population problems; prospects for biologically acceptable methods of pest and weed control. The course will comprise a mixture of lectures and round-table discussions of an interdisciplinary nature. Prerequisite: Human Biology core or 20 units of Biology.

4 units, Aut (Staff) MWF 11, given 1973-74

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. The sociology and economics of therapeutic care (medical services) will be discussed only briefly and then in relation to the other issues. 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) MWF 7-10 p.m.

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, Win (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

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

135. The Transformation of Human Subsistence—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 to the environment. Prerequisite: Human Biology core or consent of instructor.

4 units, Aut (Ammerman) MWF 2:15

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. Students may register for 3 or 5 units, the latter requiring a term paper. Prerequisites: high school physics and junior standing or consent of instructor.

3 or 5 units, Spr (Connolly, Liebes)
T9; Th 9–11

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 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. Prerequisite: Human Biology 3A; 4A desirable.

4 units, Win (Djerassi) T 2:15–5:05, alternate years, given 1973–74

155. Seminar in International Health — (Same as Pediatrics 203.) Discussion of political, sociologic, economic, and medical aspects of health in the developing world. Special consideration will be given to the operation of international public health organizations. Prerequisite: Human Biology core or consent of instructor.

3 units, Aut (——) T 10–12

160. Primate Behavior — This course will study in detail the research literature on behavior of higher primates in natural habitats. Primary attention will be given to chimpanzee behavior, but some 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. Prerequisite: Human Biology core.

3 units, Aut (Brodie) T 2:15–4:05

165. Piaget’s Cognitive Development Theory—(Same as Psychology 266A.) The child’s construction of reality and his adaptive intelligence from birth to adulthood will be examined from the interactionist perspective of the genetic epistemologist, Jean Piaget. Emphasis will be on the theoretical constructs and the empirical research generated by them. Other foci will be cross-cultural research, socio-cultural factors pertaining to development, and education implications. The cognitive-developmental approach will be contrasted with the psychometric view of intelligence. Prerequisite: Human Biology 3A and Psychology 111.

4 units, Aut (Feldman) TTh 9–11

173. Philosophy of Human Life—(Same as Philosophy 173.) This course in bio-ethics 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, abor-
tion, and personal identity); 4) human and social engineering; and 5) the distribution of medical and other welfare services.

3 units, Aut (Schwartz) TTh 11 and section Th or F

199. Directed Reading: Special Projects.
Any quarter (Staff) by arrangement

International Studies
(Committee on)

The Committee 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 Committee meets several times each year, is concerned with major policy questions and decisions and with the ordering of priorities within the overall program.

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.

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 and East Asian 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 his area interest within his disciplinary preparation for the degree.

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.

A special interdisciplinary program for undergraduates is being developed by a subcommittee of the CIS in response to initiatives taken in 1968 to review this aspect of the international studies curriculum. Initial course offerings under this program 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, Committee on International Studies, Building 460, Room 465, Stanford, California 94305.
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 Interschool 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 Subcommittee on Interschool Majors, the faculty members are committing themselves to act as a regular academic advisory committee for the student until graduation. The Subcommittee on Interschool Majors 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 Interschool and Interdepartmental Majors Program is administered by the Subcommittee on Interschool Majors of the Committee on Undergraduate Studies. The Subcommittee 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 Subcommittee 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 Subcommittee must reject a proposal which, though of considerable academic merit, requires resources which are not available at Stanford. The Subcommittee 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 and which articulates the motivation for, and the justification and ultimate goal of, the major. 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 committee.

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 Interschool 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.

Since each proposal is considered individually, the student and his faculty advisory committee may request exception to these guidelines.

Further information on the program may be obtained at the Academic Information Center, extension 2426.
Mathematical Sciences
(Program in)

Committee in Charge: John G. Herriot (Computer Science), Chairman; Paul W. Berg (Mathematics), Herman Chernoff (Statistics), Richard W. Cottle (Operations Research)

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 (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), John D. Goheen (Chairman), Douglas D. Davis (ex officio), James L. Gibbs, Jr. (ex officio), George Collier, Stanley Fischman, Kathy Flores, C. John Herington, Leonard M. Stephenson, Robert Wenger

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-C, Stanford University, Stanford, California 94305.

Stanford Workshops on Political and Social Issues (SWOPSI)

Stanford Workshops on Political and Social Issues (SWOPSI) is a student-initiated, 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 2,000 students in over 100 workshops. In the future SWOPSI will offer for credit an average of 20 to 25 workshops per quarter acting as a Joint Special Agency of the Academic Senate.

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**

*Committee in Charge: Konrad Krauskopf (Chairman), Barbara Chattin, John Franklin, George Gregory, Alfred H. Grommon, Jerry Irish*

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 pre-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 per cent 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 nonresidents 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. (No more than three credits may be offered for an Undergraduate Special course.)
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.*

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 quarter in which the proposed course is to be offered.

Following is a partial listing of the Undergraduate Special Program. Additional courses will be listed each quarter in the Academic Information Center.

* 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.

99. Individual Work for Undergraduates—Individual work which is an extension of other Undergraduate Special courses or carried on under the direction of a professional school or institute staff member not normally teaching undergraduates. Application should be made to the Committee on Undergraduate Studies.

106. Interrelations Between People and Geography—Attempts to develop a composite picture of a region or a nation, stressing the relationship between man and planet earth.

3 units, Aut (Terry, Undergraduate Studies) W 7:30-9:30 p.m.

102. Risk and Insurance—The course will cover the general or "classical" theory of risk, an introduction to the theory of games, and analytical case study. It will give the student the kind of knowledge needed to analyze and solve problems involving personal and business decisions in the field of risk and insurance management.

3 units, Win (Serbein, Graduate School of Business) MTh 4:15

104. Symbols and Meaning in Science and Culture—An exploration into the meaning and uses of symbols, symbolic forms and structures. Two oral reports are expected of each student: one of these to be a critical examination of the symbolic structures, their meaning and validity, within his own major; the other to be a similar examination in another discipline of his own choosing.

Reading will consist of such books as S. Langer, Philosophy in a New Key; E. Cassirer, An Essay on Man; M. Polanyi, Personal Knowledge; and F. S. C. Northrop, The Logic of the Sciences and the Humanities.

3 units, Aut (Ripley, Physical Sciences) W 2:15-4:05

108. Right of Privacy—A study of the theoretical background of the legal concept of privacy, and of the current status of law on the subject. Readings will include some Law Review articles and Supreme Court cases.

3 units, Win (Gregory, General Secretary's Office) Th 2:15-4:05

109. World of Aldous Huxley—Traces Huxley's development as a writer and philosopher. Readings will include Point Counter Point, Eyeless in Gaza, Devils of Loudun, and Island.

3 units, Spr (Gregory, General Secretary's Office) Th 2:15-4:05
110. Masters of Twentieth Century Architecture—Introduction to the work of Wright, Gropius, Mies, LeCorbusier, and their followers, with an emphasis on American architects, to discover the fundamental principles underlying the modern movement in architecture.

Readings will include Coles and Reed, Architecture in America, and Sherban Cantacuzino, Great Modern Architecture.

3 units, Win (Cole, Drama) TTh 2:15

112. Mystics and Mysticism: The Christian Tradition—The course seeks to introduce the student to the literature of mysticism as found in the Western world and to the distinctive elements of mysticism as a type of thought and experience. After preliminary reading in Evelyn Underhill, Mysticism, each student will take the writings of one of the great mystics and give a report presenting mysticism as reflected in that figure.

3 units, Win, Spr (Watkins, Political Science) Th 2:15–4:05

113. Europe as Seen Through Travel Literature—Travel literature as a means of perceiving the physical and spiritual development of the regions of the world; the uniqueness of literary and historical form produced by the perception of cultures by outsiders; emphasis upon European regions and cultures. Each student selects, with the advice of the instructor, one book for careful analysis. Since the books vary constantly, the course may be repeated for credit. Students wishing to take the course to satisfy the language requirement should select a book in their special language and sign up for four units.

3 to 4 units, Aut, Win, Spr (Hilton, Spanish and Portuguese) TTh 10

114. The Destiny of Europe—An important problem discussed in many books from different viewpoints is the destiny of Europe, of the individual countries which compose it, and of the various facets of its culture. Each student selects, with the advice of the instructor, one book for careful analysis, and prepares a critical paper. The course is of special interest to students going to Europe, who may earn an extra unit of credit for fieldwork there.

3 to 4 units, Aut, Win, Spr (Hilton, Spanish and Portuguese) TTh 11

116. Issues in Science and Religion—An attempt to explore the present and probable future sources of conflict between scientific and religious approaches to life, with special attention to basic presuppositions and their effect on conclusions reached. Readings will include Barbour, Issues in Science and Religion; Bube, The Encounter Between Christianity and Science; and Jeeves, The Scientific Enterprise and Christian Faith.

3 units, Aut, Spr (Bube, Materials Science and Engineering) T 4:15–6:05

122. Management Problems of International Business—Class meetings are devoted primarily to discussions of student reports selected on the basis of individual interest. Subjects may range from broad issues, such as adaptation of company policies to conform to distinctive cultural features or government policies in different countries, to more technical problems, such as those involving corporate financing across national boundaries or the measurement of consolidated income.

3 units, Win (Smith, D. T., Graduate School of Business) by arrangement

Values, Technology, and Society (Program in)

Chairman: Walter G. Vincenti
Coordinator: Robert E. McGinn
Administrative Committee: William A. Clebsch, Robert E. McGinn, Alberta E. Siegel, Walter G. Vincenti

Professors: Francis A. Cancian (Anthropology), William A. Clebsch (Humanities Special Programs), Lee J. Cronbach (Education), Lawrence M. Friedman (Law), Eric Hutchinson (Chemistry), Stephen J. Kline (Mechanical Engineering) (on leave 1972–73), William C. Reynolds (Mechanical Engineering), Philip H. Rhinelander (Philosophy and Humanities Special Programs), Alberta E. Siegel (Psychiatry), David F. Tuttle (Electrical Engineering), Walter G. Vincenti (Aeronautics and Astronautics)

Assistant Professors: Robert Bridgham (Education), George A. Collier (Anthropol-
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 to provide students with the materials and opportunities for synthesis which will enable 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.

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 genuinely fruitful, it must be informed with historical and cross-cultural perspective, coupled with a pronounced emphasis on the abiding importance of human values, and supplemented by detailed study of the professions as the arenas in which constructive interdisciplinary syntheses find their practical applications to pressing human needs. Thus, VTS hopes to generate in prospective professionals and citizens a keen 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 the present time, 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 Business, Education, 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 which 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

Existing VTS courses will be particularly valuable for undergraduates planning further study in graduate professional schools (e.g. business, education, engineering, law, medicine, etc.) and those students wishing to relate the more specialized knowledge gained from their major fields to broader problems of human values and contemporary society.

Note: (1) Team-taught, direct-interaction seminars (101A,B, etc.) are taught by faculty teams usually composed of a humanist, a social scientist, and a natural scientist or technologist. Students in these seminars are admitted in such a way that a broad spectrum of student majors is obtained.

(2) 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 given VTS course satisfies, see the Program Coordinator in Room 61D.

INTRODUCTORY COURSE

1. Man in Contemporary Technological Society: Problems and Perspectives—An introduction to the interactions of values, technology, and society as they confront individuals living in America today. The course will confront directly the questions "What constitutes a good life?" "In what kind of man-made and natural environment is a good life possible?" and "What are the technological and resource constraints in producing a good environment for a good life?" These questions will be examined holistically by study-
ing the important human, social, technological, and environmental factors for having a meaningful life, and the interactions of these factors.

5 units, Spr (Staff) MWF 1:15-2:05; 2-hour discussion by arrangement

**TEAM-TAUGHT, DIRECT-INTERACTION SEMINARS**

101A. Technology, History and Culture — Multi-disciplinary and cross-cultural study of interactions between technology, social institutions, and human values in different historical epochs: e.g. tribal societies; medieval Europe, Africa, and China; modern industrial society. Attention will be given to social and ecological implications of technology and to ways in which different cultures affect and are affected by the technologies at their disposal.

4 units (Staff) given 1973-74

101B. Comparative World Views and Scientific Thought — Multi-disciplinary and cross-cultural (Eastern, Western) approaches to the study of human values and behavior; meaning, “proof,” and verification in both scientific and non-scientific (e.g. religious, philosophical) thought; man and nature: modes of their interaction in different cultures.

4 units (Staff) given 1973-74

101C. Psychiatry and Human Values in Technological Society — Multi-disciplinary study of psychological and ethical issues arising out of the impact of technology on contemporary human behavior and values. Examples will be drawn from psychiatry and medicine (e.g., organ transplants, abortion, behavior-modification techniques, psychoactive drugs, artificial maintenance of life, cloning, etc.). Concepts of human nature, satisfaction, aggression, sexuality, alienation, and social pathology will be examined from several perspectives, including the psychiatric, sociological, political, and philosophical. Readings include: Laring, Freud, Skinner, Marx, Nietzsche, Jung, Erikson, Lifton, Maslow, and Kafka.

4 units, Spr (McGinn and Staff)  TTh 3:15-5:05

101D. Property, Technology, and Development — Critical examination of man as possessor, exploring the interactions of property with human values, social relationships, the legal system and development processes. The efficacy of various property systems in relation to the distribution of benefits in society and the management of resources. Primitive, historical, and contemporary examples with particular attention to problems of and alternatives for the future.

4 units, Win (Friedman and Staff) by arrangement

**INDIVIDUALLY TAUGHT COURSES**

111. Human Values and Contemporary Society — Consideration of the status of a broad range of human values (moral and aesthetic, social and political, material and spiritual) in contemporary Western society. Topics include: alternate systems of human values and their bearing on life in contemporary society; education and values; cultural trends and contemporary social structure; the human costs of economic growth; interpersonal relations in contemporary society.

4 units, Aut (McGinn) MW 10; Th 3:15-5:05 or 7:15-9:05

121. Technology and Society: How Did We Get Here? — An examination of the interplay of technological change and societal development from ancient times to the beginning of the twentieth century. The intent is to provide an historical frame of reference for understanding our present industrialized civilization. The course can be taken either with a final examination (4 units) or with a research paper (5 units).

4 to 5 units, Win (Vincenti) TW 9; Th 9:00-10:50 or 2:15-4:05

122. Contemporary Technological Society — The character and uniqueness of contemporary technological society. Topics include: alienation, ideology and individualism in technological society; technique and human values; technology and ecology; technology and the transformation of culture; technocracy and politics. Readings include: Ellus, Habermas, Skinner, Grant, Zolla, Mishan, etc.

4 units, Win (McGinn) MW 3:15-5:05

131. The Professions: Human Conflict and Social Choice — Study of the professions in contemporary, technological society. Topics covered include: moral conflict and professional activity; social responsibility; conflicts with private life; impact of technologi-
cal innovation of professional technique; personal satisfaction; role-behavior; professional activism. Students examine the profession(s) they think might befit their talents and fulfill their aspiration.

4 units, Win (Siegel) TTh 1:15-3:05

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. The Communications Revolution in Contemporary Society — The “Communications Revolution” and its effect on life in contemporary society. Trends in communications research and their bearing on future society. Topics include: basic concepts of communication and information theory; information storage and transmission; information and the person; technology and participatory democracy; education and communication; society as an interactive organism; etc. For students with non-technical backgrounds.

3 units, Spr (Kincheloe) by arrangement

143. Models and Modeling: Representations of Reality—The restatement of problems (or reviewing of situations) in simpler, more readily tractable (though perhaps less accurate) forms. The role of such model making in thought and action. The nature, validity, and utility of models. Study of specific examples from as wide a variety of fields as possible (social science, physical science, humanities). Mathematics will be used only as necessary and will be developed in consonance with class background.

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

151. Science, Politics and Public Policy—A study of the formal and informal processes whereby decisions based on science, or decisions affecting the future of science, become transformed into public policy and legislation. The roles of scientific organizations, e.g. the National Academy of Science, will be studied, as well as the roles of sub-committees of formal government bodies, e.g. the research panels of the National Science Foundation, to see how these organizations and the Office of Science and Technology serve to channel decisions to the White House and the Congress. If time permits, a comparative study of the British counterparts of American organizations will be made. In addition to lectures and readings from texts, there will be individual lectures by members of the Stanford Faculty who have served in government offices and bureaus which deal with allocation of national resources for science and technology.

3 units, Win (Hutchinson) T 2:15-4:05

152. Social Implications of Genetic and Behavioral Technology — Techniques for human genetic intervention and behavioral modification are being developed; some are already in practice. Their implementation will fundamentally challenge traditional individual and social values. The course will be a broad, yet intensive, study of the techniques, their impact on men and society, and the associated problems of regulation. Since regulatory decisions will be influenced by the attitudes of the general public, participation in off-campus programs will be encouraged.

3 to 4 units, Spr (Fenster) by arrangement


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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