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Stanford, California

Published by the University
UNIVERSITY CALENDAR

AUTUMN QUARTER, 1966

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>Sept. 26-27</td>
<td>Monday–Tuesday: Registration</td>
</tr>
<tr>
<td>Sept. 28</td>
<td>Wednesday: Instruction begins</td>
</tr>
<tr>
<td>Sept. 30</td>
<td>Friday: Conferring of degrees</td>
</tr>
<tr>
<td>Oct. 2</td>
<td>Sunday: Matriculation Sunday</td>
</tr>
<tr>
<td>Oct. 18</td>
<td>Tuesday: Last day for registration</td>
</tr>
<tr>
<td>Oct. 25</td>
<td>Tuesday: Last day for filing advanced degree applications: A.M., M.S., Engineer for April conferral; Ph.D. for June</td>
</tr>
<tr>
<td>Nov. 24-27</td>
<td>Thursday–Sunday: Thanksgiving Recess</td>
</tr>
<tr>
<td>Dec. 1</td>
<td>Thursday: Last day for filing A.B. and B.S. applications</td>
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<tr>
<td>Dec. 12</td>
<td>Monday: Last day for filing A.M., M.S., Engineer theses, and Ph.D. Dissertations</td>
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<tr>
<td>Dec. 12-16</td>
<td>Monday–Friday: End-quarter examinations</td>
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WINTER QUARTER, 1967

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<th>Date</th>
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<tbody>
<tr>
<td>Jan. 4</td>
<td>Wednesday: Registration</td>
</tr>
<tr>
<td>Jan. 5</td>
<td>Thursday: Instruction begins</td>
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<tr>
<td>Jan. 6</td>
<td>Friday: Conferring of degrees</td>
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<tr>
<td>Jan. 15</td>
<td>Sunday: Last day for filing Fellowship and Graduate Scholarship applications</td>
</tr>
<tr>
<td>Jan. 25</td>
<td>Wednesday: Last day for registration</td>
</tr>
<tr>
<td>Jan. 31</td>
<td>Tuesday: Last day for filing A.B. and B.S. applications for April and June conferral</td>
</tr>
<tr>
<td>Feb. 1</td>
<td>Wednesday: Last day for filing advanced degree applications: A.M., M.S., Engineer for June conferral; Ph.D. for September</td>
</tr>
<tr>
<td>Feb. 22</td>
<td>Wednesday: Washington’s Birthday (Holiday)</td>
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<tr>
<td>Mar. 9</td>
<td>Thursday: Founders’ Day</td>
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<tr>
<td>Mar. 20</td>
<td>Monday: Last day for filing A.M., M.S., Engineer theses; and Ph.D. Dissertations</td>
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<tr>
<td>Mar. 20-24</td>
<td>Monday–Friday: End-quarter examinations</td>
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SPRING QUARTER, 1967

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<th>Date</th>
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<tbody>
<tr>
<td>Apr. 3</td>
<td>Monday: Registration</td>
</tr>
<tr>
<td>Apr. 4</td>
<td>Tuesday: Instruction begins</td>
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<tr>
<td>Apr. 7</td>
<td>Friday: Conferring of degrees</td>
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<tr>
<td>Apr. 24</td>
<td>Monday: Last day for registration</td>
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<tr>
<td>May 1</td>
<td>Monday: Last day for filing advanced degree applications: A.M., M.S., Engineer for September conferral; Ph.D. for January</td>
</tr>
<tr>
<td>May 22</td>
<td>Monday: Last day for filing Ph.D. Dissertations</td>
</tr>
<tr>
<td>May 30</td>
<td>Tuesday: Memorial Day (Holiday)</td>
</tr>
<tr>
<td>June 8</td>
<td>Thursday: Last day for filing A.M., M.S., Engineer theses</td>
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<tr>
<td>June 9-14</td>
<td>Friday–Wednesday: End-quarter examinations</td>
</tr>
<tr>
<td>June 17</td>
<td>Saturday: Senior Class Day</td>
</tr>
<tr>
<td>June 18</td>
<td>Sunday: Commencement</td>
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SUMMER QUARTER, 1967

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<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>June 26</td>
<td>Monday: Registration</td>
</tr>
<tr>
<td>June 27</td>
<td>Tuesday: Instruction begins</td>
</tr>
<tr>
<td>July 4</td>
<td>Tuesday: Independence Day (Holiday)</td>
</tr>
<tr>
<td>Aug. 18-19</td>
<td>Friday–Saturday: Eight-week term examinations</td>
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<tr>
<td>Aug. 19</td>
<td>Saturday: Eight-week term closes</td>
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This section describes requirements for degrees which apply to all students at Stanford University. Special departmental or school requirements are described in the section on the school or department itself.

Candidates may be presented for graduation in January, April, June, and September, but all diplomas are awarded in June.

No degree will be conferred upon any person who has not spent at least three quarters in resident study at the University. No honorary degrees are given.

UNDERGRADUATE DEGREES

GENERAL STUDIES PROGRAM

The aims of education at Stanford are two-fold—to provide a liberal education and to make available the best in specialized study. A liberal education is designed to produce a citizen worthy of a free society and a free university. Specialized study aims to equip a student to take his place in the profession or vocation of his choice. Both are essential to modern life.

The General Studies Program is directed toward satisfying these aims and is the product of intensive study. It is spread over the entire four years of undergraduate work, permitting flexibility in planning individual programs of study. A student may spend much of the first two years in fulfilling General Studies requirements, or he may begin specialization early and carry both his major and General Studies courses for four years.

There is a great deal more in the Program which is aimed at enriching the undergraduate’s career. On the academic side, students may be awarded up to 45 units of graduating credit for superior work done in high school. Such advanced credit will be established 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 further individual study and development for the capable student. Also, development of the student’s specialization under the direction of a particular department is an essential part of his undergraduate experience. Of general application is the fact that good English is expected in all University course work and is a consideration in grading. It is not just an exercise limited to English classes.

On the extracurricular side, the University is anxious to provide adequate opportunities for the cultural and social activities which can add to the student’s educational experience in an infinite variety of ways. Much of this is up to the student, although Stanford is concerned that he not forget that the primary purpose of a university education is intellectual growth. To help keep intellectual and other activities in some balance, all students are required to participate during six quarters (two academic years) in supervised activities of recreational or vocational value. Here the goal is in part to help the individual cultivate or keep alive interests which will continue beyond the University and make the increased leisure of modern life more productive. Two of the six quarters must be in some sport or physical activity. The remaining four may be either in physical activity or in work with orchestra, band, chorus, dramatic productions, or some other approved group activity. Beyond these lies a host of activities in student government, organizations, the Stanford Daily, literary endeavors, etc., in which the student may participate if he desires.

While flexibility is one of the major strengths of the General Studies Program, the following represents the pattern of General Studies courses. Both Bachelor of Arts and Bachelor of Science (Engineering, Physics, Chemistry, Earth Science, etc.) candidates are required to complete Basic and Area requirements, that is, subjects in “A” and “B” as follows:

A. BASIC REQUIREMENTS FOR ALL STUDENTS

1. English 1, 2, 3. Freshman English (Composition and Literature).
2. History 1, 2, 3. History of Western Civilization.
3. Foreign Language or Mathematics. Students may choose to complete either a foreign language or a mathematics series.
DEGREES

a) Foreign Language. Acquisition of a reading ability equivalent to that reached in the following courses: Chinese 21, French 23, 82, German 23, 53, 82, Greek 23, Hebrew 23, Italian 23, 82, Japanese 21, Latin 23, Russian 52, Spanish 23, 53

b) Mathematics. Completion of the final course of any of the following sequences or the equivalent

1) Mathematics 10, 11, 21, 22, 23
2) Mathematics 41, 42, 43
3) Mathematics 41, 52, 53
4) Mathematics 41, 62, 63 (Recommended for Social Science majors.)

4. Group Activity. All undergraduate students except veterans, married students, and students over 24 years of age are required to participate in organized activities to a total value of 6 non-credit units. No more than 2 of such units will be counted in any one quarter. During the freshman and sophomore years at least 2 units of this requirement, 1 each year, must be devoted to a physical activity, including varsity teams, supervised intramural sport, organized physical education classes, and other physical activity offerings as listed in the Time Schedule. The remaining 4 units may be fulfilled either in physical activity offerings or in group activities approved by the General Studies Committee. Among these are chorus, band, orchestra, dramatic productions, and some journalistic activities.

Enrollment in ROTC will be accepted, quarter for quarter, in satisfaction of all or part of this requirement.

B. AREA REQUIREMENTS FOR ALL STUDENTS

Every student is exempt from the General Studies Area Requirements within that area—humanities, social sciences (including communication, history, and speech pathology and audiology) or natural sciences (including mathematics, applied science, and engineering)—in which he majors. This exemption does not affect the Basic Requirements in mathematics, foreign languages, English, and History of Western Civilization, as listed under “A” above. All students must therefore complete the following requirements in the two areas in which they are not majoring. The Humanities and Social Science area requirements are automatically fulfilled by students who attend overseas campuses.

1. Humanities. A minimum total of 8 units selected from General Studies courses in at least two of the following three fields:*

a) The Fine Arts (including Music, Art and Architecture, Speech and Drama)

b) Philosophy, Religion

c) Literature

* Only courses listed in the General Studies Bulletin may be used in fulfillment of this requirement.

2. Social Sciences. Two 5-unit General Studies courses selected from the following:

a) Anthropology 1

b) Communication 1

c) Economics 1

d) Geography 1

e) Political Science 1

f) Psychology 1

g) Sociology 1

3. Natural Sciences. Students who have not taken biology in high school will take Biology 4, 5. Those who have had biology but not physical science in high school will take one of the following complete series:

a) Physical Sciences 1, 2, 3 (9 units)

b) Physics 21, 23, 29 (12 units)*

c) Physics 51, 52, 53, 54, 55, 56, 57 (18 units)*

d) Chemistry 1, 2, 3 (13 units)

e) Geology 1, 2 (10 units)

* Majors in the physical sciences and engineering normally enroll in the Physics 50-series; other students, including pre-meds, normally enroll in the 20-series.

Students who have taken both biology and a physical science in high school must take either the biology series or one of the complete series above. The course series taken in fulfillment of this requirement must include laboratory.

With respect to all three areas listed above, students who start at Stanford are required to take at least one course in the humanities, at least one in social science, and at least one laboratory sequence in the natural sciences at Stanford. Transfer students
should consult the General Studies Bulletin for information concerning fulfillment of General Studies requirements.

C. ADDITIONAL REQUIREMENTS FOR CANDIDATES FOR THE A.B. DEGREE

1. **One of the following**
   a) Mathematics 1 and 2, Statistics 50, or an advanced mathematics course making use of calculus if mathematics was chosen under “A” above.
   b) Philosophy 3 (Logic).
   c) 4 units of additional reading in the foreign language which the student took under “A.” (This requirement may be fulfilled either in consultation with the student’s own major department or by taking French 54, German 54, Russian 54, Spanish 54, or by taking a language reading course numbered 100 or higher. Certain courses in Chinese and Japanese with lower numbers will be accepted.) This requirement may also be fulfilled by the language instruction at an Overseas Campus.

2. **Additional courses in the Natural Sciences.**
   That number of units which, when added to the work completed under “B3,” brings the total to 17 units. This additional work must be selected from the following courses in such a way as not to duplicate subject matter covered under “B3.” Courses listed under “a” through “e” may be taken without laboratory in satisfaction of this requirement, but credit will be correspondingly reduced. Requirement “B3” must include laboratory.
   a) Biology 4, 5
   b) Chemistry 1, 2, 3
   c) Physical Sciences 1, 2, 3
   d) Physics 21, 23, 29; 51, 52, 53, 54, 55, 56, 57
   e) Geology 1, 2
   f) Mathematics 10, 11, 21, 22, 23; 41, 42, 43; 52, 53; 62, 63
   g) Philosophy 3 (Logic)
   h) Statistics 50
   i) Psychology 60
   j) Anatomy 114
   k) Physical Sciences 5, 6, 7, 50, 100

3. **Senior Colloquia.** Two colloquia of 2 units each, as listed in the Time Schedule, under “Senior Colloquia.” No more than two may be taken for credit. The following A.B. candidates are exempt from the Senior Colloquium requirement:
   a) Students taking their senior year of undergraduate study as their first year in the School of Law and School of Medicine.
   b) Students enrolled in Honors programs in Humanities, and in Social Thought and Institutions.

U.S. HISTORY AND CONSTITUTION REQUIREMENT

California State law requires that baccalaureate degree programs include instruction in U.S. History and Constitution. For students who come to Stanford as freshmen, material contained in History 3 satisfies this requirement; transfers may meet this requirement through completion of any of several approved alternatives in Stanford’s Departments of Political Science and History or by completing the requirements at other collegiate institutions.

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 as 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 the student may freely choose any course which his previous studies have prepared him 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 candidates recommended by the Subcommittee on Graduation who, in addition to fulfilling the following requirements, have applied in advance for graduation:

1. The completion of 180 (quarter) units of university work, including the General Studies requirements.

2. The acquisition of twice as many grade points as there are units registered on the candidate's record card.

3. The completion of the curriculum requirements as prescribed by a major department. The recommendation of that department is necessary to graduation.

Candidates who fulfill these requirements in the Schools of Earth Sciences and Engineering, or the Departments of 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.

Forty-five units constitute a normal year's work. The degree is conferred whenever the requirements are met, provided the candidate has spent three quarters in resident study and completed at least 45 units (including the last 15) in this University. In special cases, students who have obtained at least 135 units in resident work, and who have completed all major requirements and all General Studies requirements, may be exempted from completing the last quarter's work in this University and be permitted to complete the required number of units elsewhere. In these cases the approval of the Subcommittee on Graduation is necessary.

If graduates of other universities desire to become candidates for the baccalaureate degree in a different field at Stanford University, they may apply for admission as undergraduates. If admitted, they will be given 135 quarter units of advanced standing and will be required to complete at least 45 units (three quarters) of university work and fulfill all major and General Studies requirements.

Second Bachelor's Degree

The holder of a Bachelor of Arts degree from Stanford may apply to the Subcommittee on Graduation for admission to candidacy for a Bachelor of Science degree, and the holder of a Bachelor of Science degree may apply in like manner 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 re-register 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.

As a recognition of high scholastic attainment the Bachelor's degree may be granted "With Distinction" or "With Great Distinction."

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 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 the Graduate Division. Candidacy is valid for five years from date of such approval and may be renewed by the submission and approval of a new application. All applications or petitions to the University Committee on the Graduate Division
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, Registrar's Office, Stanford University, Stanford, California 94305.

**BACHELOR OF ARCHITECTURE**

Upon recommendation to the Academic Council by the faculty of the Department of Art and Architecture and the University Committee on the Graduate Division, the degree of Bachelor of Architecture (B.Archit.) is conferred on candidates who have satisfied the requirements laid down by the faculty of the Department of Art and Architecture and the University. (Full particulars concerning these requirements will be found elsewhere in this Bulletin.)

**MASTER OF ARTS OR MASTER OF SCIENCE**

Upon recommendation to the Academic Council by the faculty of the major department and the University Committee on the Graduate Division, 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 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 the Graduate Division 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, after which it may be renewed by the approval of a new application by the major department and the University Committee.

Three bound copies of the thesis, 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 the original and first two carbon copies, typed on paper of standard size and weight, with title and signature pages in the form prescribed by the University Committee on the Graduate Division. 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, Registrar's Office.

**MASTER OF BUSINESS ADMINISTRATION**

Upon recommendation to the Academic Council by the faculty of the Graduate School of Business and the University Committee on the Graduate Division, 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 Busi-
ness and the University. (Full particulars concerning these requirements will be found in the *Graduate School of Business Bulletin*.)

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### ENGINEER

**General Regulations**—Upon recommendation to the Academic Council by the faculty of the major department and the University Committee on the Graduate Division, the degree of Engineer is conferred on candidates who have satisfactorily completed six quarters of approved graduate work (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 the Graduate Division 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 and may be renewed by the approval of a new application by the major department and the University Committee.

**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 the original and first two carbon copies, typed on paper of standard size and weight, with title and signature pages in the form prescribed by the University Committee on the Graduate Division, 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, Registrar’s Office.

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### MASTER OF FINE ARTS

**General Regulations**—Upon recommendation to the Academic Council by the faculty of the major department and the University Committee on the Graduate Division, the degree of Master of Fine Arts (M.F.A.) is conferred on candidates who have satisfactorily completed six quarters of approved graduate work (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 school or department.

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### DOCTOR OF EDUCATION

Upon recommendation to the Academic Council by the faculty of the School of Education and the University Committee on the Graduate Division, 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 office of the Dean of the School of Education.)

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### DOCTOR OF MUSICAL ARTS

Upon recommendation to the Academic Council by the faculty of the Department of Music and the University Committee on the Graduate Division, the degree of Doctor of Musical Arts (D.M.A.) is conferred on cand-
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, practice, conducting, or music education parallel to the musico-logical 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 or dissertation 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 Executive Head of the Department of Music.

**BACHELOR OF LAWS**

Upon recommendation to the Academic Council by the faculty of the School of Law and the University Committee on the Graduate Division, the degree of Bachelor of Laws (LL.B.) 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 quarter units required under the current Faculty Regulations of the School of Law after devoting not less than nine full quarters thereto, and who otherwise have satisfied the requirements of the University and of the School of Law.

**MASTER OF LAWS**

Admission to candidacy for the degree of Master of Laws (LL.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 year (39 quarter units) of work in this School in accordance with the rules of the University and of the School of Law. Upon his admission to candidacy, each student must present for the approval of the School of Law Committee on Graduate Study the program which he 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 have received the degree of Master of Laws at this University, and who have completed the work required for such Master's degree with marked excellence and have given clear proof of their ability to do legal research of high quality.

The degree of Doctor of the Science of Law is conferred upon applicants so admitted to candidacy who spend one full academic year in independent legal research and as a result thereof 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 Academic Council by the faculty of the School of Medicine and the University Committee on the Graduate Division, 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 Academic Council by the faculty of the major department and the University Committee on the Graduate Division, 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.

A minimum of three years (nine quarters) of graduate registration satisfactorily completed is required of each candidate. The minimum requirements which must be com-
completed as a graduate at Stanford are three full quarters (or the equivalent in part-time registrations as calculated on tuition payments) and 36 quarter units. 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, and has completed the reading requirement in at least one foreign language, the major department may certify him to the University Committee on the Graduate Division 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 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 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 and may be renewed by the submission and approval of a new application.

Foreign Language Requirement

With the application for admission to candidacy, a certificate must be filed stating that the student possesses a reading knowledge of one or more languages in addition to English. The language or languages required will be selected in individual cases by the mutual assent of the student and the major school or department. The languages so selected will be those most likely to be useful in connection with the individual student's program of study for the degree and his predoctoral and postdoctoral research program. Any necessary certificate will be issued by an examiner designated by the major school or department.

University Oral Examination

When a candidate has been admitted to candidacy, and has shown special ability in his field of study and proved his capacity for independent investigation to the satisfaction of the schools or departments concerned, he 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 fields of study and to confirm his fitness for scholarly pursuits. The examining committee is to be composed of (1) the Dean of the Graduate Division or his delegate, presiding, (2) four or more faculty members appointed by the Dean of the Graduate Division from the major and minor departments, (3) any additional representatives selected by the major and minor departments and the Dean of the Graduate Division, and (4) 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 head will take responsibility for appointing (on Form G81) a faculty reading committee consisting of the candidate's research adviser, a second member from within the major department, and a third member chosen from the major or another department. 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 should be encouraged to follow and advise on the progress of the research. Each member of the reading committee will certify by signature on the final copies of the dissertation that he has read
the dissertation, and that in his 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.

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, the original copy will be sent to the author, the first two carbon copies to the Stanford University Library, and the third carbon copy to the major department.

Directions regarding the form of the dissertation, title and signature pages, and the abstract may be obtained from the Graduate Study Office. The abstract (600 words or fewer in length) will be published in Dissertation Abstracts 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
1966–67

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.

Courses marked (#) may be used in satisfaction of General Studies requirements or options.

Summer Session

The Summer Session of 1967 will be eight weeks in length, except in certain schools which will offer ten-week courses.

This announcement includes, for the Summer Session of 1967, only those courses which can be tentatively scheduled at this time by each department. For the complete list of courses and faculty, request should be made for the special Summer Session Bulletin to be issued in February 1967.
GRADUATE SCHOOL of BUSINESS

Dean: Ernest C. Arbuckle

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 for its current bulletin.

SCHOOL of EARTH SCIENCES

Dean: Richard H. Jahns
Associate Dean: Konrad B. Krauskopf
Assistant Dean: Ernest I. Rich

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

The aims of the School are threefold: (a) to train men for responsible positions in industry, government, education, and research in the fields of geology, paleontology, geochemistry, geophysics, mineral engineering, extractive metallurgy, and petroleum engineering; (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 head 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 below for each department. As a general requirement for the School, a student's mean grade in required courses in each of the fields of mathematics, chemistry, physics, and earth sciences must be C or better.

ROTC—Reserve Officers' Training Corps are maintained at Stanford by the Army, the Navy, and the Air Force (see Aerospace Studies, Military Science, and Naval Science in this Bulletin). Students enrolled in the School of Earth Sciences who are also enrolled in an ROTC program will usually require more than four years (twelve quarters) in the University to obtain a baccalaureate degree.

These aerospace, military, and naval science courses require 36 units of credit in addition to the earth science course requirements, and the additional time required will vary from one to three quarters depending upon the circumstances in each case.

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 in Hydrology are also offered. See the section "Hydrology" 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. With the limited facilities available, it is not possible to accept all who apply for admission.

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 about twenty-two teaching assistantships are awarded to qualified students to assist in laboratory instruction.

GEOLOGY

Emeriti: Eliot Blackwelder, Siemon W. Muller (Professors)

Executive Head: Benjamin M. Page

Associate Executive Head: Joseph J. Graham


Associate Professor: William R. Dickinson.

Assistant Professors: Arvid M. Johnson (Geology and Mineral Engineering), Paul Switzer (Statistics)


PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The following requirements for the degree of Bachelor of Science in Geology and Geochemistry are in addition to the University requirements in general studies.

It should be noted that the Department of Geology has a specific requirement in foreign language. The general University requirement is completion of either Mathematics 23 or a course numbered 23 in a foreign language, but the Department of Geology requires completion of a language sequence whether or not Mathematics 23 is taken. Any modern language is accepted in fulfillment of this requirement, but German is recommended.

In addition to General Studies courses and foreign language, the following courses are required of all students:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
<th>Given Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 1, 2, 3</td>
<td>General Chemistry</td>
<td>AWS</td>
<td>13</td>
</tr>
<tr>
<td>Mathematics 10, 11</td>
<td>Analytical Geometry and Calculus</td>
<td>Any</td>
<td>6</td>
</tr>
<tr>
<td>Geology 1. Physical Geology</td>
<td>Any</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 2. Historical Geology</td>
<td>W or S</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 25. Elementary Mineralogy and Crystallography</td>
<td>A</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 51. Elementary Petrology</td>
<td>W</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 105. Structural Geology</td>
<td>S</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 107. Geologic Field Techniques</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geology 108, 109. Field Geology (See Note 1)</td>
<td>Summer</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Total: 62

Note 1.—A student who takes Geology 108 and 109 during the summer following his junior year will normally graduate at the end of winter quarter in his senior year.

Further course work depends on a student's special interests. Three alternative curricula are suggested below, all leading to the degree of Bachelor of Science in Geology. Substitution of other courses for some of the listed requirements is possible in exceptional cases. Such changes should be arranged in consultation with the adviser and must be approved by the faculty of the Department.

Curriculum in Physical Geology—For students planning careers in general geology,
economic geology, petroleum geology, engineering geology, field geology.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
<th>Given Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 112. Elementary Paleontology</td>
<td>A</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 171. Introduction to Geochemistry</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>At least 5 additional units in geology</td>
<td>Any</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geophysics 190. General Geophysics</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>WSA</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Mathematics 21, 22. Calculus</td>
<td>Any</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mathematics 23, or Statistics 50 or 110</td>
<td>Any</td>
<td>3–5</td>
<td></td>
</tr>
</tbody>
</table>

Total..............................40–42

Curriculum in Paleontology—For students interested primarily in paleontology, stratigraphy, relations of biologic activity to geologic processes.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
<th>Given Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least 15 units from courses listed in the section on Paleontology and Stratigraphy. (Qualified students may take 200-level courses.)</td>
<td>Any</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Geology 157. Sedimentary Petrology</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 21, 23, 29. Elementary Physics</td>
<td>WSA</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Statistics 50. Elementary Statistics</td>
<td>AS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>At least 10 units from courses listed under the Department of Biological Sciences</td>
<td>Any</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

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

Curriculum in theoretical earth science—For students planning careers involving research in the quantitative aspects of the earth sciences.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
<th>Given Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 171, 271. Geochemistry</td>
<td>AW</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Geology 209. Physics of Underground Fluids</td>
<td>W</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 106. Physical Oceanography</td>
<td>S</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Geophysics 190. General Geophysics</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mathematics 21, 22, 23, 24. Calculus</td>
<td>Any</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>WSA</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

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

Electives—A student entering Stanford with credits for two years of high school language and four years of mathematics will normally have 26–30 units of free electives, depending on which of the above curricula he chooses (based on an average load of 15 units per quarter). If his preparation is less adequate, the number of electives is correspondingly smaller. Electives should be chosen after consultation with the adviser. They may be courses offered by the Geology Department or by any other department in the University. The following geology courses are particularly recommended as electives, depending on a student’s individual interests: Geology 133 and 134, Geomorphology and Map Interpretation; Geology 220, Optical Mineralogy; Geology 160, Elementary Stratigraphy; Geology 182, Petroleum Geology and Subsurface Mapping; Geology 281, Ore Deposits; Geology 284, Engineering Geology; Geology 285, Hydrogeology. (Courses numbered in the 200's are open to qualified undergraduates.)

Order of courses—The order in which courses are taken may be adapted somewhat to suit individual needs, but is restricted by the fact that some courses are prerequisites for others. It is strongly recommended that students intending to major in the Department of Geology take Chemistry 1, 2, 3 and Geology 1 during their first year, and Geology 25 as soon as possible after Geology 1, since these courses are required as preparation for many of the more advanced courses. A student should work out his schedule of courses with his adviser well in advance, so that he can be sure to arrange the courses in proper sequence.

Grade requirements—In addition to the University requirement of an overall mean grade of C or better for graduation, the Department requires that the mean grade in required courses in each of the fields of mathematics, chemistry, physics, biology, and earth sciences must be C or better.

Special programs—Students whose interests lie in special fields such as mineralogy, economic geology, geomorphology, geochemistry, oceanography, or particular branches of paleontology should use some of their elective units to broaden their backgrounds in these fields. Special programs in these fields, involving possible substitutions for requirements listed above, may be arranged in consultation with the adviser and may be submitted to the faculty of the Department for approval.

Honors Program—The Geology Honors Program is designed to give a limited num-
ber 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, 25, 51, and 105. Entry is possible at any time after the end of the sophomore year. The Honors Program consists of the following:

1. The courses required of all geology majors: Chemistry 1, 2, 3; Mathematics 10, 11; Geology 1, 2, 25, 51, 105, 107, 108, 109.

2. The courses in other science departments required for any one of the three regular curricula of the department.

3. 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.

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—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. Units from School of Earth Sciences courses with grades of D will not be counted toward the required 45 units of work, and the average of all grades 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 be approximately equivalent to one of the three curricula leading to the B.S. degree in Geology at Stanford. Geology 220 and 221 (or equivalents) and one course in economic geology must be taken, if these courses or equivalents have not previously been completed.

4. Demonstrate by examination his ability to read geologic literature in a foreign language. The examination must be passed no later than the date of filing for the Master of Science degree, and in any case, within the first three quarters of residence.

5. Demonstrate in one of the following ways his knowledge of basic principles and research methods in his 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:

- Petroleum engineering
- Materials science
- Mineral engineering
- Geophysics and structural geology
- Geomorphology and photogeology
- Mathematics and statistics
- Civil and industrial engineering
- Mechanical engineering and engineering mechanics
- Electrical engineering
- Economic geology
- Paleontology and stratigraphy
- Mineralogy
- Petrography and petrology
- Physics
- Chemistry and geochemistry
- Biology
- Business
- Law

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, and geophysics.

Requirements for the Degree — A minimum of three years (nine quarters) of graduate study must be satisfactorily completed. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. The candidate must demonstrate by examination his ability to read German or Russian and one other foreign language. The candidate is urged to learn these languages before starting graduate work. He should pass one of the foreign languages during the first year of graduate study. The second language should be passed before completion of the second year of graduate study. His record must indicate outstanding scholarship, and deficiencies in previous training must be removed. Although he need not obtain an M.S. degree, the candidate will be expected to have, or to obtain, a training approximately equivalent to the Stanford M.S. program. He must pass the Departmental oral examination. He must fulfill the requirements of the minor department, if a minor is elected. He must prepare under faculty supervision a dissertation which is a contribution to knowledge and the result of independent work. (The dissertation must be reasonably concise, prepared in a form suitable for publication of a part or the whole.) He must pass the University oral examination, which is centered around the dissertation problem.

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 year in which to submit their dissertations.

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.

#1. Physical Geology—Elementary study of the earth, particularly materials, structure, internal condition, physical and chemical processes at work upon it. Lectures, one 3-hour laboratory period per week; field excursion(s). Fee required for excursion expenses. (Students who have taken Physical Science 3 will receive only 3 units credit for Geology 1.)

5 units, Aut (Compton) MWF 8; lab, field trips by arrangement
Win (Page) MWF 9; lab., field trips by arrangement
Spr (Davis) MWF 8; lab., field trips by arrangement
Sum (8 weeks), ( ) MTWThF 10; lab., field trips by arrangement

#2. Historical Geology—Principles of interpretation of earth history. Evolution of continents, oceans, mountain systems, other features of the earth; development of its animal, plant inhabitants. Prerequisite: 1.

5 units, Win (Graham) MWF 8; lab., field trips by arrangement
Spr ( ——) MWF 9; lab., field trips by arrangement

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

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

105. Structural Geology—Nature and origin of faults, folds, and structures of metamorphic and plutonic rocks. Deformation of the earth's crust. Prerequisites: 1 and 51.

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

106. Physical Oceanography — Prerequisites: Mathematics 22 and Chemistry 3.

4 units, Spr ( ——) MTWTh 8
107. Geologic Field Techniques—Introduction to geologic field methods, instruments. Prerequisites: 51 and 105 (the latter may be taken concurrently).
3 units, Spr (Rich) by arrangement

108. Field Geology I—First half of summer (mid-June to mid-July) will be spent in an area consisting mainly of sedimentary rocks, generally in one of the California coast ranges. Geology will be plotted on topographic maps and aerial photographs. A report, prepared at Stanford during the latter half of August, will include a complete stratigraphic and structural description of the entire area covered by the class. (For second half of summer field work, see 109.) (Open to women students if two or more women register.) Prerequisites: 51, 105, and 107.
8 units, Sum (first half) (Compton)

109. Field Geology II—Second half of field season (mid-July to mid-August) will be spent in Nevada or eastern California, in an area of metamorphic and igneous rocks. (Open to women students if two or more women register.) Prerequisite: 108.
7 units, Sum (second half) (Compton)

133. Principles of Geomorphology—Landforms; processes which create, modify them. Prerequisite: 1. Recommended: 2, 51, and 171.
4 units, Aut (Howard) MWF 9; lab.
F 1:15–4:05; field trips by arrangement

134. Map Interpretation and the Scientific Method—Topographic maps provide basic data for application of the scientific method in interpretation of geologic structure and local and regional geomorphic development. Prerequisite: 133 (may be taken concurrently).
4 units, Win (Howard) MWF 10; lab.
F 1:15–4:05

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. Introduction to Mechanics of Earth Materials—Elementary stress, strain, and strain-rate relations for elastic, plastic, and viscosity models. Includes theories of failure and applications to various geologic and mining phenomena. Prerequisite: Calculus.
3 units, Aut (Johnson) by arrangement

3 units, Win (Johnson) by arrangement

204. Computer Applications in the Earth Sciences—Introduction to use of high-speed digital computers, including preparation of programs. Development of mathematical simulation as an experimental tool, particularly in dealing with problems not amenable to direct experimentation. Applications to economic geology, paleontology, sedimentation, petrology, mineral engineering, and geomorphology.
3 units, Win (Harbaugh) MWF 11

205. Statistical Problems in Earth Sciences—Estimation of frequency distribution of minerals and of total ore tonnage, identification of minerals by remote sensing, design of field sampling procedures, evaluation of map accuracy, and other topics chosen from participants' interests. No prerequisites.
3 units, Spr (Switzer) by arrangement

5 units, Win (Hubbert) MTWThF 11

210. Geology of California.
3 units, Spr (Muller), TTh 11
F 1:15–4:05
235. Photogrammetry and Photogeology—Photogrammetric principles, practices applicable to geology; geologic interpretations from air photos. Registration limited. See instructor before enrolling.

5 units, Spr (Howard) MWF 10; lab. W 1:15–4:05 and one lab. by arrangement

301. Problems in Various Fields of Geology and Geochemistry.

Each quarter (Staff) by arrangement

305. Seminar in Theoretical Foundations of Geology.

2 units, Win (Hubbard) by arrangement

320. Advanced Structural Geology—Significant topics of structure and orogenesis. Two lectures and one seminar per week, plus reading and term report. Prerequisite: 105 or equivalent.

3 units, Aut (Page) TTh 9; seminar W 4:00–5:30

337. Seminar in Geomorphology.

2 units, Win (Howard) by arrangement

361. Permafrost (Geocryology)—Engineering problems in permanently frozen ground. Open to graduate students; others by permission of instructor.

2 units, Spr (Mutter) W 1:15–3:05

400. Research in Various Fields of Geology and Geochemistry.

Each quarter (Staff) by arrangement

MINERALOGY, PETROLOGY, AND GEOCHEMISTRY

25. Elementary Mineralogy and Crystallography—Rudiments of crystal structure, morphology and symmetry. Crystal classes and the stereographic projection. Properties of some of the more common rock-forming and ore-forming minerals. Introduction to the chemistry of silicates and mineral associations. Prerequisites: 1 and/or Chemistry 1 (either may be taken concurrently).

5 units, Aut (——) TTh 10; lab. TTh 1:15–4:05 and one lab. by arrangement


5 units, Win (Dickinson) TTh 9; lab. TTh 1:15–4:05 and one lab. by arrangement, optional field trip by arrangement


3 units, Spr (Dickinson) TTh 10; one lab., field trip by arrangement

171. Introduction to Geochemistry—Application of elementary chemical principles to geologic problems. Prerequisites: 1, Chemistry 3, and Geology 25; the last may be taken concurrently.

3 units, Aut (Krauskopf, ———) MWF 9

207. Advanced Sedimentary Petrology—Characteristics, origin of sedimentary rocks as deduced from petrographic and field studies. Prerequisites: 221 and 157 (the latter may be taken concurrently).

4 units, Spr (Dickinson) M 1:15–4:05; two labs. 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: 25 and Physics 55, or equivalents.

5 units, Aut (Hutton) TTh 11; lab. TTh 1:15–4:05 and one lab. by arrangement

221. Petrography—Use of petrographic microscope in identifying, classifying rocks; determining origin, geologic history of rocks and rock masses. Prerequisites: 51 and 220.

5 units, Win (Compton) MW 9; lab. TTh 1:15–4:05 and one lab. by arrangement

223. Mineralogy of Sediments—(a) Laboratory methods for fractionating sediments. (b) Systematic study of mineral particles, with special reference to those of high density. Prerequisites: 221, and permission of instructor.

5 units, Spr (Hutton) Th 11; lab. TTh 1:15–4:05 and two labs. by arrangement

224. Advanced Petrology—Advanced topics of igneous and metamorphic petrology. Prerequisites: 105 and 221.

6 units, Spr (Compton) TTh 9; lab. W 1:15–4:05 and two labs. by arrangement

225. Advanced Mineralogy—(a) Survey of methods for mineral diagnosis. (b) Syste-
matic study of the more important rock-forming and ore minerals. Prerequisites: 221, Chemistry 110, 111, and permission of instructor.

7 units, Win (Hutton) TTh 10–12; lab. TTh 1:15–4:05 and one lab. by arrangement

240. Electron Microprobe Analysis.
3 units, Spr (——) by arrangement

271. Geochemistry—Application of physical chemistry to geologic problems. Distribution of chemical elements in geologic environments. Prerequisites: 51 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

272. Spectrochemical Analysis—(Enroll in Mineral Engineering 272.) Fundamentals of spectrochemical analysis and its application to study of rocks and minerals. (Enrollment limited to 6.) Prerequisite: consent of instructor required.

5 units, Win (Staff) MW 10; lab. MW 1:15–4:05 and one lab. by arrangement


3 units, Spr (Staff) three 3-hour labs. by arrangement

310. Phase Relations in One and Two Component Systems of Petrologic Interest—Geometry of binary phase diagrams in which pressure, temperature, and composition are the variables.

2 units, Aut (Tuttle) by arrangement

311. Phase Relations in Three and Four Component Systems of Petrologic Interest—Continuation of 310, with emphasis on condensed systems. Prerequisite: 310.

2 units, Spr (Tuttle) by arrangement

312. Laboratory Methods for Phase Equilibria Studies at High Pressures and Temperatures—Two 3-hour labs.; enrollment limited to 8 students. Prerequisite: 311.

2 units, Sum (10 weeks) (Tuttle) by arrangement

327. Seminar in Igneous Petrology.
2 units, Win (Jahns) by arrangement

371. Geochemistry of Ore Solutions—Prerequisites: 271 and 281.
2 units, Spr (Krauskopf) by arrangement

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

PALEONTOLOGY AND STRATIGRAPHY

111. Curatorial Methods in Paleontology.
1 unit, Spr (Keen) by arrangement

112. Elementary Paleontology—Prerequisite: 2.
5 units, Aut (Evitt) MWF 10; lab. W 2:15–5:05 and one lab. by arrangement

115. Biological Oceanography.
4 units, Aut (Keen) MTWTh 9

119. Vertebrates of the Past—A survey for nonspecialists. Distinctive characters, specializations for particular modes of life, evolutionary history, distribution in space and time of major vertebrate groups. No prerequisites.

3 units, Spr (Evitt) MWF 11

160. Elementary Stratigraphy—Classification of stratigraphic units, facies, unconformities, and principles of correlation. Prerequisite: 105. Recommended: 112.

3 units, Win (——) TTh 10; lab. M 1:15–4:05

213. Cenozoic Invertebrate Paleontology—Mollusca, Echinodermata, Coelenterata. Prerequisite: 112.
4 units, Win (Keen) MWF 11; lab. W 2:15–5:05 and two labs. by arrangement

214. Paleozoic Invertebrate Paleontology—Brachiopods, Graptolites, Trilobites. Prerequisite: 112.
4 units, Aut (Evitt) TTh 9; two labs. by arrangement, alternate years, given 1967–68

217. Mesozoic Invertebrate Paleontology—Prerequisite: 112.
4 units, Win (——) TTh 9; two labs. by arrangement, alternate years, given 1966–67

218. Introduction to Micropaleontology—Principles, techniques of preparation, classification of various fossil plants and animals.
Two lectures and two laboratory periods per week.

5 units, Aut (Graham) lec. and lab.
by arrangement

316. Introduction to Palynology—Study of microfossils smaller than 200 microns.
5 units, Win (Evitt) by arrangement

317. Stratigraphic Palynology — Continuation of 316.
5 units, Spr (Evitt) by arrangement

2 units, each quarter (Staff)

Readings in Paleobotany—See Biology 170.
Biogeography—See Biology 174.

ECO NO M I C G E OLOGY

120. Mine Exploration—(Enroll in Mineral Engineering 120.) — Lectures, discussion, seminar. A survey of how mines are found, including prospector, geological and geophysical methods; organization, and economic aspects. Prerequisite: Geology 105.
3 to 4 units, Win (Just) by arrangement

3 units, Win (Staff) by arrangement

215. Mineral Economics—(Enroll in Mineral Engineering 215.) Lectures, discussions on property acquisition, valuation, financing, marketing, geography, accounting, taxation, conservation, stabilization, government activities, international affairs, and labor relations pertaining to minerals, including petroleum, natural gas, and coal; surveys of individual minerals as commodities.
3 to 4 units, Aut (Just) by arrangement

281. Ore Deposits — Principles of occurrence, processes of deposition, structure of ores. Prerequisites: 51 and 105.
5 units, Aut (Park) MTWTh 10; lab., field trips by arrangement

4 units, Win (Park) M 1:15–4:05; two labs. and one seminar by arrangement

284. Engineering Geology—Application of geology to engineering practice in construction of dams, highways, foundations, etc. Prerequisite: 1. Recommended: 25, 51, and 105.
3 units, Aut (Jahns, Johnson) TTh 8; lab. by arrangement

5 units, Win (Davis) MWF 8; seminar M 2:15–4:05; lab. W or Th 1:15–4:05

286. Development of Ground-Water Resources—Numerical, graphical analysis of pumping tests; interpretation of well hydrographs; field techniques used in groundwater surveys. Prerequisite: 285.
3 units, Spr (Davis) TTh 11; lab. by arrangement

287. Minerals, Politics, and Economics — Mineral resources of the world; their political, economic effects.
3 units, Win (Park) MWF 9

383. Genesis of the Metallic Ores — Advanced study of mineral, district collections; emphasis on genesis, localization control. Prerequisite: 283.
6 units, Spr (Park) MF 1:15–4:05; two labs. by arrangement

387. Seminar in Ore Deposits—Class is organized as a Board of Directors to which mineral propositions are presented.
2 units, Aut (Park) by arrangement

487. Seminar in Hydrogeology.
2 units, Aut (Davis) by arrangement

GEOPHYSICS

Executive Head: Joshua L. Soske
Professors: Joshua L. Soske, George A. Thompson
Associate Professors: Robert L. Kovach, Ronald J. P. Lyon
Acting Assistant Professor: Chapman Young III
Research Associates (By Courtesy): William E. Bell, Allan V. Cox, Richard R. Doell, David G. Willis

OFFERINGS AND FACILITIES

Geophysics relates to that phase of earth science dealing with exploration for economic mineral resources and studies of the physics of the earth. 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. Qualified students are encouraged to take some graduate study because the broad scope of geophysics includes fundamentals of geology, mathematics, physics, and engineering. The objectives of the graduate program are to prepare students for positions in the exploration industry, geophysical research programs, governmental work, and education. The physical facilities for graduate study include the Henry Salvatori Laboratory of Geophysics. Graduate programs lead to the degree of Master of Science, and Doctor of Philosophy.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The following requirements for the degree of Bachelor of Science in Geophysics are in addition to the University requirements in general studies. It should be noted that the Department of Geophysics has a specific requirement in foreign language. The general University requirement is completion of either Mathematics 23 or a course numbered 23 in a foreign language, but the Department of Geophysics requires completion of a language sequence in addition to mathematics. Any modern language is accepted in fulfillment of this requirement, but German is recommended.

In addition to General Studies courses and foreign language, the following courses are required of all students:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 1, 2, 3. General Chemistry</td>
<td>AWS</td>
<td>13</td>
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<tr>
<td>Mathematics 10, 11, 21, 22, 23, or 41, 42, 43, and 44. Analytical geometry and calculus</td>
<td>Any</td>
<td>18</td>
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<tr>
<td>Mathematics 130. Ordinary Differential Equations</td>
<td>A or W</td>
<td>3</td>
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<tr>
<td>Mathematics 131. Partial Differential Equations</td>
<td>W</td>
<td>3</td>
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<td>Geology 1. Physical Geology</td>
<td>Any</td>
<td>5</td>
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<td>Geology 2. Historical Geology</td>
<td>W or S</td>
<td>5</td>
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<tr>
<td>Geology 25. Mineralogy</td>
<td>A</td>
<td>4</td>
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<tr>
<td>Geology 51. Elementary Petrology</td>
<td>W</td>
<td>5</td>
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<tr>
<td>Geology 171. Geochemistry</td>
<td>A</td>
<td>3</td>
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<td>Geology 105. Structural Geology</td>
<td>S</td>
<td>5</td>
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<td>Geology 107. Geologic Field Techniques</td>
<td>S</td>
<td>3</td>
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<tr>
<td>Geology 108, 109. Field Geology (See Note 1)</td>
<td>Summer</td>
<td>15</td>
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<tr>
<td>Geophysics 190, 191. Elementary Geophysics</td>
<td>AW</td>
<td>6</td>
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<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>WSA</td>
<td>15</td>
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<tr>
<td>Physics 57. Atomic Physics</td>
<td>W</td>
<td>3</td>
<td></td>
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<tr>
<td>Physics 61. Optics and Wave Motion</td>
<td>S</td>
<td>3</td>
<td></td>
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<tr>
<td>Physics 110, 111. Mechanics</td>
<td>WS</td>
<td>6</td>
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Note 1.—A student who takes Geology 108 and 109 during the summer following his junior year will normally graduate at the end of winter quarter in his senior year.

As electives in the Geophysics Curriculum, the following courses are recommended: Geology 106, 209, 220, 221, 271; Physics 120, 121, 122 and Mathematics 45, 46, 132.

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.
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 by examination his ability to read geologic literature in a foreign language. The examination must be passed no
later than the date of filing for the Master of Science degree.

**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 graduate study must be satisfactorily completed. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. Candidates are urged to complete Physics 210, 211, 212 or Applied Physics 213, 214, 215. In addition, candidates are encouraged to take advanced course work selected from the following disciplines: Communication Theory, Electromagnetic Theory, Advanced Mechanics, Geology, Geophysics, Physics of Solids, Quantum Mechanics, Numerical Analysis, Plasma Physics, and Astrophysics. The candidate must demonstrate by examination his ability to read German and one other foreign language. His record must indicate outstanding scholarship, and deficiencies in previous training must be removed. He must pass the Departmental oral 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**

**190. General Geophysics** — Elementary study of gravitational, magnetic, seismic, electrical, and thermal properties of the earth. Potential theory is introduced. Prerequisites: Geology 105, Mathematics 22, and Physics 55; any or all of these courses may be taken concurrently with 190.

*3 units, Aut (Thompson) MWF 11*

**191. Procedures of Geophysical Exploration**—Geological applications, possibilities, limitations of the several methods. Prerequisite: 190.

*3 units, Win (Soske) TTh 10; lab. by arrangement*

**250. Rock Magnetism and the Geomagnetic Field**—Origin of magnetism in rocks, origin of earth's field; basic background for research in paleomagnetism.

*3 units, Win (——) MWF 11*

**291. Magnetic Measurements**—Theory, use of field magnetic measurements as an aid to geological investigations. Prerequisites: Geology 107, 182, Mathematics 23, and Physics 55.

*3 units, Aut (Soske) TTh 10; 3-hour lab. by arrangement*


*3 units, Spr (——) TTh 9; lab. by arrangement*

**293. Electrical Methods** — Principles and applications of electrical and electro-magnetic techniques to geophysics. Prerequisites: Geology 107, Physics 53, and Mathematics 130.

*3 units, Win (Kovach) two lecs., 3-hour lab., by arrangement; alternate years, given 1967–68*


*4 units, Spr (Soske) TTh 11; two 3-hour labs. by arrangement*

**295. Advanced General Geophysics**—A discussion of the available data of seismology, geodesy, heat flow and high pressure laboratory work in the understanding of the properties of planetary interiors. Prerequisite: Geophysics 190.

*3 units, Spr (Kovach) three lecs., by arrangement*
296. Remote Geologic Sensing — Examination of relationships between ultraviolet, visible, infrared, microwave, and radar electromagnetic signatures from rocks, soils, vegetation, and oceans. Analysis in the laboratory of spectral data and imagery; work with infrared instrumentation. Previous photogeological experience is recommended.

2 units, Win (Lyon) T 1:15; lab.
T 2:15–4:05

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

328a,b. Theoretical Structural Geology — Structural deformation studied as a physical process: elastic, nonelastic properties of rocks; theories of flow, rupture; stress analysis; scale models; geophysical, geological evidence bearing on origin of major earth structures. Prerequisites: 190 and Geology 105.

328a. 3 units, Win (Thompson) MW 9; seminar by arrangement
328b. 3 units, Spr (Thompson) MW 9; seminar by arrangement

397. Seminar in Geophysics.
2 units, any quarter (Staff) by arrangement

400. Research in Geophysics.
Each quarter (Staff) by arrangement

MINERAL ENGINEERING

Emeritus: Welton J. Crook, Evan Just (Professors)
Executive Head: To be announced.
Professor: Norman A. Parlee
Associate Professor: George A. Parks (on leave autumn and winter quarters)
Assistant Professor: Arvid M. Johnson

Members of the faculties of other divisions of the University giving courses or cooperating in the offerings of the Department of Mineral Engineering are O. Cutler Shepard, David A. Stevenson, Paul Switzer, and William A. Tiller.

The Mineral Engineering curricula are designed for the threefold purpose of making graduates competent in the technology of mining, mineral processing, and chemical and extractive metallurgy, qualifying them for promotion to executive status in the mineral industry, and producing versatility in basic sciences, engineering, and business to cope with changes in technology, human affairs, and personal experience. The Department offers courses in exploration, development, and mining of mineral deposits, in processing minerals for market, in extracting, refining and alloying of metals, and in mineral economics. Exceptions can be made, with Departmental permission, for students desiring more specialized study in narrower fields or those interested in academic or scientific rather than industrial careers.

UNDERGRADUATE PROGRAMS OF STUDY

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

Mineral Processing and Chemical and Extractive Metallurgy curricula are combined under the latter name. 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>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 4, 5</td>
<td>General Chemistry</td>
<td>8</td>
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<tr>
<td>Math. 41, 42, 43</td>
<td>Analytical Geometry and Calculus</td>
<td>15</td>
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<tr>
<td>Physics 51 to 56</td>
<td>Engineering Physics</td>
<td>15</td>
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<tr>
<td>English 1, 2, 3</td>
<td>Freshman English</td>
<td>9</td>
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<tr>
<td>History 1, 2, 3</td>
<td>History of Western Civilization</td>
<td>12</td>
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<tr>
<td>Econ. 1</td>
<td>Elementary Economics</td>
<td>5</td>
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<tr>
<td>Social Sciences (Psychology 1 recommended)</td>
<td>5</td>
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<tr>
<td>Humanities (English 7 or 9, Art 1, or Music 1 recommended)</td>
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<td>Group Activities (General Studies Requirement)</td>
<td>(6)</td>
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<tr>
<td>Engr. 11</td>
<td>Engineering Mechanics</td>
<td>2</td>
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<tr>
<td>Engr. 12</td>
<td>Engineering Mechanics</td>
<td>4</td>
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<tr>
<td>Engr. 15</td>
<td>Mechanics of Materials (See Note 1)</td>
<td>3</td>
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<tr>
<td>Engr. 21</td>
<td>Mechanics of Fluids (See Note 2)</td>
<td>4</td>
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<tr>
<td>Engr. 41 and 42</td>
<td>Circuits, Electronics, and Electromechanics</td>
<td>8</td>
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<tr>
<td>Speech 20</td>
<td>Public Speaking: Practice and Criticism</td>
<td>3</td>
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<tr>
<td>Geol. 1</td>
<td>Physical Geology</td>
<td>5</td>
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<tr>
<td>Geol. 25</td>
<td>Elementary Mineralogy</td>
<td>4</td>
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<tr>
<td>Geol. 204</td>
<td>Computer Applications in Earth Sciences</td>
<td>3</td>
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<tr>
<td>Min.E. 100</td>
<td>Industrial Report</td>
<td>1</td>
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<tr>
<td>Min.E. 101</td>
<td>Elements of Mining</td>
<td>3</td>
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<tr>
<td>Min.E. 103</td>
<td>Principles of Mineral Processing</td>
<td>4</td>
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<tr>
<td>Min.E. 105</td>
<td>Extractive Metallurgy Processes</td>
<td>3</td>
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<tr>
<td>Min.E. 175 or 176</td>
<td>Field Trip</td>
<td>3</td>
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<td>Total</td>
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<td>124</td>
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</table>
MINING OPTION

Course No. Subject Units
Geol. 51. Elementary Petrology 5
Geol. 105. Structural Geology 5
Geol. 281. Ore Deposits 5
Engr. 9. Engineering Drawing 4
Engr. 161. Engineering Economy 3
Min.E. 114. Elementary Problems in Mining Engineering 2
Min.E. 118. Mining Methods 2
Min.E. 120. Mine Exploration 3
Min.E. 200. Introduction to the Mechanics of Earth Materials 3
C.E. 20. Elementary Surveying 3
C.E. 245. Advanced Construction Equipment and Methods 3
C.E. 180. Elementary Structural Analysis 4
I.E. 133. Industrial Accounting 4
Electives 10
Total: 56

CHEMICAL AND EXTRACTIVE METALLURGY OPTION

Course No. Subject Units
Chem. 171, 173, 175, 176. Physical Chemistry 12
Ch.E. 10. Introduction to Chemical Engineering 3
Ch.E. 130b. Transport Phenomena 3
Engr. 50. Introductory Science of Materials 3
Math. 44. Advanced Calculus 3
Math. 130. Ordinary Differential Equations 3
Mat.Sci. 121. Mass Transport 3
Mat.Sci. 122. Solid State Thermodynamics 3
Mat.Sci. 124. Phase Equilibria 3
Mat.Sci. 125. Structural Transformation in Materials, or Min.E. 225. Surfaces and Interfaces, or Min.E. 227. Equilibria and Kinetics in Aqueous Systems 3-4
Min.E. 216. Mineral Processing Seminar (Engineering), or Min.E. 228. Extractive Metallurgy Seminar (See Note 3) 9-10
Electives 12-13
Total: 56

MANAGEMENT OPTION

This option is recommended for students interested in futures in mining industry management, to be coupled with a fifth year—Master's degree—emphasizing economic aspects of mining and metallurgy and courses in the Graduate School of Business.

Course No. Subject Units
Econ. 5. Economics of Prices and Markets 5
Engr. 161. Engineering Economy 3
I.E. 133. Industrial Accounting 4

Lang. 1, 2. Modern European Language 8
and Group A or B below:
A (Mining)
- Geol. 51. Elementary Petrology 5
- Geol. 105. Structural Geology 5
- Geol. 281. Ore Deposits 5
- Min.E. 114. Elementary Problems in Mining Engineering, or Min.E. 118. Mining Methods 2
- Min.E. 120. Mine Exploration 3
- Electives 11

Total: 56

B (Chemical and Extractive Metallurgy)
Chem. 171, 173. Physical Chemistry 6
Engr. 50. Introductory Science of Materials 3
Min.E. 216. Mineral Processing Seminar (Engineering), or Min.E. 228. Extractive Metallurgy Seminar (See Note 3) 9-10
Electives 12-13
Total: 56

RECOMMENDED ELECTIVES

Course No. Subject Units
Chem. 121. Organic Chemistry 3
I.E. 152. Introduction to Operations Research 3
Geol. 171 and 271. Geochemistry 6
Mat.Sci. 105. Imperfections in Crystalline Solids 3
Min.E. 200. Introduction to the Mechanics of Earth Materials 3
I.E. 133. Industrial Accounting 3
Phys. 57. Atomic Physics 3

Mining Option

Chem 171. Physical Chemistry 3
Geol. 107. Geologic Field Techniques 2
Geophys. 190. General Geophysics 3
C.E. 240. Construction Planning 2

Chemical and Extractive Metallurgy Option

Engr. 161. Engineering Economy 3
Geol. 283. Microscopic Study of Ore Minerals 3
Mat.Sci. 105. Imperfections in Crystalline Solids 3
Min.E. 200. Introduction to the Mechanics of Earth Materials 3
I.E. 133. Industrial Accounting 3

Note 1.—Engineering 11, 12, and 15 can be replaced by Mathematics 130 and Physics 110 and 111.
Note 2.—Chemical Engineering 130a may be substituted and is preferred in the Chemical and Extractive Metallurgy option.
Note 3.—Courses taken to satisfy this requirement must include at least one from the group Min.E. 106, 107, 109, and at least one from the group Min.E. 216 or Min.E. 228. Min.E. 204 may be used to complete the maximum unit requirement.
GRADUATE PROGRAMS OF STUDY

The Department of Mineral Engineering offers graduate programs to prepare students for responsible engineering, supervisory, research, and executive positions in the mining and metallurgical industries, or for governmental work or education. 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 Mineral Engineering recommends at least one year of graduate study.

Because the majority of mineral engineers 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 Mineral Engineering 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

Specific Requirements

1. Complete 45 units, at least 6 of which must be independent work on a research program properly reported; research work may include up to 24 units. Students must be registered in the graduate school for at least three quarters.

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.

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>Min.E. 215</td>
<td>Mineral Economics</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 300</td>
<td>Advanced Work</td>
<td>6</td>
</tr>
</tbody>
</table>

MINING OPTION

I.E. 133 or Business 210-11. Industrial or Management Accounting 4-6
Min.E. 211. Rock Mechanics Seminar 1-2
Min.E. 230. Mining Seminar 4
Min.E. 231. Mining Seminar 4
Min.E. 232. Mining Seminar 4
Electives 16-19

MINERAL PROCESSING OPTION

Min.E. 203. Advanced Solid Separations: Principles 4
Min.E. 216. Mineral Processing Seminar (Engineering) 2
Min.E. 217. Mineral Processing Seminar (Research) 2
Min.E. 225. Surfaces and Interfaces, or Min.E. 227. Equilibria and Kinetics in Aqueous Systems 3
Electives 22

CHEMICAL AND EXTRACTIVE METALLURGY OPTION

Min.E. 223. Equilibria and Kinetics in High Temperature Reactions 3
Min.E. 227. Equilibria and Kinetics in Aqueous Systems 3
Min.E. 228. Extractive Metallurgy Seminar 3
Min.E. 229. Principles of Steelmaking 3
Mat.Sci. Electives 6
Electives 18

MANAGEMENT OPTION

Bus. 200-01. Business Economics 6
Bus. 210-11. Management Accounting, or I.E. 133. Industrial Accounting 4-6
Bus. 371. Employment Relationships 3
Mineral Engineering Electives 8
Electives 7-9

ENGINEER

A minimum of two years (six quarters) of graduate study is required. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. The candidate must complete 90 units of course work, no more than 10 of which may be applied to overcoming deficiencies in undergraduate training. At least 30 units must be taken in advanced work, that is, work beyond the undergraduate requirements, in engineering and closely allied fields. The student must prepare a thesis meeting the approval of the supervising instructor and the University Committee on the Graduate Division.
Courses Required for the Engineer 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>
<tr>
<td>Stat. 110. Statistical Methods in Engineering</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>I.E. 252. Operations Research</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Min.E. 300. Advanced Work (Thesis)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>C.S. 136. Use of Automatic Digital Computers</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

* In addition to requirements for Master’s degree.

DOCTOR OF PHILOSOPHY

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

Prior to applying for admission to candidacy the students must (1) demonstrate mastery of his option and related subjects by passing a written qualifying examination usually taken during the first year of residence, and (2) within one year after passing the written examination, demonstrate a high level of proficiency in his option by passing a Departmental oral examination, and should he elect as his option Mineral Processing or Chemical and Extractive Metallurgy, (3) develop and demonstrate his ability to plan and execute research problems by successful treatment of short assigned projects while enrolled for a minimum of two units in course Min. E. 300. Candidates who take a Master of Science degree at Stanford may use their six-unit research requirements toward fulfillment of item (3).

UNDERGRADUATE COURSES

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

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

101. Elements of Mining—Introduction to mining. Prospecting, development, mine plant and equipment, mining methods, mine-engineering problems. Serves needs of engineering or geological student who seeks general knowledge of mining.

3 units, Aut (Staff) by arrangement

103. Principles of Mineral Processing—Study of mineral separation techniques and auxiliary operations aimed at recognizing the basic principles involved and the means by which they may be applied in practice. Topics include comminution, sizing, solid-liquid separations and gravity, magnetic, electrostatic, and flotation techniques of solid-solid separation. Prerequisites: Chemistry 5, Physics 55, and Mathematics 43.

4 units, Aut (Staff) MWF 11 and one lab. by arrangement

105. Extractive Metallurgy Processes—Introduction to metallurgical 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. In addition, Chemistry 173 is recommended.

2 to 3 units, Win (Parlee) by arrangement

106. Engineering Aspects of Mineral Processing—Directed reading and laboratory projects culminating in written reports. At least two projects selected from the following topics: comparison and selection among alternative operations, optimization, scale-up, quality control and automation. Offered in conjunction with 206. May be repeated with credit. Offered only on enrollment of four or more unless advance arrangements are made. Prerequisites: 103 or equivalent, required; Statistics 110 and Geology 204 recommended.

2 units, Win (Staff) by arrangement

107. High Temperature Laboratory—Lectures and laboratory projects relating to high temperature processes, atmosphere control, and vacuum technology; thermodynamic and kinetic measurements. Prerequisite: Chemistry 173 in special cases.)

2 units, Spr (Parlee) TTh 1:15-4:05, alternate years, given 1967–68

109. Separation Flowsheet Development—Techniques of examination of ores and plant products. Practice in choice of treatment, integration of operations and diagnosis of problems. May be repeated with credit. Offered only on enrollment of four or more unless advance arrangements are made. Prerequisite: 103 or equivalent, required. Materials Science 127 and Geology 220, or Geology 283 recommended.

2 units, Spr (Staff) by arrangement
114. Elementary Problems in Mining Engineering—Problems involved in mining practice, designed to supplement 101 as added work for those whose major interest is mining. Open to those concurrently registered in 101.

2 units, Aut (Staff) by arrangement

118. Mining Methods—To follow 101. Discussion, seminar, using case histories to illustrate methods, equipment, and costs. Prerequisite: 101.

2 units, Win (Staff) by arrangement

120. Mine Exploration—Lectures, discussion. A survey of how mines are found, including prospector, geological and geophysical methods, organization, and economic aspects. Prerequisite: Geology 105.

3 to 4 units, Win (Just) by arrangement


3 units, Aut (Stevenson) MWF11

175. Field Trip—A ten-day field trip to various mining and metallurgical operations, including Ruth and McGill, Nevada; Bingham, Garfield, Tintic, Price and Moab, Utah; and Mt. Pass, California. This or 176 required of all candidates for the Bachelor of Science degree in Mineral Engineering. Given in alternate years with 176.

3 units, Spr vacation (Staff) by arrangement, alternate years, given 1967–68

176. Field Trip—Similar to 175 except to mining and metallurgical operations in California and Arizona, including New Idria, San Manuel, Ray, Hayden, Christmas, Pima, Magma, Mission, Iron King, Eagle Mountain, and Boron.

3 units, Spr vacation (Staff) by arrangement, alternate years, given 1966–67

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

GRADUATE COURSES

200. Introduction to the Mechanics of Earth Materials—Elementary stress, strain, and strain-rate relations for elastic, plastic, and viscosity models, and for simple combinations of them. Includes theories of failure and applications of the relations to various geologic and mining phenomena. Separate lectures for two options. Option for students in geology: Applications of the relations to folding, faulting, landsliding, earth and glacier flow, intrusion of dikes, and jointing. Option for students in mining and engineering geology: Applications of the models to analysis of stresses around underground openings, strata control, subsidence and landsliding. Prerequisite: Calculus.

3 units, Aut (Johnson) by arrangement

201. Principles and Methods of Crystal Growth—(Enroll in Materials Science 201.) 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, Spr (——) MWF 9


3 units, Win (Johnson) by arrangement

203. Advanced Solid Separations: Principles—A sequel to 103. Advanced study of separation and auxiliary operations as listed under 103. Emphasis on use of elementary physical inorganic chemistry and solid state physics in critical study of principles. May be taken for 1 unit by students who have previously taken 103. Prerequisite: 103 or equivalent. Chemistry 175, Geology 25, and Engineering 50 recommended.

4 units, Aut (Staff) MWF11; one recitation section by arrangement

204. Physical Chemistry of Metal Refining—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. Prerequisite: 105, or Chemistry 173 or equivalent.

3 units, Aut (Parlee) by arrangement

205. Statistical Problems in Earth Sciences — (Enroll in Geology 205.) Estimation of frequency distribution of minerals and of total ore tonnages, identification of minerals by remote sensing, design of field sampling procedures, evaluation of map accuracy, and other topics chosen from participants' interests.

3 units, Spr (Switzer) by arrangement

206. Advanced Solid Separations: Engineering — Advanced independent study of topics listed under 106. Offered in conjunction with 106 under the same conditions. Added prerequisites: 203 and 205.

2 units, Win (Staff) by arrangement

209. Separation Flowsheet Development — Advanced treatment of material described under 109. Offered in conjunction with 109 under the same conditions. Prerequisites: Materials Science 127, and Geology 220, or Geology 283.

2 units, Spr (Staff) by arrangement

211. Rock Mechanics Seminar — Weekly meetings for critical review of current literature and research. Occasional guest speakers. May be repeated. Prerequisite: 200 or permission of instructor.

1 to 2 units, Aut, Win (Johnson) by arrangement

215. Mineral Economics — Lectures, discussions on property acquisition, valuation, financing, marketing, geography, accounting, taxation, conservation, stabilization, government activities, international affairs, and labor relations pertaining to minerals, including petroleum, natural gas, and coal; surveys of individual minerals as commodities.

3 to 4 units, Aut (Just) by arrangement

216. Mineral Processing Seminar (Engineering) — Lectures, guest speakers, and student seminars on Mineral Processing topics, emphasizing engineering and economic aspects. Open to undergraduates by permis-


1 to 2 units, Win, Sum (Staff) by arrangement

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

2 units, Spr (Just) by arrangement

222. Statistical Thermodynamics — (Enroll in Materials Science 222.) Systematic development of the methods of statistical mechanics. Applications to problems in Materials Science. Prerequisite: Materials Science 122.

3 units, Spr (Stevenson) MWF

223. Equilibria and Kinetics in High Temperature Reactions — Gas-metal reactions. Metallic solution reactions. Multi-phase reactions. Prerequisite: 105 or Chemistry 173. In addition, Mineral Engineering 204 or 229, or Materials Science 122 also recommended.

3 units, Sum (Parlee) by arrangement, alternate years, given 1967–68

224. Physical Chemistry of Metals Seminar — Lectures, student seminars, guest speakers on topics in the physical chemistry of metals and in properties of liquid metals. Can be repeated with credit.

1 to 3 units, Sum (Parlee) by arrangement, alternate years, given 1966–67

225. Surfaces and Interfaces — A general study of solid-gas and solid-electrolyte interfaces. Applications in froth flotation or other topics selected by the individual, such as surface conduction and the role of surfaces in mechanical behavior. Prerequisites: Chemistry 175 and Materials Science 122.

3 units, Spr (Parks) three lecs. by arrangement, alternate years, given 1966–67

226. Corrosion and Electrometallurgy — (Enroll in Materials Science 226.) Electrochemical principles with applications to corrosion, electrolytic processes and energy
conversion cells. Prerequisite: Chemistry 173.

3 units, Win (Shepard) MWF 11

227. Equilibria and Kinetics in Aqueous Systems—Review and development of concepts useful in predicting probability, extent and rate of heterogeneous reactions involving one aqueous phase. Applications in hydrometallurgy or other topics chosen by the student. Prerequisites: either Chemistry 173 and Materials Science 122 or Chemistry 173 and Geology 171.

3 units, Spr (Parks) three lecs. by arrangement, alternate years, given 1967–68

228. Extractive Metallurgy Seminar — Student seminars, discussions, and guest speakers on various aspects of chemical and extractive metallurgy.

2 to 3 units, Spr (Parlee) by arrangement, alternate years, given 1967–68

229. Principles of Steelmaking—Systematic development of the physical chemistry underlying ironmaking and steelmaking processes. Treatment generalized to promote understanding of the physical chemistry of other metals as well. Seminar treatment of important processes. Prerequisite: 105 or Chemistry 173 in special cases.

3 units, Win (Parlee) by arrangement, alternate years, given 1967–68


4 units, Aut (Staff) by arrangement

231. Mining Seminar — Case histories, economics.

4 units, Win (Staff) by arrangement

232. Mining Seminar — Valuation, law, organization.

4 units, Spr (Staff) by arrangement

272. Spectrochemical Analysis — Fundamentals of spectrochemical analysis and their application to study of rocks and minerals. Enrollment limited to 6. Prerequisite: Consent of instructor.

5 units, Win (Staff) MW 10; lab. MW 1:15–4:05 and one lab. by arrangement

273. Advanced Spectrochemical Analysis—Enrollment limited to 6. Prerequisite: 272.

3 units, Spr (Staff) three 3-hour labs. by arrangement

287. Minerals, Politics and Economics — (Enroll in Geology 287.)

300. Advanced Work in Mining or Metallurgical Engineering — Individual work on a research problem in mining, mineral processing, or chemical and extractive metallurgy.

Each quarter (Staff) by arrangement

PETROLEUM ENGINEERING

Emeritus: Frederick G. Tickell (Professor)
Executive Head: Frank G. Miller
Professors: Sullivan S. Marsden, Jr., Frank G. Miller, Henry J. Ramey, Jr.
Visiting Lecturers: Robert C. McFarlane, Thomas D. Mueller
Research Associate (By Courtesy): Marshall B. Standing

OFFERINGS

The study programs of the Department of Petroleum Engineering are designed to make 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 (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, staff offices, and office study space for graduate students.

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 each of the fields of mathematics, chemistry, physics, and mineral science 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, Chem. 4, 5</td>
<td>General Chemistry, or Chem. (Quantitative Treatment)</td>
<td>13 or 8</td>
</tr>
<tr>
<td>Chem. 171</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23, 44</td>
<td>Analytical Geometry and Calculus</td>
<td>18</td>
</tr>
<tr>
<td>(Mathematics 40 series may be substituted for the 20 series)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>C.S. 5</td>
<td>Computer Programming, or C.S. 136. Automatic Digital Computers</td>
<td>2 or 3</td>
</tr>
<tr>
<td>English 1, 2, 3</td>
<td>Freshman English</td>
<td>9</td>
</tr>
<tr>
<td>History 1, 2, 3</td>
<td>History of Western Civilization</td>
<td>12</td>
</tr>
<tr>
<td>Physics 51, 53, 55</td>
<td>Mechanics, Sound, Electricity, Light, and Heat</td>
<td>12</td>
</tr>
<tr>
<td>Physics 52, 54, 56</td>
<td>Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 20</td>
<td>Elementary Surveying, or Geol. 107. Geologic Field Techniques</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 9</td>
<td>Engineering Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 11</td>
<td>Engineering Mechanics (Statics)</td>
<td>2</td>
</tr>
<tr>
<td>Engr. 12</td>
<td>Engineering Mechanics (Dynamics)</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 15</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 21</td>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 31</td>
<td>Elementary Engineering Thermodynamics</td>
<td>5</td>
</tr>
<tr>
<td>Engr. 41</td>
<td>Circuits, Electronics, and Electromechanics</td>
<td>4</td>
</tr>
<tr>
<td>Geol. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 1</td>
<td>Physical Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 2</td>
<td>Historical Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 25</td>
<td>Elementary Mineralogy and Crystallography</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 51</td>
<td>Petrology or Geol. 157. Sedimentary Petrology</td>
<td>5 or 3</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Pet.E. 103</td>
<td>A Survey of the Petroleum Industry</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 100, Petroleum Reservoir Fluids Laboratory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pet.E. 150a, 150b, 150c</td>
<td>Formation Evaluation</td>
<td>8</td>
</tr>
<tr>
<td>Pet.E. 151a</td>
<td>Petroleum Reservoir Fluids</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 151b</td>
<td>Fluid Behavior in Reservoir Rocks</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 152</td>
<td>Development and Production Technology</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 153</td>
<td>Development and Production Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>Pet.E. 160</td>
<td>Report on Oil Field Training</td>
<td>1</td>
</tr>
<tr>
<td>Social Sciences* (General Studies Requirement)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Group Activity (General Studies Requirement)</td>
<td>6</td>
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<tr>
<td>Humanities (General Studies Requirement)</td>
<td>8</td>
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<tr>
<td>Restricted Electives</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

*Economics 1 is recommended for partial fulfillment of the Social Sciences requirement.

**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 five years of college study. The demand for men with this background exceeds the supply. As a result, there are many attractive employment opportunities.

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 of these units must be independent work on a research problem. Units from courses with grades of D will not be counted toward the required 45 units of work, and the average of all grades must be a B or better.

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>
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<tr>
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<tbody>
<tr>
<td>fE.M. 251</td>
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<td>Formation Evaluation</td>
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</tr>
<tr>
<td>Group Activity (General Studies Requirement)</td>
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<td>Humanities (General Studies Requirement)</td>
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<tr>
<td>Restricted Electives</td>
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*Economics 1 is recommended for partial fulfillment of the Social Sciences requirement.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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<tr>
<td>Pet.E. 267</td>
<td>Engineering Valuation and Appraisal of Oil and Gas Properties</td>
<td>3</td>
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<tr>
<td>Pet.E. 270a</td>
<td>Elements of Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270b</td>
<td>Applications of Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 270c</td>
<td>Applications of Oil Reservoir Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 271</td>
<td>Advanced Production and Reservoir Engineering Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>Pet.E. 272a</td>
<td>Natural Gas Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 272b</td>
<td>Natural Gas Engineering</td>
<td>3</td>
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<td>Electives*</td>
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<td>9</td>
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<td>Total</td>
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<td>45</td>
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</table>


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

**Doctor of Philosophy**

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

A minimum of three years (nine quarters) of graduate study must be satisfactorily completed. At least one of these years, ordinarily the last, must be spent as a registered student at Stanford. The candidate must demonstrate by examination his ability to read two foreign languages: Russian or German plus French or Spanish. His record must indicate outstanding scholarship. He must pass the Departmental oral 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 re-apply for admission to candidacy and retake the Departmental 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 offshore 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 (Marsden) TWF 11

108. Petroleum Reservoir Fluids Laboratory—Laboratory, lectures. Physical properties of petroleum and its products, including
distillation with fractionation, gravity, viscosity, surface tension. Heat of combustion and specific gravity of natural gas. Infrared absorption and gas chromatography. Prerequisite: 103.

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


3 units, Aut (McFarlane) MWF 10


3 units, Win (McFarlane) MWF 9

150c. Formation Evaluation — Lectures, problems. Continuation of 150b. Drill stem testing, dip logging, nuclear magnetism logging, formation evaluation programs.

2 units, Spr (McFarlane) WF 10


3 units, Aut (Miller) MWF 9


3 units, Win (Marsden) MWF 10

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

3 units, Spr (Miller) T 9–11 and Th 9, alternate years, given 1967–68


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

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


3 units, Win (Miller) S 9–12, alternate years, given 1967–68


3 units, Aut (Miller) MWF 11


3 units, Win (Miller) MWF 11


4 units, Spr (Mueller, Miller) MWF 11 and T 1:15–2:05

271. Advanced Production and Reservoir Engineering Laboratory — Capillary pressure-desaturation tests, pore size distribution measurements, relative permeability, pressure-volume-temperature relations of crude oil–natural gas mixtures, model studies. Prerequisite: 153 (270a should be taken concurrently).

3 units, Aut (Ramey) 1-hour lec.; six hours of lab. by arrangement

272a. Natural Gas Engineering—Lectures, problems, and group discussions. Transient
flow problems in natural gas reservoirs, testing of gas wells, and hydrate formation. Prerequisite: consent of instructor.

3 units, Win (Ramey) by arrangement

272b. Natural Gas Engineering—Lectures, problems, and group discussion. Field separation processes, reserve estimation, underground storage. Prerequisite: consent of instructor.

2 units, Spr (Ramey) by arrangement


Any quarter (Staff) by arrangement

360. Advanced Work in Petroleum Engineering—Graduate level work in either experimental, computational or theoretical research. Advanced technical report writing.

Any quarter (Marsden, Miller, Ramey) by arrangement
SCHOOL of EDUCATION

Emeriti: A. John Bartky, W. H. Cowley, Maud M. James, Lucien B. Kinney, Maud L. Knapp, Quinn McNemar, Jesse B. Sears (Professors); Margaret Barr, Elwyn Bugge, Ernest P. Hunt (Associate Professors)

Dean: To be announced.


Assistant Professors: Elizabeth G. Cohen, Miriam B. Lidster, Marian S. Ruch, Helen W. Schrader, Hans N. Weiler


Members of the faculties of other divisions of the University giving courses or cooperating in the offerings of the School of Education are John D. Black, Howard Dallmar, William P. Fehring, Charles E. Finger, James Gaughran, John C. Gilmore, Joseph R. Higgins, Conrad Jarols, Payton Jordan, William L. Leland, Raymond E. Lunny, Jr., Rudolph Morgan, Virginia Putch, John Raslon, Clifford F. Weigle, and J. Raymond Young.

The School of Education is responsible for the preparation 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.

In the listing of courses below, only those which can be reasonably scheduled at this time are listed for the Summer Session, and there may be changes in these. The Summer Session Bulletin, issued each year in February, will contain more definite information.

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 the degrees offered by the School of Education and the credentials with which they 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)
M.A.T. Not usually associated with a credential because this program is for experienced teachers

GRADUATE DEGREES

Students who wish to be candidates for the Ed.D. or Ph.D. degree are urged to write to the Office of the Dean, 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 Office of the Dean, School of Education.

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

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 objective 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 objective. Each candidate will select a faculty adviser 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.

- General School Administration*
- Elementary School Education
- Secondary School Education
- Higher Education
- Junior College
- Guidance
- Philosophy and/or History of Education
- International Development Education (formerly Comparative Education)
- Psychological Foundations of Education
- Social Foundations of Education
- Health Education
- General Curriculum
- Child Development
- Mathematical Studies in Educational Processes
- Teacher Education, or Secondary Education, or Special Curriculum, with concentrations in any of the following:
  - Art
  - Health
  - Journalism
  - Language Arts or English
  - Mathematics
  - Modern European Languages

* Elementary School and Secondary School Administration and Supervision are included in the concentrations of Elementary School and Secondary School Education, respectively.
Music
Physical Education for Men
Science
Social Studies
Speech

Candidates who select one of the fields of concentration listed above should identify their field as in the following examples:

Art: Teacher Education
Science: Secondary Education
Journalism: Special Curriculum

Other possible fields of concentration may be arranged for candidates with the approval of both the student's adviser and the Committee on Advanced Graduate Degrees.

Application for formal admission into the doctoral programs is required after 12 units of advanced graduate work have been completed at Stanford. Application forms may be obtained at the office of the School of Education.

**MASTER OF ARTS**

The program for the degree of Master of Arts in Education provides for a common core of training for all candidates for the degree, and for specialization in the selected fields of concentration which follow:

Elementary Education (with specializations such as Supervision, Administration, Curriculum, Teaching)
Secondary Education (general or with specializations such as Physical Education for Men, Social Studies, etc.)
Student Personnel and Counseling
Health Education

Other possible fields of concentration may be arranged for individual advanced graduate candidates when approved by both the student's adviser and the Master of Arts Committee of the School. Requirements for the core program are listed for each of the concentrations. Courses presented for core requirements must have been taken within five years of the date of the formal application. The remaining courses are to be determined by the candidate and the adviser. Graduate course work taken seven or more years before the date of formal application will be evaluated by the adviser and the Master of Arts Committee, and additional course work in the foundation fields will be required in certain cases.

General requirements for the completion of the degree of Master of Arts (A.M.) include:

1. A minimum of 45 units of graduate study is required. At least 36 units must be completed at Stanford. Two-thirds 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 full quarters, or the equivalent, after the conferring of the Bachelor's degree. Evaluation of residence is based on tuition payments. One full-time quarter (a minimum of 12 units) is required. The remainder of the work may be carried on a part-time basis.

2. A student admitted to graduate standing in the School of Education is eligible to apply for candidacy to a Master of Arts degree program when he has completed at least 12 units of graduate course work at Stanford. If, after the completion of these 12 units,
   a) he has a grade point average of at least 2.75 and the recommendation of his adviser, his application for candidacy will be approved;
   b) he has a grade point average between 2.50 and 2.75, the application will be reviewed jointly by the Committee on the Master of Arts Degree and the student's adviser to determine whether or not the application for candidacy will be approved;
   c) he has a grade point average below 2.50, his application for candidacy will not be approved.

A student admitted to candidacy must maintain at least a 2.75 grade point average in the program of courses approved by his adviser for the Master of Arts degree. A candidate who does not achieve the minimum grade point average at the completion of his approved program may petition the Committee on the Master of Arts Degree for the inclusion of no more than 15 additional units to raise his grade point average to the required minimum.

(Units receiving a "+" grade and units transferred from other institutions will count toward the unit requirements for the degree...
but will not be included in the computation of the grade point average.)

3. Preliminary application materials, listed below, are to be submitted to the Master of Arts secretary in the School of Education two quarters before the conferring of the degree:
   a) Transcripts of all academic work previously taken.
   b) A proposed program of courses for the degree, signed by the adviser.

4. Satisfaction of all requirements for the degree within five years after the formal application for the degree has been accepted.

5. Completion of student teaching, internship, or other appropriate practicum, or one year of teaching experience.

6. Recommendation from the adviser and the Master of Arts Committee that the degree be granted.

The degree of Master of Arts (A.M.) is conferred by the University, on recommendation of the University Committee on the Graduate Division.

Two types of programs are offered leading to the degree of Master of Arts in education:


2. School Specialist type. No thesis. Planned for elementary and secondary school teachers, administrators, guidance workers, etc.

List of current advisers, programs of study, and order of procedure should be obtained from the School of Education Credential Secretary during registration day 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, History, Mathematics, Modern European Languages, Physical Sciences, Physics, Political Science, Sociology, 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, humanities, and linguistics. 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 and must submit evidence of having had one or more years of successful teaching experience.

3. Three quarters of full-time residence (or its equivalent) are a requirement for this degree. This requirement may be satisfied by the candidate’s attending a series of summer quarters.

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

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

6. At least 12 units of the MAT requirements shall consist of graduate courses in the School of Education at Stanford. Certain courses cross-listed in two departments may be used to satisfy requirements in either the academic department or the School of Education, but the same courses may not be used to meet requirements in both departments. Requirements for the School of Education consist of recent advanced courses in the following areas to supplement the candidate’s preparation:
   a) Curriculum and methods in the candidate’s teaching field.
   b) General curriculum in Secondary or Elementary education.

* 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.
c) Foundations of Education (such as Psychological, Social, Health, History, Philosophy, Comparative Education, Cultural Transmission, etc.). Recent work in Psychological and Social Foundations is required.

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 achieve 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 135 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 will be required during the course of work to register at Stanford for a minimum of one academic year (three 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 after the candidate has passed his qualifying examinations. 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 an adviser in his field of concentration. The adviser will make recommendations to the Committee on Advanced Graduate Degrees 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 Office of the Dean of the School of Education.

**Doctor of Philosophy**

The degree of Doctor of Philosophy (Ph.D.) is conferred by the University on recommendation of 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 a faculty member of a college or university.

**Residence** — Nine quarters of graduate study (a minimum of 135 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 will be required during the course of work to register at Stanford for a minimum of one academic year (three 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 an adviser in his field of concentration. All programs require the approval of the School of Education Committee on Advanced Graduate Degrees and the University Committee on the Graduate Division.

Complete information concerning this program may be secured from the Office of the Dean of the School of Education.

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 Chairman of the Committee on Advanced Graduate Degrees in the School of Education.

CREDENTIALS FOR PUBLIC SCHOOL SERVICE

The University is authorized to recommend for certain credentials for service in the California public schools, and in 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.

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. Contingent upon completion of course work, 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 its equivalent. If the Master’s degree or the baccalaureate degree plus the equivalent of Master’s degree work is not in an academic subject matter area, the two years of postgraduate education shall include the equivalent of 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 elementary or secondary 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) A baccalaureate degree plus the equivalent of a Master’s degree in an academic subject matter area in an institution offering a doctoral degree but not a Master’s degree in that area.
   c) A doctoral degree, including 36 quarter hours of work in academic subject matter areas.

2. The possession of a valid basic credential.

3. A minimum of five years of successful full-time classroom teaching experience in public elementary or secondary 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.
   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.

**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 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, History 60, or History 151.

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.

**Exemption from Student Teaching (Junior College)**—Part of the student teaching requirement may be waived for one year of successful teaching or student teaching elsewhere after the satisfactory completion of half of the student teaching requirement at Stanford. Such a waiver does not imply granting of credit. Course work must be substituted for exemptions in order to have the required number of education units.

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.

**Teaching Credential (Secondary)**—

**SECONDARY INTERNSHIP PROGRAM:**

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 of colleges and universities of recognized standing 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 fifteenth of March. However, candidates who wish to receive consideration for scholarship awards must have their applications filed by January 15. Candidates who intend to earn the credential through a teaching major in a modern foreign language are urged to submit their scores in the ETS-MLA test for advanced students and teachers at the time of their application.

3. Personal interviews. Three personal interview dates have been established for intern applicants. At the time a candidate submits his application, he should indicate which of these dates is most convenient. In unusual cases it is possible to petition to have the personal interview waived.
   a) Saturday, December 17, 1966
   b) Saturday, February 4, 1967
   c) Saturday, March 11, 1967

4. Notice of admission. Within three weeks after the personal interview, candidates will be notified about admission to preliminary candidacy.

5. School internship. School placement is a requisite of internship. Placement may be guaranteed for outstanding candidates at the time of admission. Cooperating high schools will consider for employment persons who have been admitted to preliminary candidacy. Employment interviews are arranged by the Intern Office. 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). The intern spends the balance of his half day in school in supplementary activities, such as classroom observation.

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

   *a) A four-year college course with 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. (Competency in composition must be demonstrated, either by completing a college course or passing an examination.) 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 cre-
dential in the following major fields only: Art, English, Mathematics, Modern Language, Music, Physical Education (Men), Physical Sciences, Biological Sciences, Social Studies, Speech and Drama.

c) A teaching minor consisting of a minimum of 30 quarter units (20 semester units) of course work in a single academic subject.

d) A program of professional courses including all of the following, unless specifically waived by the adviser and the Secondary Education Committee.

**Secondary Teaching Internship Program Requirements**

<table>
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<th>Course No.</th>
<th>Subject</th>
<th>Quarter</th>
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<tr>
<td>Academic Courses</td>
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<tr>
<td>211a, b. Psychological Foundations</td>
<td></td>
<td>Su A</td>
<td>6</td>
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<tr>
<td>211c. Social Foundations</td>
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<td>240a. Secondary Education</td>
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<tr>
<td>240d. Secondary Education</td>
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<tr>
<td>246 Series</td>
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<tr>
<td>246a. Instruction Laboratory</td>
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<td>Summer</td>
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<tr>
<td>246b. Internship</td>
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<td>246c. Internship</td>
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<td>246d. Internship</td>
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<tr>
<td>(212a.b. History/Philosophy—required for A.M. only)</td>
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</tbody>
</table>

The Graduate Record Examination ( Aptitude Test and Advanced Subject Test) is required for admission.

7. Other tests must be completed during the week prior to the beginning of the first summer quarter and at other designated times during the program. However, these tests are NOT a part of the admission or evaluation procedures of the program.

**STANDARD TEACHING CREDENTIAL (JUNIOR COLLEGE):**

A student preparing for the Junior College credential will fulfill the following requirements.

1. Completion of professional course requirements, which include a course or courses in the psychological foundations of education, curriculum and instructional procedures and materials (students must start program at the beginning of either autumn or summer quarter), and practice teaching.

2. Completion of the Master's degree in the teaching major.

3. Completion of a teaching major and a teaching minor satisfactory to the departments concerned. For details consult the Credential Secretary of the School of Education.

4. Completion of general education courses prescribed by the California Administrative and Education Codes.

5. Acceptance by the academic department and the School of Education.

**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 and school psychology. 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 successful 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>
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</thead>
<tbody>
<tr>
<td>Ed. 230. Foundations of Guidance, or</td>
<td></td>
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<tr>
<td>Ed. 230a. Guidance in Elementary Schools</td>
<td></td>
<td>3</td>
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<tr>
<td>Ed. 215. Psychological Foundations of Education</td>
<td></td>
<td>4</td>
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<tr>
<td>Psych. 131. Abnormal Psychology</td>
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<td>4</td>
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<tr>
<td>Ed. 333a. Counseling Techniques: The Interview</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Ed. 333b. Counseling Techniques: Testing</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Ed. 312. Occupational Trends</td>
<td></td>
<td>3</td>
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<tr>
<td>Ed. 150. Statistical Analysis in Education</td>
<td></td>
<td>3</td>
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<tr>
<td>Psych. 114. Exceptional Children</td>
<td></td>
<td>3</td>
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<tr>
<td>Ed. 398. Reading in Secondary Schools</td>
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<td>4</td>
</tr>
<tr>
<td>Ed. 323. Public School Law</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Ed. 333c. Counseling Techniques Practicum</td>
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<td>9</td>
</tr>
</tbody>
</table>

2. Candidates who desire to qualify as school counselors and who have not had (or
will not be able to obtain) three years of successful full-time teaching experience may qualify for the credential by meeting the following minimum requirements:

a) All the requirements listed under "1" (above).

b) A total of 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. The required additional courses will include as a minimum the following or their equivalent:

- Ed. 251. Educational Testing and Evaluation 4
- Ed. 204. Philosophy of Education, or 4
- Ed. 200. History of Education 3
- Psych. 113. Adolescent Development, or 3
- Ed. 116. Development in Middle Childhood 3

(c) An additional 240 clock hours of supervised field experience in pupil personnel services over a second full academic year while enrolled in Ed. 333c, Counseling Techniques Practicum, for an additional 9 units.

**Authorization in School Psychology:**

Candidates who desire to qualify as school psychologists must meet the following minimum requirements:

a) Must be doctoral candidates who have been admitted through the preliminary interview.

b) Must have met all the requirements in either 1 or 2 (above).

c) Must have completed the following courses satisfactorily:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Ed. 352</td>
<td>Individual Psychological Testing by arrangement</td>
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<tr>
<td>Psych. 252</td>
<td>Personality Assessment I</td>
<td>3</td>
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<tr>
<td>Psych. 253</td>
<td>Personality Assessment II</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 333d</td>
<td>Practicum in School Psychology by arrangement</td>
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</tbody>
</table>

d) Must receive verification by Stanford University as a competent psychologist to recommend placement in programs requiring an individual examination to determine the mental or emotional characteristics of a minor.

**Courses in Other Divisions of the University**

It is required that workers in education have thorough backgrounds in areas outside of professional work. 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 individual study for advanced graduates: 400–499.

The various courses are distributed as follows:

- Foundations of Education (Digits 00–19), e.g., 218, Health Foundations of Education
- Administration (Digits 20–29), e.g., 320a, b, c. Advanced Public School 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
- Testing, Evaluation and Research (Digits 50–54), e.g., 251, Educational Testing and Evaluation
- Physical Education (Digits 55–59 and 70–79), e.g., 155, Elementary Analysis of Body Movement
- 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

**Junior-Senior**

These courses are also open to graduate students.

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

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

**116. Development in Middle Childhood — (Enroll in Psychology 113.)**

**Development of the child from six to twelve.** Research readings, observations, development of case study materials. Prerequisite: Psychology 111 or equivalent.

- **4 units**, Win (Sears) MWF 9 and one 3-hour block by arrangement

**143a. Observation and Participation in Special Educational Facilities — By permission only.** Opportunities provided for study and
work with children in institutional and special settings.

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

150. Elements of Statistical Analysis in Education—Introduction to statistical description and inference in the study and conduct of educational research. No previous college mathematics necessary. This or a more advanced course in the field required of all doctoral candidates. Students planning to continue with 250a, b should elect Statistics 7 (Economics 7, Sociology 7) or Psychology 60.

3 units, Aut (Coladarci) MWF 2:15
4 units, Sum (——) MTWThF 9

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.

3 units, Spr (Grommon) Th 4:15–6:05 and
by arrangement

GRADUATE

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

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—Detailed study of American educational history in its cultural setting. Education 200 will provide a helpful background but is not a prerequisite.

4 units, Spr (Quillen) MW 4:15–6:05
Sum (——) MTWThF 10

204. Philosophy of Education—Philosophical issues in epistemology, value theory, metaphysics of significance to educational policy, practice. No previous study of philosophy assumed.

4 units, Win (Thomas) MTWThF
Sum (Thomas) MTWThF 2:15

205. Social and Economic Revolutions in Asia: Their Educational Implications—An assessment of the role of education in the process of nation-building in selected Asian countries.

4 units, Sum (——) MTWThF 11

206a. Comparative Education—An introductory course for non-majors in International Development Education.

3 units, Spr (Hanna) TWTh 2:15

206b. Comparative Education—An introductory course in International Development Education.

4 units, Sum (——) MTWThF 2:15

210. Social Foundations of Education—For credential and Master of Arts degree candidates. Influence of social structure on schools, school systems; American cultural values and their influence on education; special problems of ethnic groups in American schools; school system as formal organization in mass society; case studies of teachers, administrators.

4 units, Aut (Cohen) MTWTh 1:15
Sum (Cohen) MTWThF 11

The following courses in the Foundations of Education are taken by students admitted to the program for the secondary teaching internship. Students enrolled in other programs select foundation courses from 200, 204, 206, 210, 215, 218.

211a. Foundations of Education: Psychological—Application of psychological principles to problems of learning and development. Major topics include learning, personality development, social interaction, and theories of instruction. Prerequisite: Psychology I or equivalent.

3 units, Sum (McDonald) MTWTh 1:15

211b. Foundations of Education: Psychological—Measurement and evaluation of student characteristics and achievement. The construction and interpretation of evaluation procedures are major activities in this course. Necessary statistical ideas are presented at an elementary level. Prerequisite: 211a.

3 units, Aut (McDonald) M 4:15–6:05
and W 4:15

211c. Foundations of Education: Social—Application of sociological and anthropo-
logical principles to problems of learning and development.

3 units, Win (Cohen) MW 4:15 and by arrangement

2 to 4 units, Spr (Gross) M 4:15–6:05

2 to 4 units, Spr (Thomas) W 4:15–6:05

213. Foundations of Aesthetic Education—Analysis of historical and philosophical aspects of art education. Designed to introduce students to the changing functions of art in American education and to the examination of various conceptions of art as they relate to education.
4 units, Aut (Eisner) MW 4:15–6:05

215. Psychological Foundations of Education—Introductory course in application of psychological principles to educational practices. Prerequisite: Psychology 1 or equivalent.
4 units, Aut (Gage) MTWTh 9
Sum (——) MTWTh 8 and by arrangement

218. Health Foundations of Education—Relationship of health and education; nature of a practical school health program.
3 units, Aut (Cobb) MWF 9
Win (Byrd) MWF 11
4 units, Sum (Byrd) MTWThF 9

219. Artistic Development of the Child—Designed to introduce students to research in the behavioral sciences having relevance for understanding of the child’s artistic development.
4 units, Win (Eisner) MW 4:15–6:05

220. Introduction to Public School Administration—School district organization for administration; emphasis upon development, function of school administration.
3 units, Win (Odell) Th 7–10 p.m.
4 units, Sum (Odell, Strand) MTWThF 9

221. Elementary School Administration and Supervision—Roles, problems of the elementary school principal and supervisor with focus on administration of a single school. Course required for elementary school administrative and supervisory credentials.
3 units, Aut (Sowards) Th 7–10 p.m.
4 units, Sum (——) MTWThF 9

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 (Boyan) Th 7–10 p.m.
4 units, Sum (——) MTWThF 11

225. Field Practice in Elementary School Supervision and Administration—Field practice in elementary school administration and supervision that will meet requirements for California Elementary School Administration Credential and California Supervision Credential. Consent of instructor required.
1 to 6 units, Aut, Win, Spr (Sowards, Shaftel, James) by arrangement

227. Field Practice in Secondary School Administration and Supervision—Field practice in secondary school administration and supervision that will meet requirements for California Secondary School Administration Credential and California Supervision Credential. Consent of instructor required.
1 to 6 units, Aut, Win, Spr (Boyan, James) by arrangement

228. Case and Field Studies of the Junior College.
3 units, Spr (Mayhew) M 3:15–5:05 and by arrangement

229. Administration of School Health Program—Significant problems in school health facing school personnel.
3 units, Spr (Byrd) W 7–10 p.m.
4 units, Sum (Byrd) MTWThF 11

3 units, Aut (McDaniel) Th 7–10 p.m.
4 units, Sum (——) MTWThF 8

3 units, Spr (Sears) alternate years, given 1967–68
239a, b. Observation of Study Skills and Developmental Reading in College, and Directed Teaching of Study Skills and Developmental Reading — Two-quarter practicum, 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.

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. Topics are specifically related to the instruction laboratory (246a) which is taken concurrently. Limited to Secondary Interns.

3 units, Sum (Allen) MTWTh 2:15

240b. Secondary Education: Student Problems — Consideration of typical student personnel problems confronting the beginning teacher. Specifically related to the internship experience (246b) which is taken concurrently. Prerequisite: 240a.

1 unit, Aut (Allen) W 5:15

240c. Secondary Education: Curriculum Problems — Consideration of problems and issues of curriculum design, including the relationship between instruction in various subject areas of the secondary school curriculum. Specifically related to the internship experience (246c) which is taken concurrently. Prerequisite: 240b.

1 unit, Win (Bush) W 5:15

240d. Secondary Education: Staff and Organizational Problems — Consideration of the administrative structure of the secondary school, including proposals for change. Problems of internal communication and staff relationships. Specifically related to the internship experience (246d) which is taken concurrently. Prerequisite: 240c.

1 unit, Spr (Boyan) T 5:15

241. Audio-Visual Aids — Theory and laboratory course to acquaint teachers with audio-visual principles, materials, equipment. Enrollment limited. (Students must enroll in School of Education Office.)

1 unit, Aut, Win (——) M or W 4:15

242. Student Teaching in Speech Correction — Supervised teaching in speech therapy and lip reading in public schools in partial fulfillment of requirements for special credential in these fields.

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

243. Developing a Flexible High School Program — Consideration of organizational and instructional alternatives to the present high school program, including the use of modular schedules, team teaching, non-graded programs, and new technological media.

2 to 4 units, Sum (Allen) MWF 8 and by arrangement

246a. Instruction Laboratory: Micro-teaching Clinic — Training and practice in specific skills of teaching. Micro-teaching 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. The clinic is closely associated with concurrent courses in the secondary education program: 211a, 240a, and the 260 series course in the teaching major. Limited to Secondary Interns.

3 units, Sum (Allen, ——) MTWTh 8–1 and 4:15

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 (Allen, ——) by arrangement

246c. 2 to 6 units, Win (Allen, ——) by arrangement

246d. 2 to 6 units, Spr (Allen, ——) by arrangement

248. Student Teaching in the Junior College.

3 to 6 units, Aut, Win, Spr (Mayhew) by arrangement (total of 6 units required)

250a. Statistical Analysis in Educational Research — Designed for graduate students who expect to use statistical methods in their research. Foundations of statistical infer-
ence. Review of special hypotheses and test procedures for the normal distribution. Non-parametric analysis. Prerequisite: Statistics 7, Psychology 60, or equivalent.

3 units, Win (Olkin) MWF 11:00-12:30


3 units, Spr (Olkin) MWF 11:00-12:30

251. Educational Testing and Evaluation—Introduction to principles of evaluation; emphasis upon application to construction and use of tests in educational practice. Prerequisite: 215 or equivalent.

4 units, Sum (——) MTWTh 1:15 and by arrangement

252. Introduction to Test Theory — Concepts of reliability and validity; mathematical models underlying commonly used procedures for test analysis. Test scales and norms. Prerequisite: Psychology 60, Statistics 7, or equivalent.

3 to 4 units, Aut (Cronbach) MW 2:15-4:05, alternate years, given 1967-68

255. Human Abilities — (Same as Psychology 155.) The nature, development, and measurement of intellectual abilities. Prerequisites: Psychology 1, and Psychology 60 or Education 250b.

3 units (Cronbach) alternate years, given 1967-68

CURRICULUM AND INSTRUCTION IN SECONDARY SCHOOL MAJOR TEACHING FIELDS

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

261a,b,c,d. Curriculum and Instruction in Secondary School Art — Lectures and discussions on foundations of art education and curriculum development.

261a. 3 units, Sum (Eisner) MTWTh 3:15
261b. 1 unit, Aut (Eisner) T 4:15-6:05
261c. 1 unit, Win (Eisner) T 4:15-6:05
261d. 1 unit, Spr (Eisner) T 4:15

262a,b,c,d. 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 (——) MTWTh 3:15
262b. 1 unit, Aut (Grommon) T 4:15-6:05
262c. 1 unit, Win (Grommon) T 4:15-6:05
262d. 1 unit, Spr (Grommon) T 4:15

263a,b,c,d. Curriculum and Instruction in Secondary School Mathematics — Purposes and programs of mathematics in secondary curriculum; teaching materials, methods.

263a. 3 units, Sum (——) MTWTh 3:15
263b. 1 unit, Aut (Begle) T 4:15-6:05
263c. 1 unit, Win (Begle) T 4:15-6:05
263d. 1 unit, Spr (Begle) T 4:15

264a,b,c,d. Curriculum and Instruction in Secondary School Modern Languages — Methods, techniques of foreign language teaching, testing. Survey of language teaching to the present. Materials of foreign language teaching. Use of audio and visual aids in language work.

264a. 3 units, Sum (Politzer) MTWTh 3:15
264b. 1 unit, Aut (Politzer) T 4:15-6:05
264c. 1 unit, Win (Politzer) T 4:15-6:05
264d. 1 unit, Spr (Politzer) T 4:15

265a,b,c,d. Curriculum and Instruction in Secondary School Music—(Same as Music 265a,b,c,d.) Theory and practice of vocal and instrumental instruction.

265a. 3 units, Sum (Kuhn) MTWTh 3:15
265b. 1 unit, Aut (Kuhn) T 4:15-6:05
265c. 1 unit, Win (Kuhn) T 4:15-6:05
265d. 1 unit Spr (Kuhn) T 4:15

266a,b,c,d. Curriculum and Instruction in Secondary School Physical Education (Men)—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. 1 unit, Aut (Ruff) T 4:15-6:05
266c. 1 unit, Win (Ruff) T 4:15-6:05
266d. 1 unit, Spr (Ruff) T 4:15
267a,b,c,d. Curriculum and Instruction in Secondary School Science—Introduction to objectives of secondary science teaching; selection and organization of teaching units; laboratory and demonstration techniques; tests, evaluation. Emphasis upon instructional materials, community resources for science teaching.

267a. 3 units, Sum (——) MTWTh 3:15
267b. 1 unit, Aut (Hurd) T 4:15-6:05
267c. 1 unit, Win (Hurd) T 4:15-6:05
267d. 1 unit, Spr (Hurd) T 4:15

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. 1 unit, Aut (Gross) T 4:15-6:05
268c. 1 unit, Win (Gross) T 4:15-6:05
268d. 1 unit, Spr (Gross) T 4:15

269a,b,c,d. Curriculum and Instruction in Secondary School Speech and Drama — Theory, practice in curriculum and instruction in speech and drama.

269a. 3 units, Sum (——) MTWTh 3:15
269b. 1 unit, Aut (Schrader) T 4:15-6:05
269c. 1 unit, Win (Schrader) T 4:15-6:05
269d. 1 unit, Spr (Schrader) T 4:15

280. Art in Elementary Education — Lectures and discussions of methods, research and goals for art education in American public schools.

3 units, Aut (Eisner) M 7–10 p.m.

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) MTWThF 1:15

281a. Linguistics for Teachers of Modern Languages — (Same as 281, but first four weeks only.)
2 units, Sum (Politzer) MTWThF 1:15

2 units, Win (Morgan) TTh 10

283. German Applied Linguistics—(Same as German 190).
2 units, Win (Politzer) T 2:15–4:05

288. Methods of Teaching French—(Same as French Teacher Training course 288).
3 units, Win (Politzer) M 4:15–6:05 and by arrangement

289. Curriculum and Instruction in the Junior College—Curriculum and methods of teaching in junior colleges.
3 units, Win (Mayhew) M 7–10 p.m.

291. Methods of Teaching German—(Same as German 200).
3 units, Spr (Lohnes) MWF 11

292. Methods of Teaching Spanish—(Same as Spanish 200).
2 units, Win (Morgan) TTh 3:15

293. Seminar for Science and Mathematics Teachers—Lectures by guest scientists and mathematicians; field trips to research laboratories. (Enrollment limited to Shell Merit Fellows.)
4 units, Sum (Hurd) MTWTh 11–1:15; field trips F 11–5

295. Use of Language Laboratory—(Same as Modern European Languages Teacher Training course 200).
2 units, Aut (Morgan), T 7–9 p.m.
Sum (Morgan) TTh 9 and by arrangement

297. Seminar in the Development of Laboratory Techniques—(Same as Modern European Languages Teacher Training course 201.)
2 units, Sum (Morgan) TTh 1:15 and by arrangement

299. Children’s Literature—General survey of children’s literature for both pre-school and elementary school years.
3 units, Win (Iverson) W 7–10 p.m.
4 units, Sum (Iverson) MTWThF 11

COURSES FOR EXPERIENCED TEACHERS OR ADVANCED GRADUATE STUDENTS

305. Social Philosophies and Education—Construction of a democratic theory of education; consideration of conflicting views of
fascism, communism, individualism, pragmatic liberalism.

4 units, Win (Thomas) MTWTh 11
   Sum (Thomas) MTWThF 11


2 to 4 units, Aut (Weiler) Th 4:15–6:05

306b. Seminar on Education and Economic Development — The role of education in building modern production systems and the significance of levels of economic development for educational problems and plans. Required course for all first-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Aut (Staley) T 4:15–6:05

306c. Seminar on Asia and Educational Planning—Interrelations of educational developments with social-economic-political development in selected Asian countries. Required course for all first-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Win (Textor) Th 4:15–6:05

306d. Seminar on Education and Political Development — The relationship between the educational system and the behavioral and institutional aspects of politics, with special emphasis on the problems of citizenship education and the political role of educational administrators. Required course for all first-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Win (Weiler) T 4:15–6:05

306e. Seminar on Latin America and Educational Planning — Interrelations of educational development with economic-social-political development in Latin America. Required course for all first-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Spr (Staley) Th 4:15–6:05

306f. Seminar on Anthropology and Development Education—The role of education in fostering general socio-economic development will be examined from anthropological perspectives. Required course for all first-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Spr (Textor) T 4:15–6:05

307. Social Psychology of Higher Education—Analysis of the behavior and development of college students and of the college as a social organization.

2 units, Spr (Sanford) T 4:15–6:05

308. Introduction to American Higher Education I — For those planning careers in teaching, research, or administration in American higher education. Explores European, American historical backgrounds, to the end of comprehending current scene and planning for the future.

4 units, Aut (Cowley) TTh 2:15–4:05

310. Education in American Society—Analysis of education in American society as applied to problems of educational leadership. Assumes that class members have had teaching experience or equivalent. For Ed.D. and Ph.D. candidates.

4 units, Aut (Cohen) MTWTh 10
   Sum (Cohen) MTWThF 10

312. Occupational Trends—Current nature of American labor force; occupational structure; intended for vocational counselors, advanced students of educational sociology. Prerequisite: 210 or 310.

3 units, Spr (McDaniel) T 3:15–4:05
   and Th 3:15–5:05

314. Advanced Educational Psychology: Differential Psychology — An advanced course examining the concepts and data of differential psychology for their relevance to educational practice. Attention given to methodological problem in studying individual and group differences. Prerequisites: 317a and b, or equivalent.

4 units, Win (Coladarci) MWF 11 and
   by arrangement, alternate years,
   given 1967–68

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.

3 units, Aut (Spindler) M 7–10 p.m.
4 units, Sum (——) MTWThF 9
316. Advanced Educational Psychology: Classroom Learning—An advanced course applying the concepts of learning and motivation to instructional practices in school subjects; analysis of research on variables related to the design of instructional systems. Concurrent enrollment in individual study in a subject matter curriculum area is normally expected to review relevant research. Prerequisites: 317a and b, or equivalent.

4 units, Aut (McDonald) MWF 9 and by arrangement

317a,b. Advanced Psychological Foundations of Education—An advanced course in topics in educational psychology covering motivation, learning, measurement, individual differences, developmental psychology, the social conditions of learning, personality development and problems of personal and school adjustment. Required of doctoral candidates in education. Prerequisites: Education 150, or Psychology 60, or their equivalents, and Education 215 or its equivalent.

317a. 4 units, Win (Staff) MTWTh 3:15
317b. 4 units, Spr (Staff) MTWTh 3:15

318. Advanced Educational Psychology: Social Psychology and Educational Practice—An advanced course applying the concepts of social psychology to educational practice. Review of relevant social psychological research. Application of role theory, small group theory to educational processes; analysis of interpersonal process research literature. Prerequisites: 317a and b.

4 units, Win (Gage) MWF 9 and by arrangement

320a,b,c. Advanced Public School Administration—Designed primarily for advanced degree candidates in school administration. Autumn quarter will be devoted to the role of theory in educational administration; the winter quarter to a training group in group behavior in administrative situations; the spring quarter to administrative relationships in education. Prerequisite: 220 or equivalent, or consent of instructor.

320a. 3 units, Aut (Strand) W 7–10 p.m.
320b. 3 units, Win (Odell) W 7–10 p.m.
320c. 3 units, Spr (Odell) W 7–10 p.m.

321. Problems in Elementary School Administration and Supervision—Designed to provide elementary school principals and supervisors an opportunity to examine these roles in light of the changes taking place in the program and organization of the elementary school. Prerequisite: administrative experience; other registrants by permission of instructor only.

3 units, Spr (Sowards) W 7–10 p.m.

322. Seminar in Secondary School Administration and Supervision—Critical analysis of problems of the secondary school principalship as related to function of the secondary school; its curriculum; appraisal of teaching and learning; pupil characteristics; patterns of organization of personnel and resources. Prerequisite: consent of instructor.

3 units, Win (Boyan) W 7–10 p.m.

323. Public School Law—Nature of legal responsibilities faced by public school administrator; resources available to him for solution of legal problems. Specifically designed to meet requirements for California administrative credentials.

3 units, Spr (James) M 7–10 p.m.
4 units, Sum (James) MTWThF 2:15

324. 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 (Boyan) Th 7–10 p.m.
4 units, Sum (——) TWTh 4:15–5:45

325. School Planning—Basic course in relating educational planning to school plant needs. The winter quarter is a continuation of the autumn quarter and only candidates who have the consent of the instructor will be admitted.

3 units, Aut, Win, Spr (MacConnell, Staff) S 9–12


3 units, Aut (James) M 7–10 p.m.
4 units, Sum (James) MTWThF 3:15

326c. Public School Business Administration—Basic principles, methods, and problems in public school administration.

3 units, Win (James, Staff) M 7–10 p.m.
327. **Internship in Secondary School Administration and Supervision**—Field experience as secondary school administrator—intern in office of secondary school principal.

1 to 3 units, Aut, Win, Spr (Boyan)

by arrangement

329. **American Higher Education II**—This course is a continuation of 308 and examines the development of the research and auxiliary functions of American colleges and universities. Although 308 is not a prerequisite, students are encouraged to take it first.

4 units, Win (Cowky) TTh 1:15-3:05

333a. **Counseling Techniques: The Interview**—Basic concepts, practices of counseling interview. For graduate students who expect to become school counselors.

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

333b. **Counseling Techniques: Testing**—Study and practice with psychological tests employed in counselors' study of individual client. Experience in taking tests, administering them, analyzing and interpreting data.

4 units, Win (Krumboltz) TTh 1:15-3:05

333c. **Counseling Techniques Practicum**—Experience and observation in school counseling under supervised conditions. Placements made in nearby secondary schools. Student must arrange schedule so that he can spend eight hours per week for three terms in the secondary school in addition to a one-hour seminar each week. This sequence must be started in the autumn quarter. Consent of instructor required.

3 units, Aut (Krumboltz, Staff), T 4:15 and eight hours per week by arrangement

Win (McDaniel, Krumboltz, Staff) T 4:15 and eight hours per week by arrangement

Spr (McDaniel, Krumboltz, Staff) T 4:15 and eight hours per week by arrangement

333d. **Practicum in School Psychology**—Supervised experience in the work of the school psychologist. Open only to doctoral candidates in guidance.

3 units, Aut, Win, Spr (McDaniel)

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 permission. May be repeated for credit.

2 to 4 units, Aut, Win, Spr (Black, Lyon)

by arrangement

335. **Organization and Administration of Pupil Personnel Programs**—Determination of student personnel functions in the school setting. Analysis of principles of organization. Study of existing organizational patterns. Problems of supervision, staffing and program evaluation. Prerequisite: consent of instructor.

3 units, Spr (McDaniel) TTh 1:15-3:05

338. **Student Personnel Services in Higher Education**—Critical examination of operation of student personnel services in American colleges and universities.

1 to 3 units, Aut (Gordon) F 10-12 and by arrangement

343. **Secondary School Curriculum, Instruction, and Supervision**—For experienced teachers and students working for specialist or doctoral degrees. Comprehensive analysis of problems of curriculum development in secondary schools; historical, comparative emphases.

4 units, Win (Bush) MW 8-10

Sum (——) MTWThF 9

344a. **Survey of Elementary School Curriculum**—First level graduate course in theory, practices, issues, trends in designing of total elementary school curriculum and in teaching of the several subjects.

3 units, Aut (Shaftel) M 7-10 p.m.

344b. **Elementary School Curriculum, Instruction, and Supervision**—Theory, trends, issues in curriculum of elementary school. Advanced graduate course for which 344a., or its equivalent, is a prerequisite.

3 units, Spr (Sowards) M 7-10 p.m.

4 units, Sum (Shaftel) MTWThF 11

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) Th 7-10 p.m.

347. **The Junior College**—Suggested for all candidates for junior college credential.
Philosophy, problems of the junior college.

3 units, Aut (Mayhew) M 7–10 p.m.
4 units, Sum (Mayhew) MTWThF 1:15

348. American Higher Education III — An examination of the self-continuity functions of colleges and universities: their administration and government. Although 308 and 329 are not prerequisites, students are encouraged to take them first.

4 units, Spr (Cowley) MW 1:15–3:05

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

4 units, Spr (Allen) MW 3:15–5:05
4 units, Sum (Sowards) MTWThF 1:15

350. Research Methodology—Introduction to nature of scientific thinking in education, various methodological approaches relevant to research problems. Consideration given to particular concerns relating to doctoral dissertations. Prerequisite: 314.

4 units, Win (Coladarci) MW 3:15–5:05

351a. Advanced Statistical Analysis in Educational Research I—An advanced course in statistical methodology devoted to the analysis of multivariables. Multivariate normal distribution, multiple regression, partial and multiple correlation; linear and non-linear models, analysis of covariance. Prerequisites: 250b or equivalent and consent of instructor.

3 units, Aut (Olkin) alternate years, given 1967–68

351b. Advanced Statistical Analysis in Educational Research II—Multivariate analysis and factor analysis, matrix theory, discriminant analysis, canonical correlation. Prerequisites: 351a or equivalent and consent of instructor.

3 units, Win (Olkin) alternate years, given 1967–68

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 (P. Sears) by arrangement, alternate years, given 1966–67

353. Problems in Measurement — 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 equivalent.

3 to 4 units, Aut (Cronbach) MW 2:15–4:05, alternate years, given 1966–67

354. Curriculum Evaluation—Functions of evaluation, outcomes to be measured, design of evaluation programs, qualities desired in evaluation instruments. For persons concerned with curriculum research. Prerequisites: 251 and permission of instructor.

3 to 4 units, Sum (Cronbach) MTWTh 10
alternate years, given 1966–67


4 units, Sum (Eisner) MTWThF 2:15

359. Recent Developments in Secondary School Foreign Languages—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, Aut (Politzer) W 7–10 p.m.
4 units, Sum (——) TTh 2:15–4:05 and by arrangement

387. Elementary School Language Arts — For experienced teachers, graduate students. Reviews research, curriculum issues, instructional procedures related to language arts in elementary schools.

3 units, Aut (Iverson) W 7–10 p.m.
4 units, Sum (Iverson) MTWThF 11

388. Foreign Languages in the Elementary School—Discussion of the rationale, curriculum, methods and materials of foreign language instruction in the elementary school; problems of articulation with the high school curriculum in foreign languages.

3 units, Spr (Politzer) W 7–10 p.m.

390. Recent Developments in Elementary School Mathematics — Purposes and program of mathematics in elementary schools; teaching materials, methods. For experienced teachers, supervisors, administrators only.

2 units, Win (Begle) M 4:15 and by arrangement
4 units, Sum (——) MTWThF 10
391. Recent Developments in Secondary School Mathematics — Purposes and program of mathematics in secondary curriculum; teaching materials, methods. For experienced teachers only. Enrollment limited to Shell Merit Fellows.

3 units, Sum (——) MTWTh 2:15

393. Elementary School Science — Purposes, content, methods of elementary school science, with special emphasis on new curriculum developments.

3 units, Win (Hurd) M 7–10 p.m.
4 units, Sum (——) MTWThF 8

394. Recent Developments in Secondary School Science — Current problems in enrollment; new types of courses, instructional techniques; curriculum development; guidance materials for science students. Content of course will be varied to consider teaching problems of those enrolled. For experienced teachers only. Prerequisites: major or minor in science and teaching experience in science. Summer enrollment limited to Shell Merit Fellows.

4 units, Spr (Hurd) TTh 1:15–3:05
3 units, Sum (Hurd) MW 2:15–4:05


4 units, Sum (——) MTWTh 2:15 and by arrangement


4 units, Aut (Shaftel) TTh 9–11
Sum (Shaftel) TTh 3:15–5:05 and by arrangement


3 units, Aut (Iverson) M 7–10 p.m.

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

3 units, Win (Iverson) M 7–10 p.m.
4 units, Sum (Iverson) MTWThF 9

Mass Communications in Society — See Communication 220.
Non-Commercial Station Operation — See Communication 201S.
Teaching by Television—See Communication 203S.
Television Production — See Communication 214S.

SEMINARS AND INDIVIDUAL STUDY FOR ADVANCED GRADUATE STUDENTS

400i. Individual Study in the History of Education.

(Gross) by arrangement

404. Seminar in the Philosophy of Education — Intensive study of student-selected topics in comparative philosophies of education. Prerequisite: 204 or consent of instructor.

3 units, Spr (Thomas) M 7–10 p.m.

404i. Individual Study in the Philosophy of Education.

(Thomas) by arrangement

406a. Advanced Seminar on Anthropology and Development Education—(Same as Anthropology 228.) A continuation of Education 306f, with greater emphasis on detailed case studies and research problems. Required course for all second-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Spr (Textor) M 4:15–6:05

406b. Advanced Seminar on Education and Economic Development — Manpower analysis and economic development targets as they affect educational planning; important issues related to the respective roles of general and occupational education. Continuation of 306b. Required course for all second-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units, Aut (Staley, Platt) W 4:15–6:05

406c. Advanced Seminar on Education and Political Development — Theoretical approaches to the problem of political development and the relevance of these approaches for the study of political implications in education. Continuation of 306d. Required course for all second-year SIDEC
2 to 4 units. Win (Weiler) M 4:15–6:05

406d. Seminar on Educational Planning in Theory and Practice — A synthesis of the 306 and 406 seminar series with primary consideration to the application of development theory to educational policy. Required course for all second-year SIDEC doctoral students. Consent of instructor required.

4 units. Sum (Hanna, Staff) TTh 4:15–6:05

406e. Seminar on Educational Administration for International Development — Administrative problems in designing and implementing plans for educational development within overall development programs. Required course for all second-year SIDEC doctoral students. Consent of instructor required.

2 to 4 units. Win (James, Odell, MacConnell, Allen, Sowards, SIDEC Staff) W 4:15–6:05 and by arrangement

406f. Professional Research Seminar in International Development Education—A review of research methods and techniques in human resource development, including relevant approaches used in various disciplines. Required course for all first-year SIDEC doctoral students. Consent of instructor required.

3 units. Spr (Textor, Coladarci, Staff) W 7–10 p.m.


1 unit. Aut, Win, Spr, Sum (Hanna, Staff) W 12

406i. Independent Study in International Development Education.
(SIDEC Staff) by arrangement

411i. Individual Study in Child Development.
(Sears) by arrangement

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

4 units. Aut (Cronbach) by arrangement

2 to 4 units. Spr (McDonald) by arrangement

4 units. Sum (Coladarci) by arrangement

415i. Individual Study in Educational Psychology.
(Atkinson, Coladarci, Cronbach, Gage, McDonald) by arrangement

416. Special Topics in Cultural Transmission—(Same as Anthropology 257.) Seminar on cross-cultural data on cultural transmission. Prerequisite: 315 or permission of instructor.

3 units. Spr (Spindler) Th 3:15–6:05

417a,b. Seminar in Automated Instruction: Theory and Application—An intensive survey of theoretical and applied developments in programmed learning and computer-based instruction.

417a. 3 units. Win (Atkinson) MWF 9

417b. 3 units. Spr (Atkinson) MWF 9

419. Seminar in Research on Teaching.
3 units. Spr (Gage) MWF 9

420. Seminar for Administrative Interns—Designed for interns in general school administration and for selected assistants in the School Planning Laboratory. Analysis of problems and opportunities emerging from internship assignments.

2 units. Aut, Win, Spr (Staff) by arrangement

420i. Individual Study in Administration.
(Staff) by arrangement

423a,b,c. Seminar in School 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.

423a. 3 units. Aut (MacConnell, Strand) Th 3:15–6:05
423b. 3 units, Win (MacConnell, Strand)
   Th 3:15–6:05
423c. 3 units, Spr (MacConnell, Strand)
   Th 3:15–6:05

424a,b,c. Seminar in Junior College Administration—Curricular, teaching, administrative, and philosophical developments in Junior College Education.
424a. 3 units, Aut (Mayhew) W 7–10 p.m.
424b. 3 units, Win (Mayhew) W 7–10 p.m.
424c. 3 units, Spr (Mayhew) W 7–10 p.m.

430i. Individual Study in Educational and Vocational Guidance — Study program planned by student and instructor to strengthen student's preparation for effective guidance work.
   (McDaniel, Krumboltz) by arrangement

431. Guidance Seminar — Designed for all doctoral candidates in guidance. Analysis of professional problems in guidance and personnel work. May be repeated for credit.
   1 unit, Aut (Krumboltz) Th 7:30–9:30 p.m., biweekly
   Win, Spr, Sum (McDaniel, Krumboltz) Th 7:30–9:30 p.m., biweekly

432. Research Problems in Guidance — Identification of crucial problems on which research is needed. Design of relevant research studies. Prerequisite: consent of instructor.
   3 units, Aut (Krumboltz) MW 4:15–5:30

440. Seminar in the School Curriculum — Designed for advanced graduate students preparing for leadership positions in either public schools or colleges of education. Prerequisites: recent post-A.M. work in the foundations of education and post-credential work in the elementary and/or secondary school curriculum.
   4 units, Spr (Bush) TTh 3:15–5:05
   Sum (Hanna) MTWThF 8

444. Seminar in Elementary School Education for Doctoral Candidates — Limited to advanced graduate students preparing for careers in this field of concentration.
   2 to 10 units, Aut (Sowards) TTh 3:15–5:05
   Win (Shaftel) MW 1:15–3:05
   Spr (Hanna) TTh 8–10
   Sum (Sowards) MW 3:15–5:05 and by arrangement

444i. Individual Study in Elementary School Education.
   (Hanna, Iverson, Shaftel, Sowards) by arrangement

   2 units, Aut (Boyan) W 4:15–6:05
   (Administration emphasis)
   Spr (Allen) T 3:15–5:05 (Teacher Personnel emphasis)
   4 units, Sum (Bush) MW 3:15–5:05 and by arrangement (Student Personnel emphasis)

446i. Individual Study in Secondary Education.
   (Staff) by arrangement

447. Practicum in Secondary Education — For doctoral students only. Opportunity, under direct supervision of member of regular staff, for work in teacher, supervisor, and administrator education program of the University. May be taken during more than one quarter for maximum of 15 units. Required of all majors in Secondary Education, Teacher Education (Secondary), and special fields in Secondary Curriculum, such as English, Science, Mathematics.
   3 to 5 units, Aut, Win, Spr (Staff), by arrangement

448. Seminar in Higher Education—Examination of current problems in American colleges and universities and in higher education as a field of study.
   4 units, Win (Cowley) W 7–10 p.m. and by arrangement

448i. Individual Study in Higher Education.
   Aut, Win, Spr (Cowley, Mayhew) by arrangement

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

   1 to 30 units, any quarter (Staff) by arrangement

454. Research in Education — Research practicum. Enrollee must undertake specific
research work under the direction of a member of the faculty.

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

455. Research in Higher Education — The development by each student of a system of collecting, organizing, and analyzing data of interest to him, with emphasis on higher education materials.

4 units, Aut, Spr (Cowley) W 7–10 p.m.

and by arrangement

460i. Individual Study in Measurement and Research Methodology.

(Atkinson, Coladarci, Cronbach, Olkin), by arrangement

461. Practicum in Statistical and Psychometric Consulting — This workshop is designed to permit students specializing in statistics or psychometrics to participate (with faculty members) in a consulting experience. This course serves to train students in their roles as specialists in methodology. Students will work, under supervision, on technical problems arising out of current research in education.

2 to 4 units, Aut, Win, Spr (Coladarci, Cronbach, Olkin) by arrangement

480. Research Problems in Art Education — Designed primarily for students preparing proposals for theses in the field of art education. The seminar will provide opportunity for students to discuss problems they are considering for doctoral research.

2 to 5 units, Spr (Eisner) Th 4:15–6:05

and by arrangement

480i. Individual Study in Curriculum and Instruction in Art.

(Eisner) by arrangement


2 units, Spr (Politzer) M 4:15–6:05

482i. Individual Study in Curriculum and Instruction in Modern Languages.

(Politzer) by arrangement

484i. Individual Study in Curriculum and Instruction in English.

(Grommon) by arrangement

486i. Individual Study in Curriculum and Instruction in Speech and Drama.

(Schrader) by arrangement

487i. Individual Study in Elementary School Language Arts.

(Iverson) by arrangement

490i. Individual Study in Curriculum and Instruction in Mathematics.

(Begle) by arrangement

492. Seminar in Mathematics Education — Discussion of recent research in mathematics curriculum and instruction. For advanced students.

2 to 3 units, Aut, Win, Spr (Begle) by arrangement

494. Seminar in Science Education — Discussion of recent research in science curriculum and instruction. For advanced students.

3 units, Aut (Hurd) Th 7–10 p.m.

494i. Individual Study in Curriculum and Instruction in Science.

(Hurd) by arrangement

496. Seminar in Social Studies Education — For advanced students. Discussion of recent research and trends in social studies curriculum and instruction.

3 units, Win (Gross) W 7–10 p.m.

496i. Individual Study in Curriculum and Instruction in Social Studies.

(Gross) by arrangement

499i. Individual Study in Reading in the Elementary School.

(Iverson) by arrangement

PROFESSIONAL PHYSICAL EDUCATION COURSES AND DEGREES FOR MEN

DEGREES

Graduate men desiring to major in Physical Education may become candidates for the A.M., Ed.D., and Ph.D. degrees in Education, with concentration in Physical Education. See the section on Graduate Degrees.

TEACHING CREDENTIALS

Teaching Credential in Secondary Education. Men desiring to teach Physical Education classes and coach athletic teams as their preferential assignment in secondary schools should enroll in the Physical Education secondary teaching intern program in order to qualify for the Standard Teaching Credential in Secondary Education in the
State of California. Course work in this credential teaching field program in Physical Education may begin in the sophomore or junior year. It continues through the senior and first graduate year. Interested students should obtain their A.B. degrees in a department of the School of Humanities and Sciences, and take the required professional physical education courses concurrently. For the requirements of the intern credential program, see the section “Teaching Credential (Secondary),” in the Education introductory material.

**INFORMATION**

For details concerning any of the above Physical Education programs see Professor John Nixon or Professor Wesley Ruff in the School of Education, or in the Department of Physical Education and Athletics for Men.

155. Elementary Analysis of Body Movement—Introduction to anatomical and mechanical aspects of human movement. Enrollment by permission of instructor.

2 units, Spr (Ruch) TTh 8

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

3 units, Aut (Nixon) MWF 8

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 8

171, 172. Curriculum and Instruction in Men's Physical Education — Emphasizes knowledge of physical education activities basic to the school curriculum, and substantive knowledge of health and fitness aspects of the individual participant. Considers research and principles relevant to specialized areas of the curriculum and to teaching procedures. Stresses evaluation in the teaching process. Includes both theoretical and practical training. Open only to men physical education credential and degree candidates. Not open to freshmen.

2 units, Win (Fehring, Young) TTh 11 and by arrangement

171b. Basketball.
2 units, Aut (Dallmar) Th 11 and by arrangement

171c. Football.
2 units, Spr (Ralston) TTh 10 and by arrangement

171d. Track and Field.
2 units, Win (Jordan) MW 10 and by arrangement

171e. Adapted Physical Education.
1 unit, Spr (Ruff) M 1:15

171f. Combatives.
2 units, Win (Lunny, Leland)
MWF 3:15

171h. Athletic Training and Conditioning.
2 units, Aut, Win, Spr (Jarvis) by arrangement

172a. Aquatics.
2 units, Spr (Gaughran) TTh 11 and by arrangement

172b. Gymnastics.
2 units, Win (Gilmore) MWF 2:15 and by arrangement

172c. Golf.
2 units, Win (Finger) MF 11 and by arrangement

172d. Tennis.
2 units, Aut (Gilmore) by arrangement

172e. Volleyball, Soccer, Speedball.
2 units, Spr (Ruff) MWF 2:15

176. Intramural Programs — The study of the theory and principles of intramural sports organization and administration, including program scope, competition media, scheduling, awards, evaluation, equipment, finance and personnel.

2 units, Win (Higgins) TTh 9

177. Physiology of Exercise—Physiological adaptations of the human organism to exercise stress in dance, sports and designed exercises. Includes laboratory demonstrations and exercises. Prerequisite: Biology 4 or equivalent.

3 units, Aut (Ruff) lec. TTh 8, lab. T 1:15-3:05 and one hour by arrangement

179. Kinesiology—Application of anatomy, physiology, laws of mechanics to human motion. Prerequisite: Anatomy 114.

4 units, Spr (Ruch) MWF 1:15-3:05
277. Human Physical Performance Research—Emphasizes relevant literature and laboratory research experience. Prerequisite: 177 or equivalent.
   3 units, Win (Ruff) lec. MW 12-2; lab. by arrangement

356. Current Literature and Research in Physical Education—Critique of significant recent literature in physical education, and the theory and principles of basic and applied research in physical education.
   3 units, Aut (Nixon) MWF 10
   3 units, Sum (Ruff) MTWTh 8

357. Recent Developments in Public School Physical Education—An analysis of recent philosophic trends, research developments and trends, curriculum innovations, new teaching procedures, evaluation improvements, teacher education progress, and comparative physical education contributions from selected countries.
   3 units, Spr (Nixon) M 7-10 p.m.

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.
   3 units, Sum (Ruff) TTh 1:15-3:05

458. Individual Study in Physical Education—Required of doctoral candidates for the purpose of studying a significant problem or topic in physical education or engaging in applied or basic research under the direction of the instructor.
   2 to 6 units, any quarter (Nixon, Ruff) by arrangement

459. Seminar in Physical Education—For advanced graduate students. Intensive study and discussion of recent research and crucial problems in the field of physical education.
   3 units, Win, Sum (Nixon, Ruff) by arrangement

HEALTH EDUCATION

Emeriti: George S. Luckett (Professor); Lois P. Todd (Assistant Professor)
Executive Head: Oliver E. Byrd
Professor: Oliver E. Byrd
Acting Assistant Professors: B. Otis Cobb, Harry E. Zion

The undergraduate courses in health education are based upon the philosophy that knowledge of the factors that influence health should be the possession of every cultured individual and that an understanding of the principles of healthful living requires training in the application of the scientific facts of the various fundamental sciences which are related to health.

The graduate courses in health education are designed for the training of teachers and school administrators who desire special competence in the field of school health.

TEACHING CREDENTIALS

Students in the Department of Health Education may follow a major or minor sequence of study leading to teaching credentials for the State of California. For the details of these requirements, the student is referred to the Credential Secretary of the School of Education.

PROGRAMS OF STUDY

Through the School of Education, the Department of Health Education offers the A.M. and Ed.D. degrees with specialization in health education. Candidates not interested in the field of education may secure the A.M. degree through the Department of Health Education. Candidates for the Master of Arts degree must complete at least 36 units of graduate work in the Department of Health Education. The degree of Doctor of Education may be recommended for those candidates who satisfy the requirements of the School of Education and who devote approximately one-half of their course work on the graduate level to certain offerings from the Department of Health Education. Complete information on this degree may be secured from the office of the Dean of the School of Education.

UNDERGRADUATE COURSES

100. Science of Health—Function, structure, and application of component segments of contemporary medical science. Emphasis placed on health needs of the individ-
ual and resources available through application of scientific medical knowledge. Physician specialists are used as guest speakers when appropriate.

3 units, Win, Spr (Cobb) MWF 9

101. Medicine for the Layman—A nontechnical interpretation of current medical research and clinical experience as revealed in the medical literature. Medical abstracts are based upon articles selected, condensed, and reported by the instructor. Student inquiry and group discussions are based upon these samples of opinion, research, and experience of modern medicine.

3 units, Aut, Win, Spr (Byrd, Zion) MWF 10

106. Personal Mental Health — Group discussions of the specific personal mental health problems of students enrolled in the class against the background of the problems which the present-day college atmosphere presents.

3 units, Aut, Win, Spr (Zion) MWF 9

107. Safety—A consideration of accidents as they occur — on the highway, at home, in schools, in recreation, etc.—and the means of prevention. Emphasis is placed upon looking at the individual and his values and at the environment as factors in accident prevention.

3 units, Win (Zion) MWF 10

109. Community Health — Programs and agencies now functioning to maintain and improve the health of groups of people; a careful look at the interrelationships of individual and community responsibilities in the field of health.

3 units, Win (Cobb) W 7–10 p.m.

121. Marriage and Family—A comprehensive look at marriage and the resulting family, both as a significant phenomenon of the culture and a probable, personal concern of students. Emphasis on those areas where knowledge and adjustment are most crucial for happy marriage: health aspects, courtship and mate selection, finances, sex, religion, and interpersonal relations with other family members. Spring quarter class open to juniors and seniors only.

3 units, Aut, Win, Spr (Cobb) MWF 10

GRADUATE COURSES

206. Pupil Health Emergencies—First aid, medical and legal procedures involved in teacher, nurse and school management of pupil health emergencies.

3 units, Aut (Zion) MWF 11

207. The Nurse in the School–Community Program—The potential and responsibilities of the nurse as a member of the school health–community health team. Her relationships to the purposes and structure of today’s school and community health program. For nurses, school administrators, teachers and health personnel; others with consent of instructor.

3 units, Spr (Cobb) by arrangement

214. School Health Programs — Survey of functions of school health programs as related to instruction, healthful school environment, school health services. For education majors only.

4 units, Win (Byrd) MTWTh 9

Sum (Byrd) by arrangement

215. Teaching Units—Preparation of teaching materials in health education; designed to supplement preparation of teachers, prospective teachers. For education majors only.

2 to 16 units, any quarter (Byrd) by arrangement

291a,b. Curriculum and Instruction in Health Education — Familiarization with the many current sources of facts and ideas relative to health, with special focus on periodicals; utilization of materials in developing teaching materials; consideration of various methods for using materials in teaching.

291a. 3 units, Aut (Cobb) MWF 12

291b. 3 units, Win (Byrd) by arrangement

305. Practicum in School Nursing—Participation in work of school nurse under supervision of school district and University Department.

4 to 12 units, any quarter (Byrd) by arrangement

400. Individual Study in Health Education.

2 to 15 units, any quarter (Byrd) by arrangement

405. Seminar in Health Education — Consideration of current issues and controversies in health education. Limited to advanced graduate students in health education, other graduate students with at least six courses in health, and advanced medical and nursing students.

2 units, Spr (Byrd) W 2:15–4:05
The School of Engineering has seven academic departments as organizational subdivisions (Aeronautics and Astronautics; Chemical Engineering; Civil Engineering; Electrical Engineering; Industrial Engineering; Materials Science; and Mechanical Engineering), together with some interdepartmental activities having degree programs such as the divisions of Engineering Mechanics and Engineering-Economic Systems. These departments are responsible for the various student curricula, with the exception of the School-wide programs in General Engineering and Engineering Science. In research, where the scope of faculty interest and competence embraces both engineering and the supporting sciences, there is not only a large program within the School, but there is also faculty and student participation in several inter-School activities, including the Applied Mathematics and Statistics Laboratory, the Microwave Laboratory, the Center for Materials Research, the Institute for Plasma Research, and the Radio Astronomy Institute.

The School offers undergraduate curricula leading to the degree of Bachelor of Science, and various graduate curricula (administered by the departments of the School) leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy. Requirements for the degree of Bachelor of Science may normally be completed in twelve quarters. Instruction in engineering is offered in each of the four quarters of the academic year. The summer quarter offerings include the basic courses required of all engineering students, a few other undergraduate courses, and selected regular and special graduate courses.

**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 B, 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 included in the list of "Courses Normally Taken by All Engineering Students." 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 applied to School of Engineering requirements whenever the courses are equivalent or substantially similar. Substitution of transfer credits for courses that are required by the General Studies. Program is administered by the University Committee on General Studies. 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.

UNDERGRADUATE PROGRAMS OF STUDY

The principal objective of the School of Engineering is to provide, in the setting of a comprehensive, residential university, a combination of a cultural education, through the General Studies Program (including the Overseas Program), and a broad technical preparation for careers in modern engineering. Central to the latter is a strong preparation in the basic sciences, followed by a “common core” of engineering subjects embracing concepts and techniques which are judged to be fundamental to engineering as a discipline, irrespective of field of specialization.

As to specialization, there is a modest opportunity to use elective units in a systematic way to provide an introduction to and a measure of competence in a chosen field. Or conversely, in the Engineering (General) and Engineering Science curricula, there is opportunity to increase the breadth of exposure to subjects within and outside the School of Engineering. Undergraduate options are described on the following pages under departmental listings, and for convenience are tabulated here alphabetically:

- Aeronautics and Astronautics
- Chemical Engineering
- Civil Engineering
- Construction
- Electrical Engineering (including Electronics)
- Engineering Design
- Engineering Science
- General Engineering
- Highways
- Hydraulics
- Industrial Engineering (including Operations Research)
- Materials Science (including Metallurgy)
- Mechanical Engineering
- Mechanics
- Nuclear Engineering
- Product Design
- Public Works Administration
- Structures
- Thermosciences
- Water Resources

These options are not rigid; the needs of each student can be considered individually.

The four years of the B.S. program in all of these fields divide into about one fourth general studies (humanities and social sciences), one fourth basic sciences (mathematics, physics, and chemistry), one fourth common engineering subjects, and one fourth specialization in one of the elective options. Courses in all these categories are distributed throughout the four years in order to provide a fully integrated program.

All undergraduate curricula, namely, Chemical, Civil, Electrical, General, Industrial, and Mechanical Engineering, Engineering Science, and Materials Science, are accredited by the national organization responsible for accrediting of engineering curricula: The Engineers' Council for Professional Development (E.C.P.D.). The curriculum in Aeronautics and Astronautics is also accredited, but at the Master's degree level; the undergraduate curriculum in this field is an option within Mechanical Engineering.

Courses common to all curricula appear in the first table below. Supplementary lists for each of the curricula will be found in the tables following. A student who satisfactorily completes the courses normally taken by all students of engineering, together with one of these supplementary lists, will be recommended by the School of Engineering for the degree of Bachelor of Science. The total number of required units is a minimum of 180–194, depending upon the curriculum selected.

The requirements listed below under the heading “Courses Normally Taken by All Engineering Students” may be modified in unusual situations to satisfy specific objectives. To do so requires a petition to the Registration and Graduation Committee of the School of Engineering, except for certain substitutions which are specifically permitted (see “Supplementary Requirements” for each curriculum). Such petitions must be submitted before the start of the third quarter preceding graduation to receive full consideration by the Committee.

Substitutions or deletions from the “Supplementary Requirements” may be made with the approval of the student's faculty adviser. Every student is urged to discuss with his adviser any change that would improve the curriculum for his personal needs.
COURSES NORMALLY TAKEN BY ALL ENGINEERING STUDENTS

Subject Units

1. General Education subjects
- English (English 1, 2, 3, 129) (See Note 3) 12
- History of Western Civilization (History 1, 2, 3) 12
- General Studies Humanities (See Notes 1 and 3) 5
- General Studies Social Sciences (See Notes 2 and 3) 10
- Public Speaking (Speech 20; see Notes 1 and 3) 3

Subtotal 42

2. Basic Science and Mathematics subjects
- Physics (Physics 51-57, incl.) 18
- Chemistry (Chem. 4, 5) 8
- Analytic Geometry and Calculus (Math. 41-44, inc.; see Note 4) 18
- Statistics (See Note 5) 3 or 4

Subtotal 47 or 48

3. Engineering Science and General Engineering subjects
- Engineering Mechanics (Engr. 11, 12) 6
- Mechanics of Materials (Engr. 15 or 18) 3
- Mechanics of Fluids (See Note 6) 3 or 4
- Thermodynamics (See Note 7) 3 or 5
- Electrical Science (Engr. 41, 41A, 42, 42A) 10
- Science of Materials (Engr. 50) 3
- Engineering Drawing (Engr. 9) 4
- Engineering Economy (Engr. 161, 60, or 61) 3

Subtotal 35-38

Total all subjects 124-128

Note 1.—The General Studies Humanities requirement is at least 8 units selected from the list of approved courses given in the General Studies Bulletin. Speech 20 is a requirement of the School of Engineering and also may be offered as partial fulfillment of the General Studies requirement.

Note 2.—The General Studies Social Sciences requirement is at least two 5-unit courses selected from the list of courses given in the section on the General Studies Program.

Note 3.—All students who attend an Overseas Campus in Europe automatically fulfill the General Studies requirements in Humanities and Social Sciences; in addition, the School of Engineering requirements of Speech 20 and English 129 are waived.

Note 4.—The 3-unit mathematics sequence (Math. 10, 11, 21, 22, 23, 44) is an alternative which necessitates postponing physics until the second year and hence may delay graduation in some curricula. Math. 24 may be substituted for Math. 44 if no additional mathematics courses are to be taken.


Note 6.—Engr. 21, Mechanics of Fluids, 4 units, or (for Chemical Engineering students only) Ch.E. 130a, Transport Phenomena: Momentum Transport, 3 units.

Note 7.—Engr. 31, Elementary Engineering Thermodynamics, 5 units, or Chem. 171, 173, Physical Chemistry, 6 units, or Physics 170, Thermodynamics, 3 units. (Consult adviser.) Note that Physics 170 has Math. 130 as a prerequisite. Chemical Engineering and Materials Science students should take Physical Chemistry.

SCHEDULING OF COURSES

Sample programs are available in the office of the Dean of Engineering to assist students in the scheduling of courses. Many engineering courses have prerequisites and other departmental requirements which make scheduling difficult, hence the following rules should be noted:

Engr. 5 is available for freshmen and sophomores only
Engr. 9 should be taken freshman year
Engr. 11 should be taken before end of sophomore year
Engr. 12, 15, 21, 31, 41, 41A, 42, 42A should be taken before end of junior year
Engr. 161 should be taken during the junior or senior year
Electrical engineering students should take Engr. 41, 41A, 42 before end of sophomore year.

1. SUPPLEMENTARY REQUIREMENTS, CHEMICAL ENGINEERING

Course No. Subject Units
Chem. 121, 123. Organic Chemistry 6
Chem. 122. Organic Preparations 3
Chem. 175. Physical Chemistry 3
Chem. 176. Physico-Chemical Measurements 3
Ch.E. 10. Introduction to Chemical Engineering 3
Ch.E. 120a, b. Chemical Engineering Thermodynamics 3
Ch.E. 130b. Transport Phenomena 3
Ch.E. 140a, b, c. Unit Operations 9
Ch.E. 141a, b. Chemical Engineering Laboratory 6
Ch.E. 150. Chemical Kinetics 3
Ch.E. 160. Chemical Engineering Plant Design 2

Approved Electives (See Note 1) 6 to 20
Omissions (See Note 2) 0 to –14

Note 1.—Suggested electives for added depth in closely related engineering and scientific subjects:
Ch.E. 190, 201, 202; Chem. 112, 113, 116, 125; Math. 45, 46, 107, 113, 130, 131, 132; Engr. 5; C.S. 136; I.E. 152; Stat. 116; Language.

Note 2.—A student wishing a broader engineering program may take the “Courses Normally Taken by All Engineering Students” together with 6 units from the approved electives in Note 1. Or, in order to take more of the electives suggested in Note 1, he may omit up to 14 units from the common list as follows: Engl. 129; Engr. 50, 42, 42A; Physics 57.
2. **Supplementary Requirements, Civil Engineering**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 5. Computer Programming for Engineers</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 20. Surveying</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 107. Mechanics of Fluids</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 114. Mechanics of Materials</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 116. Placing Concrete</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 118. Materials Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 138. Specifications and Contracts</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 150. Transportation Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 160. Hydrology and Hydraulic Structures</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>C.E. 180. Elementary Structural Analysis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>C.E. 181. Structural Design</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 182. Structural Design</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 190. Soil Mechanics and Foundations</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>C.E. 198. Senior Report*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Elective Courses as below</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>60</strong></td>
<td></td>
</tr>
</tbody>
</table>

*C.E. 197 may be taken in lieu of C.E. 198 and will count as 3 units of electives in addition.*

The elective courses normally will be selected from undergraduate offerings in civil engineering or closely allied subjects. With permission some courses designated as primarily for graduate students may be included. Suggested uses of these units by students with well-defined interests are listed below.

### Construction

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 126. Advanced Surveying</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>C.E. 144. Construction Estimates and Costs</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 145. Construction Equipment and Methods</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>I.E. 133. Industrial Accounting</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### Highways

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 126. Advanced Surveying</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>C.E. 151. Highway Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Plus 6 or more units among:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C.E. 144. Construction Estimates and Costs</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 145. Construction Equipment and Methods</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>I.E. 133. Industrial Accounting</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### Hydraulics and Fluid Mechanics

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 145. Construction Equipment and Methods</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 163. Hydraulic Machinery</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>C.E. 170. Man and His Environment</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 106. Complex Variable</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 130, 131, 132. Differential Equations</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

### Hydrology

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geol. 285. Hydrogeology</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Math. 130. Ordinary Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Stat. 116. Probability</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### Nuclear Design

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 171. Introduction to Nuclear Engineering</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Engr. 172. Nuclear Chemistry</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

#### Plus 7 units from:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 171. Environmental Radioactivity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 130. Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 231. Nuclear Reactor Materials</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

#### Public Works Administration

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 170. Man and His Environment</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 171. Environmental Reactivity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pol.Sci. 100. Public Administration</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>I.E. 133. Industrial Accounting</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

#### Sanitary Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 170. Man and His Environment</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 171. Environmental Reactivity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Biology 4 and 5. General Biology</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Medical Microbiology 101. General Bacteriology</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

### Structures

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 183. Structural Design</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Math. 130 and 131. Differential Equations</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Math. 45. Advanced Calculus</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Engr. 104. Dynamic Response</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### Water Resources

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 170. Man and His Environment</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.E. 171. Environmental Reactivity</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>I.E. 133. Industrial Accounting</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Pol.Sci. 100. Public Administration</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Strict adherence to one of these programs is not required. Students whose interests lie primarily in engineering administration may select industrial engineering courses as electives.

3. **Supplementary Requirements, Electrical Engineering**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 100*, 101, 102. Circuits, Elementary Network Theory</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>E.E. 110. Electromagnetic Fundamentals</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E.E. 111. Electromagnetic Waves</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E.E. 128. Control Systems</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E.E. 150, 151, 152. Electronics</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>E.E. 156, 157. Laboratory</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>E.E. 138 or 170 or 172. Laboratory, or E.E. 180. Design Project (Lists B, C)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C.S. 136, or 5, 6. Use of Digital Computers</td>
<td>3 or 4</td>
<td></td>
</tr>
<tr>
<td>Optional program, such as “A,” “B,” or “C” below</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

* Students interested in automatic control may wish to consider Engr. 104 plus supplementary study in place of E.E. 100.

Courses to complete the undergraduate program will be selected according to the student's interest. The following three lists of courses are suggested. These are arranged for three general types of interest in electrical engineering, and students who wish variations or intermediate arrangements should see their faculty advisers.
List A is for students with a primary interest in the business and administrative aspects of electrical engineering such as plant management, contracting, selling, and application engineering. Students who like to deal with people, and prefer committee work to laboratory work, may wish to choose this program.

At least 15 units of work are to be taken from the following list or from the courses listed for industrial engineering.

**List A**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 124</td>
<td>Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 138.*</td>
<td>Control Systems Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 159.</td>
<td>Electron Tubes and Associated Circuits</td>
<td></td>
</tr>
<tr>
<td>E.E. 161.</td>
<td>Information Transmission and Modulation</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 162.</td>
<td>Radio Engineering</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 164.</td>
<td>Pulse and Timing Circuits</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 172</td>
<td>Microwave Measurements</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 200.</td>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Math. 130.</td>
<td>Ordinary Differential Equations</td>
<td></td>
</tr>
</tbody>
</table>

* If not elected under Supplementary Requirements.

List B is for students who expect to engage in technical electrical engineering work such as design or operation of devices, circuits, or systems. This is the standard preparation for the professional electrical engineer. Graduate study leading to the Master of Science or Engineer degree is recommended to follow this program.

At least 15 units of work are to be taken from the following list. The first course, Math. 130, is required; others are optional, depending on the student's interest.

Substitution of Physics 110 and 111 in place of Engr. 11 and 12 is suggested for consideration by the student. Such substitution requires a petition.

**List B**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 130.</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 124</td>
<td>Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 138.*</td>
<td>Control Systems Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 159.</td>
<td>Electron Tubes and Associated Circuits</td>
<td></td>
</tr>
<tr>
<td>E.E. 161.</td>
<td>Information Transmission and Modulation</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 162.</td>
<td>Radio Engineering</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 163.</td>
<td>Fourier Transform and Its Applications</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 164.</td>
<td>Pulse and Timing Circuits</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 165.</td>
<td>Random Signals and Noise</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 167.</td>
<td>Electric and Magnetic Properties of Solids</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 172.</td>
<td>Microwave Measurements</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 234.</td>
<td>Nonlinear Network Analysis</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 235.</td>
<td>Introduction to Network Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 200.</td>
<td>Seminar</td>
<td>1</td>
</tr>
</tbody>
</table>

* If not elected under Supplementary Requirements.

List C is for students interested in science and mathematics, preparing for life work in electrical engineering research or teaching. This course should be followed by graduate study, possibly to the Ph.D. degree, in preparation for such positions.

The following courses are to be taken, also 9 units are to be elected from reasonably advanced courses in engineering, physics, mathematics, and chemistry (such as E.E. 112, 138, 163, 165, 167, 171, 172, 234, 270E, Math. 45, 46, 106, 113, 114, 131, 132, etc.). If E.E. 170 was not elected under “Supplementary Requirements,” it should be included here.

To allow time for these courses, the following may be omitted from the list of “Courses Normally Taken by All Students of Engineering”: Engr. 11, 12, and 15 (total, 9 units). Note, however, that these engineering courses may be omitted only if the student is taking all the following List C courses with the expectation of pursuing graduate study. (In this program, Physics 110 replaces Engr. 12 as a prerequisite for Engr. 21.)

**List C**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 110, 111.</td>
<td>Intermediate Mechanics</td>
<td>6</td>
</tr>
<tr>
<td>Math. 130.</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 161.</td>
<td>Information Transmission and Modulation</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 235.</td>
<td>Introduction to Network Synthesis; or E.E. 240. Linear Systems</td>
<td>3 or 5</td>
</tr>
<tr>
<td>Electives, restricted as above</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Omissions as above</td>
<td>(–9)</td>
<td></td>
</tr>
</tbody>
</table>

Total: ................................................. 15

4. **Supplementary Requirements, Engineering Science**

The procedure for entering this curriculum is described later under the heading “Engineering Science.”

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 130, 131 (Diff. Equations), or 45, 46 (Adv. Calculus)</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Restricted Electives in Engineering Science (see below)</td>
<td>21 or more</td>
<td></td>
</tr>
</tbody>
</table>
Restricted Electives in Basic Science  
(see below)  9 or more

Unrestricted Electives (see below)  17 or more

Total ........................................ 53 or more

**Restricted Electives in Engineering Science**

A total of 21 units selected from the following list of technical courses, including a minimum of 3 units in laboratory work chosen from the first six courses listed:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 122.</td>
<td>Mechanical Engineering Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>E.E. 156, 157.</td>
<td>Electrical Engineering Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>E.E. 138.</td>
<td>Control Systems Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 107.</td>
<td>High Temperature Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>E.M. 205.</td>
<td>Experimental Stress Analysis</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 107.</td>
<td>Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 114.</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 118.</td>
<td>Materials Engineering</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 180.</td>
<td>Elementary Structural Analysis</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 280.</td>
<td>Theory of Structures</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 281a,b.</td>
<td>Matrix Structures</td>
<td>6</td>
</tr>
<tr>
<td>E.E. 100, 101, 102.</td>
<td>Electric Circuits</td>
<td>10</td>
</tr>
<tr>
<td>E.E. 110.</td>
<td>Electromagnetic Fundamentals</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 111.</td>
<td>Electromagnetic Waves</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 112.</td>
<td>Electrodynamics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 124.</td>
<td>Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 128.</td>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 150, 151, 152.</td>
<td>Electronics</td>
<td>9</td>
</tr>
<tr>
<td>E.E. 161.</td>
<td>Information Transmission and</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Modulation</td>
<td></td>
</tr>
<tr>
<td>E.E. 163.</td>
<td>Fourier Transforms</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 165.</td>
<td>Random Signals and Noise</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 167.</td>
<td>Electric and Magnetic Properties of Solids</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 234.</td>
<td>Nonlinear Network Analysis</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 235.</td>
<td>Introduction to Network Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 240.</td>
<td>Introduction to the Theory of Linear Systems</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 270.</td>
<td>Electromagnetic Theory</td>
<td>3</td>
</tr>
<tr>
<td>E.M. 221, 222, 223.</td>
<td>Advanced Dynamics</td>
<td>9</td>
</tr>
<tr>
<td>M.E. 132, 133, 134, 135, 136.</td>
<td>Engineering Thermodynamics</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 107.</td>
<td>Mass Transport</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122.</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 124.</td>
<td>Phase Equilibria</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 125.</td>
<td>Structural Transformation in Materials</td>
<td>4</td>
</tr>
<tr>
<td>Mat.Sci. 127.</td>
<td>Crystallography and X-Ray Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Mat.Sci. 130.</td>
<td>Mechanical Behavior of Solids</td>
<td>3</td>
</tr>
<tr>
<td>C.S. 136.</td>
<td>Use of Automatic Digital Computer</td>
<td>3</td>
</tr>
</tbody>
</table>

Unrestricted Electives — These elective units may be used for further studies in basic science, engineering science, more specialized engineering subjects, or General Studies.

Special Note — Students majoring in Engineering Science may substitute Physics 110 and 111 for Engineering 11 and 12 in the list of “Courses Normally Taken by All Engineering Students.”

5. SUPPLEMENTARY REQUIREMENTS, GENERAL ENGINEERING

Additional courses constituting a coherent program and totaling at least 56 units are required. A minimum of 25 of these units must be in regularly scheduled courses offered by the School of Engineering. A maximum of 9 units of ROTC courses may be included in the 56 units. The program of courses is arranged by the student in consultation with one of the program advisers for General Engineering. The procedure for entering this curriculum is described later under the heading “General Engineering.”

A program in Product Design is offered within General Engineering by the Design Division of the Department of Mechanical Engineering. It is recommended that this not be considered a terminal program, and that all students majoring in Product Design continue through the Master’s degree in this field. The undergraduate program in Product Design is as follows:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 4.</td>
<td>Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 50.</td>
<td>Kinematics</td>
<td>3</td>
</tr>
</tbody>
</table>
A program in Resource Strategy is offered for engineering students interested in the techniques of application of modern science and technology to the problems and resources of newly developing nations. The program is intended to provide a broad educational background which, with experience, will enable the engineering graduate to better analyze the needs of a political or geographical area, to evaluate the available resources, and to devise an optimum plan of development. It is expected that graduates would be suited for service with international development agencies of the Federal Government, in the Peace Corps, in the Department of the Interior, with state and local governments, in international operations of private concerns, or with foreign governments. The program is particularly suited to foreign students seeking to prepare themselves for positions of leadership in their home countries. In satisfying the General Studies requirements, Anthropology 1, Economics 1, and Philosophy 5 are recommended. The required 20 units of Engineering should be selected to provide special competence in an area such as transportation, communication, industrial enterprise, or civil works. Up to 12 units may be devoted to a foreign language. The balance of 24 or more units is selected by the student in consultation with his adviser. Attention is called to the availability of the following courses:

### Course No. Subject Units

| Anthr. 131. Comparative Social Systems | 4 |
| C.E. 150. Transportation Engineering | 3 |
| C.E. 170. Man and His Environment | 3 |
| Econ. 118. Underdeveloped Economics | 5 |
| Geog. 4. Economic Geography | 5 |
| Ed. 206a. Comparative Education | 3 |
| Engr. 181a,b,c. Seminar in Resource Strategy | 6 |
| E.E.S. 212. Water-resources Planning | 3 |
| I.E. 100. Industrial Organization | 4 |
| I.E. 263. Engineering and Organization of Small Businesses | 3 |
| Pol.Sci. 107. Seminar in Government and Natural Resources | 5 |
| Sociol. 175. The Evolution of Underdeveloped Societies | 5 |

### 6. Supplementary Requirements, Industrial Engineering

**Course No.**  **Subject**  **Units**

| M.E. 4. Manufacturing Processes | 3 |
| Engr. 5. Computer Programming for Engineers | 2 |
| I.E. 100. Industrial Organization and Management | 4 |
| I.E. 108. Work Design and Measurement | 3 |
| I.E. 120. Quality Control by Statistical Methods | 3 |
| I.E. 133. Industrial Accounting | 4 |
| I.E. 141. Utilization of Computers | 3 |
| I.E. 161. Design of Production Systems | 3 |
| I.E. 162. Systems Planning and Control | 3 |
| I.E. 191. Senior Seminar | 3 |
| Psych. 122. Industrial Psychology | 3 |
| Econ. 145. Economics of Labor | 5 |
| Stat. 110. Statistical Methods or Stat. 27. Introduction to Probability Theory* | 3 or 4 |
| Restricted Electives | 11 |

Total: 59-60

* Whichever course is not taken in satisfaction of the requirements for all engineering students.

The restricted electives must be selected to provide a coordinated program to give study in depth in one area, and must be approved by the adviser. Suggested sets of electives which meet these requirements are available in the Department Office.

### 7. Supplementary Requirements, Materials Science

**Course No.**  **Subject**  **Units**

| C.S. 136 or C.S. 5 and 6. Use of Automatic Digital Computers | 3 |
| Chem. 171, 173. Physical Chemistry | 6 |
| Math. 45. Advanced Calculus | 3 |
| Math. 130, 131. Differential Equations | 6 |
| Mat.Sci. 104. Crystallography | 2 |
| Mat.Sci. 105. Imperfections in Crystalline Solids | 3 |
| Mat.Sci. 121. Mass Transport | 3 |
| Mat.Sci. 122. Solid State Thermodynamics | 3 |
| Mat.Sci. 124. Phase Equilibria | 4 |
| Mat.Sci. 125. Structural Transformations in Materials | 4 |
| Mat.Sci. 127. X-Ray Diffraction and Spectroscopy | 3 |
| Mat.Sci. 128. Materials Engineering | 3 |
| Mat.Sci. 130. Mechanical Behavior of Solids | 4 |
| Mat.Sci. 152. Electrical, Optical, and Magnetic Properties of Materials | 4 |
| Electives | 6 |

Total: 57
Materials Science cuts across several traditional fields of science and engineering. Electives are provided to allow students to develop secondary emphasis in one or more of the traditional fields. Materials Science students who desire a particularly strong background in mathematics and physics in preparation for graduate study leading to a career in research and teaching should include the following elective courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 110, 111</td>
<td>Intermediate Mechanics</td>
<td>6</td>
</tr>
<tr>
<td>Physics 120, 121, 122</td>
<td>Intermediate Electricity and Magnetism</td>
<td>9</td>
</tr>
</tbody>
</table>

To allow time for these courses, the requirements in Engineering Mechanics, Mechanics of Fluids, and Engineering 41, 41A, 42, 42A, and 161 may be omitted from the list of “Courses Normally Taken by All Students of Engineering.” A Materials Science adviser must approve each student’s selection of electives.

8. **Supplementary Requirements, Mechanical Engineering**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 5.</td>
<td>Computer Programming for Engineers; or C.S. 136, Use of Automatic Digital Computers</td>
<td>2 or 3</td>
</tr>
<tr>
<td>Engr. 104.</td>
<td>Dynamic Response</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 4.</td>
<td>Manufacturing Processes</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 50.</td>
<td>Engineering Kinematics</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 114a.</td>
<td>Mechanical Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 122.</td>
<td>Mechanical Engineering Laboratory (or A.A. 131, Experimentation in Aeronautics and Astronautics)</td>
<td>4</td>
</tr>
<tr>
<td>M.E. 132.</td>
<td>Engineering Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 136.</td>
<td>Mechanics of Compressible Fluids</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 114.</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Math. 45.</td>
<td>Advanced Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>Math. 130.</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Optional Program, from those listed below</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

Total. ........................................ 57-58

Each student should choose one of the following options and select a minimum of 23 units from the courses listed. The particular packaging of courses listed represents what is believed to be an optimum for the typical student, but the student’s adviser may authorize substitutions, or actual combinations of options, if it can be shown that the student’s program is thereby strengthened.

**Aeronautics and Astronautics**

Students in this option should take A.A. 131 in place of M.E. 122 in the supplementary requirements above, and then 23 units minimum from the following:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.A. 100.</td>
<td>Introduction to Aeronautics and Astronautics</td>
<td>2</td>
</tr>
<tr>
<td>Math. 46.</td>
<td>Advanced Calculus III or</td>
<td>3</td>
</tr>
<tr>
<td>A.A. 192.</td>
<td>Vector Analysis and Cartesian Tensors</td>
<td>3</td>
</tr>
<tr>
<td>Math. 131.</td>
<td>Partial Differential Equations I or</td>
<td>3</td>
</tr>
<tr>
<td>Math. 106.</td>
<td>Introduction to Theory of Functions</td>
<td>3</td>
</tr>
<tr>
<td>of a Complex Variable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Optional:

| Physics 61. | Optics and Wave Motion               | 3     |
| A.A. 129. | Colloquium on Life Science Problems in Space Exploration | 2     |
| A.A. 200a. | Wing Theory                          | 3     |
| A.A. 210b. | Fundamentals of Compressible Flow    | 3     |
| A.A. 211a. | Physical Gas Dynamics                | 3     |
| A.A. 220. | Physical Measurements in Fluid Dynamics | 3     |
| A.A. 226. | Astronomy for Physical Scientists    | 2     |
| A.A. 227a. | Introduction to Space Physics I      | 2     |
| A.A. 240a,b. | Aircraft and Missile Structures     | 6     |
| A.A. 242a. | Classical Dynamics I                 | 3     |
| A.A. 260a. | Aircraft and Missile Structures Laboratory | 3     |
| A.A. 279a. | Space Mechanics                      | 3     |
| A.A. 280a. | Rocket Propulsion Fundamentals       | 3     |
| Chem. 171. | Physical Chemistry                   | 3     |
| E.E. 110. | Electromagnetic Fundamentals         | 3     |
| E.E. 124. | Electromechanics                     | 3     |
| E.E. 128. | Control Systems                      | 3     |
| E.E. 270. | Elementary Electromagnetic Theory    | 3     |
| E.M. 242. | Mathematical Hydro- and Aerodynamics | 3     |
| Mat.Sci. 105. | Imperfections in Crystalline Solids | 3     |
| Mat.Sci. 130. | Mechanical Behavior of Solids        | 4     |
| M.E. 134. | Introduction to Kinetic Theory and Statistical Mechanics | 3     |

**Engineering Design**

23 units minimum from the following:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 112a.</td>
<td>Rapid Visualization</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 114b.</td>
<td>Mechanical Engineering Design</td>
<td>4</td>
</tr>
</tbody>
</table>

Optional:

| Math. 46. | Advanced Calculus III                | 3     |
| M.E. 131. | Partial Differential Equations I     | 3     |
| M.E. 112b. | Introduction to Product Design       | 3     |
| M.E. 114c. | Design of Mechanical Engineering     | 3     |
| Systems                  |                                          |
| M.E. 116a. | Human Factors in Product Design      | 3     |
| M.E. 123. | Mechanical Engineering Laboratory    | 3     |
| M.E. 135. | Heat, Mass, and Momentum Transfer    | 3     |
| M.E. 161. | Engineering Vibrations               | 3     |
| Mat.Sci. 126. | Materials Engineering Design        | 2     |
| E.E. 128. | Control Systems                      | 3     |

**Thermo and Nuclear Sciences**

(Students ultimately planning to do advanced research work in these areas may find it desirable...
to choose some courses from the Mathematics, Physics, and Engineering Mechanics Option, or to confine themselves entirely to that option.)

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 46. Advanced Calculus III 3</td>
</tr>
<tr>
<td>Math. 106. Complex Variables 3</td>
</tr>
<tr>
<td>Math. 131. Partial Differential Equations 3</td>
</tr>
<tr>
<td>M.E. 123. Mechanical Engineering Laboratory 4</td>
</tr>
<tr>
<td>M.E. 114b. Mechanical Engineering Design 4</td>
</tr>
<tr>
<td>M.E. 133. Engineering Thermodynamics 3</td>
</tr>
<tr>
<td>M.E. 134. Introduction to Kinetic Theory and Statistical Mechanics 3</td>
</tr>
<tr>
<td>M.E. 135. Heat, Mass, and Momentum Transfer 3</td>
</tr>
<tr>
<td>Engr. 171. Nuclear Energy 3</td>
</tr>
<tr>
<td>Physics 140. Elementary Nuclear Physics 3</td>
</tr>
</tbody>
</table>

**Mathematics, Physics, and Engineering Mechanics**

23 units from the following:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 61. Optics and Wave Motion 3</td>
</tr>
<tr>
<td>Physics 110, 111. Intermediate Mechanics 6</td>
</tr>
</tbody>
</table>

(Students taking these courses may omit Engr. 11 and 12 from the School of Engineering required list and should do so if they plan to take the Physics 130 series.)

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physics 130, 131, 132. Atomic and Nuclear Structure 9</td>
</tr>
<tr>
<td>Math. 46. Advanced Calculus III 3</td>
</tr>
<tr>
<td>Math. 106. Complex Variables 3</td>
</tr>
<tr>
<td>Math. 114. Linear Algebra and Matrix Theory 3</td>
</tr>
<tr>
<td>Math. 115. Fundamental Concepts of Analysis 3</td>
</tr>
<tr>
<td>Math. 131, 132. Partial Differential Equations 6</td>
</tr>
<tr>
<td>Stat. 27. Introduction to Probability Theory 3</td>
</tr>
<tr>
<td>M.E. 134. Introduction to Kinetic Theory and Statistical Mechanics 3</td>
</tr>
<tr>
<td>E.E. 167. Electronic and Magnetic Properties of Solids 3</td>
</tr>
<tr>
<td>E.E. 110. Electromagnetic Fundamentals 3</td>
</tr>
<tr>
<td>E.E. 111. Electromagnetic Waves 3</td>
</tr>
<tr>
<td>E.E. 255, 256. Semiconductor Theory 6</td>
</tr>
<tr>
<td>M.E. 161. Engineering Vibrations 3</td>
</tr>
<tr>
<td>E.E. 128. Control Systems 3</td>
</tr>
<tr>
<td>E.M. 211. Elementary Theory of Plasticity 3</td>
</tr>
</tbody>
</table>

**Reserve Officers' Training Corps**

Reserve Officers' Training Corps are maintained at Stanford by the Army, the Navy, and the Air Force (see Aerospace Studies, Military Science, and Naval Science in this Bulletin). The individual requirements of each of the Aerospace Studies, Military Science, and Naval Science programs are so varied in the nature of specialized work that the appropriate sections of this Bulletin should be consulted in preparing an engineering program including ROTC. The additional units of specialized work together with those of accredited engineering programs will normally require from one to three extra quarters of study depending upon individual circumstances. ROTC students staying for more than one extra quarter may often arrange their programs to include one or even two sequences of graduate courses in their major while working for their baccalaureate degrees. Residence credit toward an advanced degree, however, cannot be obtained until the baccalaureate degree program has been completed.

**Comprehensive Five-Year Programs**

For students who desire a broader training than any included in one of the regular four-year programs of the School of Engineering, comprehensive five-year programs leading to the degree of Bachelor of Science in Engineering are offered. These programs are worked out in cooperation with the students concerned, and can usually include one or two sequences of graduate courses in the student’s field of major interest.

**Second Bachelor's Degree**

Students receiving the Bachelor of Science degree in Engineering who wish to broaden their undergraduate education by additional work in other fields, such as in the humanities and social sciences, may also qualify for a Bachelor of Arts degree (see the description of "Second Bachelor's Degrees" at the front of this Bulletin). By careful planning it is possible to receive the second degree after three additional quarters of study, although more than one additional academic year may be required.

**Dual Degree Programs**

Stanford University cooperates with certain liberal arts colleges (presently Central College at Fayette, Missouri, Claremont Men's College, the College of Idaho, Hastings College, 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. Inquiries may be addressed to the Dean of Engineering at Stanford, or to the above listed colleges. See description of Four-Two program under "Master of Science."
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 Executive Head 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 consult the faculty member who acts as adviser in the student’s field (or departmental secretary) on registration day of his first quarter for advice in planning his program and for instruction on departmental procedures.

GRADUATE PROGRAMS OF STUDY
Departments and divisions of the School offer graduate curricula, as follows:

AERONAUTICS AND ASTRONAUTICS
Aerodynamics
Aerospace Systems Design
Aircraft, Missile, and Spacecraft Structures
Astrodynamics
Dynamics and Vibrations
Experimental Methods
Guidance and Control
Physical Gas Dynamics
Plasma Dynamics and Magnetoacrodynamics
Propulsion
Solid Mechanics and Wave Propagation
Structures and Materials

BIOENGINEERING
(See Master of Science and Doctor of Philosophy programs)

CHEMICAL ENGINEERING
Applied Reaction Kinetics
Chemical Catalysis
Interfacial Stability
Heat, Mass, and Momentum Transfer in Laminar or Turbulent Flow Systems
Non-Newtonian Fluid Mechanics
Optimization Theory
Process Dynamics and Control
Thermodynamics
Transport Properties of Fluids
Turbulence Theory

CIVIL ENGINEERING
Construction Engineering
Engineering-Economic Planning
Transportation
Water Resources
Hydraulic Engineering
Fluid Mechanics
Hydrology
Public Works Administration
Sanitary Engineering
Soil Mechanics and Foundations
Structural Engineering

ELECTRICAL ENGINEERING
Administration
Electromagnetic Theory
Electronic Systems Techniques
Medical Electronics
Microwaves
Network Theory
Plasmas
Quantum Electronics
Radio Science
Solid State Electronics
Systems Theory
Communication Theory

ENGINEERING MECHANICS
Continuum Mechanics
Elasticity, Plasticity, Viscoelasticity
Shells and Plates
Experimental Stress Analysis
Instabilities, Elastic, Plastic, Dynamic
Stress Waves in Solids
Rigid Body Dynamics, Space Dynamics
Vibrations, Linear and Nonlinear
Fluid Mechanics, Boundary Layers, Heat Transfer
Dynamic Optimization and Control
Mathematical System Theory
Stochastic System Analysis

ENGINEERING SCIENCE
Biomedical Engineering
Nuclear Engineering
INSTITUTE IN ENGINEERING-ECONOMIC SYSTEMS

Intersystem Relationships
Decision Analysis
System Analysis
Automation
Simulation
Long Range Planning

HYDROLOGY
(See separate section in this Bulletin.)

INDUSTRIAL ENGINEERING

Biotechnology
Engineering Statistics and Quality Control
Engineering Economy
Engineering-Economic Planning
Data Processing
Operations Research
Production

MATERIALS SCIENCE

Physical Metallurgy
Physical Ceramics
Photoelectronic Properties of Solids
Defects in Crystalline Solids and Their Effects on Electronics, Magnetic and Mechanical Properties
Magnetic Behavior of Solids
Mechanical Behavior of Solids and Structures
Thermodynamics of Solids
Reaction Kinetics in Solids
Phase Transformation in Solids
Crystal Growth
X-Ray and Electron Diffraction and Spectroscopy Applied to the Study of Solids

MECHANICAL ENGINEERING

Thermodynamics
Heat Transfer
Fluid Mechanics
Engineering Design
Product Design
Nuclear Engineering

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 advisors, to select courses in departments other than their own to achieve a broader appreciation of their field of study. For example, most departments in the School offer courses concerned with properties of materials, and a student interested in an aspect of materials engineering can often gain appreciable benefit from the related courses given by departments other than his 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. However, the presentation of a thesis is not required for the Master of Science degree in Engineering.

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 Science — The degree of Master of Science is available to those who wish to follow a program of study emphasizing the scientific background of some aspect of engineering (e.g., Bioengineering, Nuclear Engineering) and which does not conform to a normal graduate program in a department. Such programs usually combine work in several engineering departments, or contain an unusual amount of mathematics, physics, chemistry, statistics, etc. Application for candidacy for the Master of Science in Engineering Science should be made to the Dean of Engineering. Only students with superior academic records will be accepted for this type of program.

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 but who do not wish to undertake a Ph.D. program. The program of study must satisfy the student's department and
include 90 units of which at least 60 must be devoted to advanced or graduate study in the major subject or intimately allied subjects. The presentation of a thesis is required. The University regulations for the Engineer degree are stated in the section “Degrees” in this Bulletin, and further information will be found in the department sections following.

**Doctor of Philosophy**

Programs leading to the degree of Doctor of Philosophy are offered in each of the departments and divisions of the School. Special Ph.D. programs which may be interdepartmental in nature (e.g., Bioengineering, Nuclear Engineering) can be arranged. See “Graduate Division Special Programs” section in this Bulletin. University regulations are given in the section “Degrees” in this Bulletin, and further information will be found in the department sections following. Inquiries concerning programs in Bioengineering should be addressed to the Dean of the School of Engineering or the Dean of the School of Medicine.

**Fellowships and Assistantships**

Each department and division of the School of Engineering awards a number of fellowships, research assistantships, and teaching assistantships each year. Information and application blanks may be obtained from the head of the appropriate department or division.

**Engineering**

**Professors:** Cannon, Franzini, Gere, Harmon, Huggins, Ireson, Oakford, Skilling, R. Smith, Sturrock

**Associate Professors:** P. Kruger, Richards, Tetelman

**Assistant Professors:** Lave, Lusignan, Nix

**Lecturers:** F. Crawford, Vesper

The "Engineering" courses deal with subject areas within the basic sciences of engineering which are, in their essential nature, broader than the confines of any particular branch of engineering. Included in this category are the engineering courses which appear in the list of “Courses Normally Taken by All Engineering Students.”

**Courses**

1. **The Engineer in Modern Society**—The role of the engineer in this technological world; technical decisions and human values; the issue of “two cultures” or one; the relationship between the engineer and the scientist. Open to any student.

   2 units, Aut (R. Smith) TTh 11

2. **Introduction to Programming**—(Enroll in Computer Science 5.) This course is an introduction to ALGOL, a problem-oriented language for describing computational processes. There will be practice in solving elementary problems on Stanford's automatic digital computers. The course is limited to freshman and sophomore students. Prerequisites: Mathematics B or equivalent.

   2 units, Aut (—) WF 11
   Win (Oakford) TTh 1:15
   Spr (—) WF 11

5. **Introduction to Programming**—(Enroll in Computer Science 6.) Continuation of 5. Limited to undergraduates. 5 and 6 together include approximately the same material as Computer Science 136.

   2 units, Win (—) TTh 1:15

6. **Introduction to Programming**—(Enroll in Computer Science 6.) Continuation of 5. Limited to undergraduates. 5 and 6 together include approximately the same material as Computer Science 136.

   2 units, Win (——) TTh 1:15

9. **Engineering Drawing**—Drawing as a means of engineering communication and analysis. Emphasis will be on free-hand sketching, orthographic projection, and descriptive geometry. Laboratory work will reflect actual cases taken from industry.

   4 units, Aut (Staff) lec. MW 1:15–2:05; lab. MW 2:15–5:05 or TTh 2:15–5:05
   Win (Staff) lec. and lab. MW 1:15–5:05


   2 units, Aut (Richards, Staff) TTh 9
   Win (Richards, Staff) TTh 9
   Spr (Richards, Staff) TTh 9

12. **Engineering Mechanics (Dynamics)**—Principles of dynamics of particles and rigid bodies, application to typical mechanical problems. Should be taken before the end of
the junior year. Prerequisites: 11 and Mathematics 43.

4 units, Aut (Richards, Staff) T WThF 11
Win (Richards, Staff) T WThF 11
Spr (Richards, Staff) T WThF 11
and 2:15
Sum (Richards, Staff)

15. Mechanics of Materials — Analysis of stresses and deformations in linear elastic materials: simple tension, compression, shear, torsion, and flexure; introduction to combined stresses and instability (columns). Prerequisites: 11 and Mathematics 43.

3 units, Aut (Richards, Staff) MWF 10
Win (Richards, Staff) MWF 10
and 11
Spr (Richards, Staff) MWF 10
Sum (Richards, Staff) MThT 10

18a, b,c. Mechanics of Deformable Bodies — An independent study class on the analysis of stress and strain in deformable bodies, both elastic and inelastic. Topics covered include axial loads, bending, torsion, columns, strain energy, curved bars, beam-columns, plates, and shells. (Permission of instructor is required before registration. This course satisfies the School of Engineering requirement for Engineering 15.) Prerequisites: 11 and Mathematics 43.

3 units, any quarter (Gere) by arrangement

21. Mechanics of Fluids — Statics and dynamics of incompressible fluids; viscosity, fluid friction, laminar and turbulent flow in pipes. Laboratory exercises. Should be taken before the end of the junior year. Enrollment limited to 64 students per quarter. Prerequisite: 12.

4 units, Aut (Franzini, Staff) MWF 9; 2-hour problem session
Win (Franzini, Staff) MWF 9; 2-hour problem session
Spr (Franzini, Staff) MWF 9; 2-hour problem session
Sum (Franzini, Staff) MTWTh 9, and one hour by arrangement

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, Aut, Win, Spr, Sum (Staff) one 3-hour lab. by arrangement


3 units, Aut (Huggins) MWF 9
Win (Tetelman) MWF 11
Spr (Nix) MWF 10
Sum (——) MTWTh 11

60. Engineering Economy — A special course offered to a limited number of fresh-
man engineering students. Will satisfy School of Engineering requirements for Engr. 161.

3 units, Aut (Ireson, Staff) MWF 10

61. Engineering Economy: Tutorial—Special course in principles of engineering economy providing for intensive independent study of topics beyond those covered in Engr. 161. Limited to 10 superior undergraduate students who have completed at least 2 quarters at Stanford. Satisfies School of Engineering requirement for Engr. 161. Prerequisites: recommendation of adviser and consent of instructor.

3 units, Spr (Ireson, Staff) MWF 10

101. Engineering Casewriting — Emphasizes (1) close examination of current engineering procedures in a company and (2) writing to exacting standards. Students visit local firms (contacts arranged by instructor) and describe engineering problem situations by writing cases for use as exercises in other courses. Enrollment limited.

3 units, Win (Vesper)


3 units, Aut (Cannon) MWF 11

161. Engineering Economy—Economic decision making for engineering alternatives. 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. Simple decision making in the face of uncertainty as to possible damage or economic obsolescence. Open to those who have 90 units of credit and to others by permission.

3 units, Aut (——) MWF 8 and 10
Win (——) MWF 9 and 11
Spr (Lave) MWF 9 and 11
Sum (——) TWThF 8


3 units, Win (Staff) MWF 9

172. Nuclear Chemistry—Properties of nuclei and radioisotopes; nuclear reactions; fission, fusion, reactors and accelerators; radiation detection and measurement; radiation safety; radiation chemistry, radio-tracers, radioactivation analysis, and their applications. Prerequisites: Chemistry 3, Mathematics 23, or Physics 57.

3 units, Win (P. Kruger) TTh 11

175. Nuclear 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: concurrent 171, or 172, or consent of instructor.

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

176. Radiochemistry Laboratory—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisites: 172 or 175 or consent of instructor.

3 units, Spr (P. Kruger) Th 1:15 and one lab. by arrangement

181a,b,c. Seminar in Resource Strategy — The application of modern science and technology to the problems of newly developing nations. Analysis of technological needs, evaluation of resources, design of an optimum plan of development. Prerequisite: junior standing and consent of instructor.

2 units, each quarter (Smith) by arrangement

198. Computer Programming — Directed work in solving engineering problems with the electronic digital computer facilities of the Computation Center. Priority will be given to problems that are supplementary
to regular course work. Prerequisite: 5 or equivalent.

199. Special Studies in Engineering—Special studies, laboratory work, or reading under the direction of a faculty member. By permission only.

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

207. Introduction to Astrophysics I: 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 E.E. 271, or A.A. 285a, or equivalent.

3 units, Aut (Sturrock) MWF 11

208. Introduction to Astrophysics II: The Sun — Normal photosphere, chromosphere and corona. Fraunhofer spectrum. The solar cycle. Active phenomena: sunspots; prominences; flares; radio bursts. Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, Win (Sturrock) MWF 11

209. Introduction to Astrophysics III: Stars and Galaxies—Radiative and convective energy transport; equation of state; opacity; nuclear processes. Hertzsprung-Russell diagram; stellar evolution. Galactic morphology; structure of our galaxy; spiral arms. Radio galaxies; quasi-stellar radio sources; cosmic rays. Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, Spr (Sturrock) MWF 11

210. Astrophysics Seminar — Discussion of research problems and current literature in astrophysics with contributions by faculty, students and outside specialists.

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

211. The Laboratory Plasma—Methods of forming laboratory plasmas in gases and in the solid state and measurement of their properties. Collision processes, velocity distributions, the Boltzmann transfer equation, concepts of temperature and pressure, non-equilibrium velocity distributions. Macroscopic averages of the Boltzmann equation. D.C. and r.f. breakdown and avalanche phenomena, the effect of a magnetic field, the positive column at low pressure and medium pressure, ambipolar diffusion, the plasma sheath, wave propagation in infinite plasmas and in bounded plasma, prove theory, r.f. diagnostic techniques. Prerequisite: E.E. 271 or Physics 122 or equivalent.

3 units, Aut (Crawford)

212. Experimental Plasma Physics I—Lecture course which, together with 212A is intended to introduce the student to selected basic plasma phenomena with emphasis on the production and characteristics of d.c. and r.f. discharges, and plasma diagnostics using d.c., r.f. and optical methods. Prerequisite: E.E. 287 or M.E. 251 or A.A. 285a, or permission of instructor.

2 units, Win (Staff)

212A. Experimental Plasma Physics Laboratory I — Experimental work to accompany 212. Concurrent registration in 212 required.

2 units, Win (Staff) by arrangement

213. Experimental Plasma Physics II — Continuation of 212. Prerequisites: 212 and 212A.

2 units, Spr (Staff)

213A. Experimental Plasma Physics Laboratory II—Continuation of 212A. Prerequisites: 212 and 212A. Concurrent registration in 213 required.

2 units, Spr (Staff) by arrangement

235a,b. Space Systems Engineering — Students from all fields form a team to do a preliminary design study of a space system. In previous years a Weather-Data Satellite System and a Mars Exploration System have been designed. About 20 invited speakers from government and industry give the class the necessary background information. At the end of the second quarter the class gives a verbal briefing to government and industry representatives and publishes a final report of the system. Prerequisite: graduate standing.

235a. 3 units, Win (Lusignan) TTh 1:15–3:05 and two hours by arrangement

235b. 3 units, Spr (Lusignan) TTh 1:15–3:05 and two hours 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.

296a. 1 unit, Win (Skilling) Th 3:15–5:05

296b. 1 unit, Spr (Skilling) Th 3:15–5:05

299. Special Studies in Engineering—Special studies, laboratory work, or reading under the direction of a faculty member. By permission only.

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

**AERONAUTICS**

and **ASTRONAUTICS**

Emeriti: Alfred S. Niles, Elliott G. Reid (Professors)

Executive Head: Nicholas J. Hoff

Associate Executive Heads: Max Anliker, Daniel Bershader (on leave winter and spring quarters), Jean Mayers


Associate Professors: Max Anliker, I-Dee Chang, Chi-Chang Chao, Wilfred H. Horton, Krishnamurti Karamcheti, Jean Mayers

Assistant Professors: Donald Baganoff, Benjamin O. Lange. Acting: Maurice L. Rasmussen


**OFFERINGS AND FACILITIES**

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, aero-dynamic, 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:

Aerodynamics
Aerospace Systems Design
Aircraft, Missile and Spacecraft Structures
Astrodynamics
Dynamics and Vibrations
Elastic and Inelastic Solids
Experimental Methods
Guidance and Control
Physical Gas Dynamics
Plasma Dynamics and Magnetoo-aerodynamics

Propulsion
Solid Mechanics and Wave Propagation
Structures and Materials

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:

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
Subsonic Aerodynamics—Boundary-Layer Control
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
Astrodynamics—Orbit Perturbations
Contactor Control—Optimal Control
Biomechanics—Hemodynamics

Facilities for Instruction and Research

The work of the Department is centered in the Daniel Guggenheim Aeronautical Laboratory and the William Frederick Durand Laboratory.

The Guggenheim Laboratory houses classrooms, aerodynamic laboratory and offices. In the laboratory are a 7.5-foot subsonic wind tunnel (with six-component balance, propeller dynamometer, pressure recording and scaling equipment, etc.) which, with special equipment, is being used, at present, for extensive jet flap studies. A zirconium-oxide pebble-heater blow-down tunnel is available for investigations of a structural nature in a hypersonic airflow at total temperatures up to 4,000 degrees Fahrenheit.

The Durand Laboratory houses a library, research laboratories for structures and gas dynamics, an aerophysics laboratory, a machine shop, and faculty offices. The library contains a collection of text and reference books, reports of the principal aeronautical research organizations, and files of scientific journals and technical periodicals. The structures laboratory is set up with particular emphasis on equipment suitable for the study of structural behavior at high temperatures. Quartz-lamp heaters and a plasma jet are used to produce rapid changes of temperature both in space and time. Ovens capable of maintaining temperatures of 1,000 degrees Fahrenheit are also used to investigate the effects of creep on stress distribution and structural stability. The gas dynamics laboratory includes a 15-inch arc-discharge wind tunnel for the investigation of hypersonic flows at Mach numbers up to 20 and total temperatures up to 14,000 degrees Fahrenheit. The aerophysics laboratory houses a high-pressure shock tube for the purpose of quantitative study of shock-heated plasmas. A student fluid dynamics laboratory includes a supersonic jet; a small low-turbulence air flow apparatus; hot wire equipment and apparatus for studying hydrodynamic sound production; a shock tube; optical equipment, including schlierecn and interferometer apparatus; ballistic free-flight equipment; and associated control and recording devices.

In addition, there are three small laboratories adjacent to the Guggenheim Laboratory, two of which are being used for experimental work in the field of gas dynamics (experimental determination of the velocity distribution in gases with the aid of lasers) and one for guidance-and-control instrumentation. A plastic-structures research laboratory is under construction.

The Stanford Computation Center makes available to our students modern computation equipment such as the IBM 7090 and Burroughs 5000.

The Department also sponsors a student branch of the American Institute of Aeronautics and Astronautics which holds periodic meetings and conducts visits to nearby research, military, 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 may 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, aircraft and missile structures, dynamics, control, and experimentation. In ad-
dition, 6 units of mathematics are required, plus a minimum of 9 units of advanced courses in one of four engineering areas (aerodynamics, structures, guidance and control, and astronautics) and 6 units of approved electives, making in all 45 units of course work. A detailed list of the requirements can be obtained upon request to the Department. No thesis is required. A minimum grade point average of 2.75 is expected.

Science Curriculum — To secure the recommendation of the Department for the Master’s degree with a specialization in aero- and astronautical sciences, a candidate must complete 24 units of basic course work to be selected from the same areas as listed for the Engineering Curriculum, 9 units of mathematics, 9 units of advanced courses chosen from a list of physical science subjects, 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.

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, 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) Aerodynamics, (b) Aircraft, Missile and Spacecraft Structures, (c) Astronautics, (d) Guidance and Control, (e) Physical Gas Dynamics, (f) Plasma Dynamics and Magnetohydrodynamics, (g) Experimental Methods, (h) 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 examination is given twice a year (autumn and spring) and should be taken as soon as possible in the second graduate year. A general list of subject matter for which the candidate is held responsible in the examination is available from the Department. Research on the doctoral dissertation may not be started formally prior to passing the examination. The candidate’s study program must fulfill the 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 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 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 the National Science Foundation, National Aeronautics and Space Administration, Ford Foundation, Douglas Aircraft Company, Stanford University, and Affiliates of Stanford University in Aeronautics and Astronautics carry grants up to $4,000 for the nine-month academic year. NSF and NASA training grants have been allocated for students who plan to become doctoral candidates in the aerospace sciences. Students who already have a Master of Science degree or equivalent 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 for 9 units per quar-
Research assistants are normally given the opportunity of full-time summer employment at the 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

A study program in aeronautics and astronautics leading to the Bachelor of Science degree is available in the form of the Aeronautics and Astronautics Option in the Mechanical Engineering Department.

COURSES

100. Introduction to Aeronautics and Astronautics—Explanation of principles of flight and propulsion. Concise discussion of aero-dynamic performance, trajectories outside the atmosphere, and the problems of re-entry. Remarks on the history of aeronautics and astronautics.

2 units, Aut (Hoff) TTh 9


3 units, Aut (Cannon) MWF 11

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.

2 units, Win (Ogden, Billingham, Feller, Young) W 2:15-4:05

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 to 4 units, Win (Bershader, Baganoff)
lec. Th 1:15-2:05; lab. Th 2:15-5:05
or T 1:15-4:05

188. Experimental Plasma Physics I—(Enroll in Engineering 212.) Lecture course which, together with 188A, is intended to introduce the student to selected basic plasma phenomena, with emphasis on the production and characteristics of direct current and radio frequency discharges, and plasma diagnostics using direct current, radio frequency, and optical methods. Prerequisite: 285a or Engineering 211, or permission of instructor.

2 units, Win (Staff)

188A. Experimental Plasma Physics Laboratory I — (Enroll in Engineering 212A.) Experimental work to accompany 188. Concurrent registration in 188 required.

2 units, Win (Staff) by arrangement

192. Vector Analysis and Cartesian Tensors with Applications—Vector algebra. Differentiation and integration of scalar and vector fields. Gradient, divergence and curl. Theorems of Gauss, Stokes, and Green. Cartesian tensors. 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 45.

3 units, Aut (Rasmussen) MWF 8

200a. Wing Theory — Primarily, theory of lift and resistance of monoplane and multiplane. Prefaced by fundamental hydrodynamics, followed by applications to wind tunnel boundary influence, ground effect, downwash, etc.; includes wing pitching moments, elementary profile theory. Prerequisites:

2 units, Win (Ogden, Billingham, Feller, Young) W 2:15-4:05
sites: Engineering 12 and 21, and (or concurrent registration in) 100 and C.E. 107.

3 units, Aut (——) MWF 9

200b. Aerodynamics of the Airplane—Span load distribution; viscosity; boundary layer and skin friction; boundary layer control and effects on drag and separation; control and lift augmenting devices; (subsonic) compressibility effects; mutual interference; aerodynamic characteristics of complete airplane; static and elementary dynamic stability; controllability. Prerequisites: 200a and 210a.

3 units, Win (——) MWF 9

200c. Airplane Performance — Generalized drag and power methods; rigorous methods of predicting performance for propeller-driven and turbojet airplanes; special problems of range, endurance, take-off, landing; estimation of performance characteristics by use of formulae and charts. Prerequisites: 200b and 201.

3 units, Spr (——) MWF 9

201. Aircraft Propellers — Modern screw propulsion theory developed and correlated with experimental results to enable the intelligent selection of propellers for, and prediction of performance of, aircraft powered by reciprocating and turboprop engines. Influences of design and operating parameters upon characteristics of controllable, constant speed, and dual rotation propellers are examined in some detail. Prerequisite: 200a.

2 units, Win (——) TTh 9


3 units, Aut (Flügge-Lotz) MWF 1:15


3 units, Win (Flügge-Lotz) MWF 11

207. Mechanics of Viscous Flow — (Enroll in E.M. 244.) Navier-Stokes equations. Very slow motion. Boundary layer equations for incompressible laminar flow. Energy equation for thermal boundary layers; compressible laminar boundary layer flow. Stability of boundary layer flows; introduction to turbulent flow. Prerequisites: 206a and either 210a or M.E. 238b, or permission of the instructor.

3 units, Spr (Flügge-Lotz) MWF 11


3 units, Aut (Chang) MWF 10

210a. Fundamentals of Compressible Flow — Fundamentals of the flow of a perfect gas from the standpoint of the aerospace 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: Equations and some general results for steady and unsteady three-dimensional flows; exact solutions; irrotational homentropic motion; equations of the linearized theory; thin airfoil in steady subsonic and supersonic motion. Prerequisites: 210a (or M.E. 136 or M.E. 138a) and 192.

3 units, Win (Karamcheti) MWF 1:15

210c. Fundamentals of Compressible Flow — Continuation of 210b: Slender body of revolution in steady subsonic and supersonic motion; introduction to higher approximations; similarity rules; hodograph method; method of characteristics. Prerequisite: 210b.

3 units, Spr (Rasmussen) MWF 1:15

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 (C. Kruger) MWF 2:15

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: 210b (or M.E. 238b) and 211a or consent of instructor.

3 units, Spr (Vincenti) MWF 2:15

211c. Physical Gas Dynamics—Kinetic theory of gases in translational nonequilibrium: concepts from statistical mechanics; Boltzmann equation; molecular encounters and related concepts; conservation equations; H-theorem; Maxwell distribution; Chapman-Enskog method; viscosity and thermal conductivity for different molecular force models; selected applications. Prerequisites: 192 and acquaintance with basic equations of viscous flow, or consent of instructor.

3 units, Aut (Karamcheti) MWF 1:15

212. Gaskinetics—Gas dynamics based on kinetic theory: review of the theory for monoatomic gas mixtures; introduction to the theory of polyatomic and reacting gases; boundary conditions at a solid-gas interface; outline of techniques for solving gasdynamic problems from the point of view of the Boltzmann equation, moment equations and model equations; discussion of selected specific problems such as Couette flow, boundary layer, free molecule drag and heat transfer, shock structure, and sound propagation; experimental methods. Emphasis is given to applications. Prerequisites: 211c and 207 (207 may be taken concurrently).

3 units, Spr (Van Dyke) MWF 9

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

215. Radiative Gas Dynamics—Interaction of radiative transfer and fluid motion: fundamentals of radiative transfer of energy in gases; conservation equations of radiative gas dynamics; types of approximations; solution of simple flow problems. Prerequisite: 211a, b, or permission of instructor.

2 units, Win (Vincenti) TTh 10

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 9

217. Aerodynamic Heating—Definition of, and factors that influence aerodynamic heating; relation of aerodynamic heating rates to structural temperature distribution; heat balance; boundary-layer theory with largely varying properties; diffusion and mass transfer; turbulent boundary-layer phenomena and analysis; semi-empirical and engineering approaches. Prerequisite: 207 or both M.E. 231a and M.E. 238b.

2 units, Win (---) TTh 8, alternate years, given 1966-67

218. Symmetry and Similitude in Fluid Mechanics—Cylindrical and conical flow fields; separation of variables; local solutions; homogeneous and self-similar solutions; group properties; phase-plane methods; behavior at infinity; applications to problems of ideal, viscous, and compressible flow. Prerequisites: 207 or 210c, Mathematics 106, and Mathematics 132; or consent of instructor.

3 units, Win (Van Dyke) MWF 9

219. Perturbation Methods in Fluid Mechanics—Examples of perturbation solutions; asymptotic expansions; series and iteration schemes; singular perturbation problems; the method of matched asymptotic expansions; Lighthill's and other techniques; application to flow problems; improvement of series. Prerequisites: 207 or 210c, Mathematics 106, and Mathematics 132; or consent of instructor.

3 units, Aut (Van Dyke) MWF 9

220. Physical Measurements in Fluid Dynamics—Lecture-laboratory course on experimental aerodynamics emphasizing compressible flow; measurement of flow vari-
ables and comparison with theoretical predictions for steady and non-steady gas motions; selected experiments dealing with application of pitot techniques, schlieren, interferometry, and hot-wire anemometry to jet flows; introductory shock-tube experiments; ballistic free-flight measurements; line reversal measurement of flame temperature. Prerequisite: 210a or equivalent.

3 units, Spr (Baganoff) lec. T 2:15–3:05; lab. Th 2:15–5:05

221. Introductory Reentry Aerophysics — Description of the high temperature airflow environment surrounding hypervelocity vehicles. Application of equilibrium thermodynamics and thermostatistics to the analysis of dissociating and ionizing shock waves. Introduction to boundary layer flows, leading to a formulation of the hypersonic stagnation-point heat transfer problem. Concepts of gaskinetic collision phenomena as the basis for determination of transport properties. Fundamentals of thermal radiation in gases, with discussion of the absorption coefficient for air, and simple examples of radiative transport.

3 units, Aut (Bershader) T 2:15–3:05 and Th 2:15–4:05

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; Wiener-Khintchine relation; difference and differential equations for probability densities; Fokker-Planck equation with application to diffusion; Ehrenfest model and approach to thermodynamic equilibrium.

3 units, Aut (Baganoff) MWF 2:15

226. Astronomy for Physical Scientists — 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 and general properties of the planetary system. Techniques and technical problems.

2 units, Spr (Herbig) S 10–12

227a. Introduction to Space Physics I — Introduction to selected topics of geophysics and astrophysics with emphasis on conditions in the solar and terrestrial atmospheres and in interplanetary space. Solar-terrestrial relations, sun spots, flares, solar wind, geomagnetic storms, ionospheric disturbances. Prerequisite: Physics 55.

2 units, Aut (Spreiter) M 3:15–5:05

227b. Introduction to Space Physics II — Fundamentals of the motion of charged particles in electric and magnetic fields, hydrodynamics and plasma physics with application to theories of Van Allen belts, solar phenomena, interplanetary plasma streams and shock waves, geomagnetic storms and wave propagation in the upper atmosphere and interplanetary space. Prerequisite: 227a or equivalent.

2 units, Win (Spreiter) M 3:15–5:05

229. Selected Topics in Cardiovascular Dynamics — Transmission of pulsewaves and sounds in cardiovascular systems. Dispersion and stability phenomena in the arterial tree. Discussion of problems and experiments pertaining to manned space flight.

2 units, Spr (Anliker and Ogden) W 2:15–4:05, alternate years, given 1967–68

230a. Vertical Take-Off Aircraft — Lift, propulsion and control and resulting performance of subsonic VTOL aircraft. Prerequisite: 100.

2 units, Win (Carlson) M 3:15–5:05, alternate years, given 1966–67

230b. Vertical Take-Off Aircraft — Mechanics, structural design and fatigue problems of helicopters and VTOL aircraft including ground resonance, propeller whirl, wing flutter and drive-system dynamics.

2 units, Spr (Carlson) M 3:15–5:05, alternate years, given 1966–67

235a,b. Space Systems Engineering — (Enroll in Engineering 235a, b.) Students from all fields of engineering form a team to do a preliminary design study of a space system. In previous years a Weather-Data Satellite System and a Mars Exploration System have been designed. About 20 invited speakers from government and industry give the class the necessary background information. At the end of the second quarter the class gives a verbal briefing to government and industry representatives and publishes a final report of the system. Prerequisite: graduate standing.

235a. 3 units, Win (Lusignan) TTh 1:15–3:15 and two hours by arrangement
235b. 3 units, Spr (Lusignan) TTh 1:15–3:15 and two hours by arrangement


3 units, Win (Flugge-Lotz), MWF 9


3 units, Aut (Kalman) TTh 11:00–12:15


3 units, Win (Kalman) TTh 11:00–12:15


3 units, Spr (Kalman) TTh 11:00–12:15

239d. Mathematical System Theory: Stochastic Optimization — (Enroll in E.M. 239d.) Markovian realization of random processes. Construction of optimal predictors and filters. Applications to stochastic control and information theory. Prerequisites: Probability; 239c or consent of instructor.

3 units, Aut (Kalman) alternate years, given 1967–68

240a. Aircraft and Missile Structural Analysis — Elements of one- and two-dimensional linear and nonlinear elasticity theory; strength of thin-walled structures in bending, shear, torsion; introduction to shear lag and diagonal tension behavior; potential energy principle, direct and indirect methods of the calculus of variations, deflection analysis of straight and curved beams, effects of nonuniformity of loading and sectional properties. Prerequisite: C.E. 114.

3 units, Aut (Mayers) MWF 11

240b. Aircraft and Missile Structural Analysis — Potential energy principle applied to elastically restrained beams and plates, stability of plates in compression and shear; Galerkin procedure and applications; complementary energy principle, redundant structures, bending and torsion of nonuniform plates, shear lag; Reissner’s variational principle and applications. Prerequisite: 240a.

3 units, Win (Mayers) MWF 2:15

240c. Aircraft and Missile Structural Analysis—Further applications of the variational principles to nonlinear behavior of beams, plates and shells; thermal effects; orthotropic and sandwich structures; dynamic behavior of structural elements in bending and torsion; finite difference and matrix methods, influence coefficients. Prerequisite: 240b.

3 units, Spr (Mayers) MWF 10

241a. Introduction to Structural Systems Synthesis and Analysis—The interaction of structures relative to aerodynamics, propulsion, guidance, payload and ground support for a given mission; the factors (system characteristics or operational requirements) involved in systems synthesis; assignment of priorities to system characteristics; effect of nonengineering constraints (e.g., producibility, economy, maintainability, simplicity) on design aimed at system optimization; preliminary design philosophy; parametric studies and configuration evolution; environments (cumulative and noncumulative) and basic loads (static, dynamic, aerodynamic and thermal); structural analysis versus stress analysis; weight control; structural materials; factors and margins of safety; allowable stresses; design of experiments; prototype testing; behavior predictions versus experiment; design flexibility and growth factor; reliability and structures. Prerequisites
site: fundamental knowledge of elementary structures, aerodynamics and vibrations.

3 units, Aut (Mayers, Staff) MWF 2:15

241b. Introduction to Structural Systems Synthesis and Analysis — Application of the elements of structural systems synthesis and analysis to the preliminary design of a hypothetical aircraft and/or guided missile system subject to compromise between cost, schedule and performance; utilization of advanced structural analysis theory, methods and techniques to effect design definition of major structural assemblies taking into account the influences on structural idealizations of fabrication processes, tolerances, eccentricities, misalignments, subsystem interactions, and substructure joints and fittings (boundary conditions). Prerequisites: 240c, 241a, 243b, 248b and Computer Science 136 (or equivalents).

3 units, Win (Mayers, Staff) MWF 11


3 units, Aut (Anliker) TTh 11:00–12:15


3 units, Spr (Anliker) MWF 12


3 units, Aut (Anliker, Staff) MWF 11


3 units, Win (Anliker, Staff) MWF 12

244. Basic Problems in Aeroelasticity — Deformation of aircraft structures under static and dynamic loads, lift distribution on elastic wings, static aeroelastic phenomena, approximate methods of computing natural mode shapes and frequencies, general outline of flutter analysis, dynamic response phenomena, statistical methods of loads analysis.

3 units, Spr (Anliker, Staff) MWF 8


3 units, Aut (Chao) MWF 9


3 units, Win (Chao) MWF 10

3 units, Win (Flügge) MWF 9


3 units, Spr (Flügge) MWF 9


3 units, Aut (——) MWF 1:15


3 units, Win (——) MWF 1:15


3 units, Spr (——) MWF 1:15, alternate years, given 1966–67


3 units, Spr (Hoff) MWF 1:15, alternate years, given 1967–68

249. Modern Developments in Shell Theory — Elements of tensor analysis, differential geometry, three-dimensional stress and strain analysis. Reduction of the three-dimensional problem of the continuum to the two-dimensional shell problem. Examination of foundations of shell theory. Consistent approximate theories of shells. Variational techniques in shell theory. Prerequisites: 245a and either 247 or 248a.

3 units, Sum (——) by arrangement

250a. Thermal Effects in Structures—Heat transfer from boundary layer to surface of structure in supersonic airflow, analysis of distribution of temperature in structure. Prerequisite: C.E. 114 or equivalent.

2 units, Win (Hoff) TTh 10


2 units, Spr (Hoff) TTh 10


2 units, Win (Goodier) TF 3:15


2 units, Spr (Goodier) TF 3:15

255. Creep Effects in Structures—Phenomenon of creep; its effect on distribution of stresses in structural elements; buckling caused by creep; concept of structural safety in presence of creep. Prerequisite: C.E. 114 or equivalent.

3 units, Spr (Hoff) MWF 11

260a. Aircraft and Missile 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 trans-
ducers, accelerometers, oscillographic and strip chart recorders, scanners, analog-to-digital converters, and digital data systems.

3 units, Aut (Horton) lec. T 9; lab. TTh 2:15-4:05

260b. Aircraft and Missile Structures Laboratory—Continuation of 260a; visual and optical techniques, including thermally sensitive paints; strain transfer techniques, photogram 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.

3 units, Win (Horton) lec. T 9; lab. TTh 2:15-4:05

260c. Aircraft and Missile 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. Undercarriage testing, ground resonance testing and the specific application of the techniques outlined in courses 260a and b to the varied problems of testing as defined above.

3 units, Spr (Horton), lec. T 9; lab. TTh 2:15-4:05


3 units, Win (Hetényi) TTh 8 and one lab. by arrangement

271. Automatic Control of Space and Aerospace Vehicles — Basic dynamics of vehicles in three dimensions. The environment of space and aerospace vehicles, and its role in their control. Passive attitude control, such as gravity gradient, magnetic, solar, spinning, etc. Sensors and active control moment devices (jets, reaction wheels, gyros, magnetic devices, etc.). Space vehicle control system synthesis and techniques. Aircraft stability and response. Automatic flight-control-system synthesis. Prerequisites: 242a or E.M. 222, and E.E. 128.

3 units, Spr (Cannon) WF 2:15-3:45


3 units, Win (Cannon) TTh 11:00-12:15


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

274. Numerical Methods in Flight Mechanics—The application of digital computation to the solution of the trajectory problems of powered and coasting aerospace vehicles at speeds up to several times orbit speed; the problems associated with the boost and entry phases of space flight with applications to such areas as trajectory selection to maximize payload or to minimize heating and acceleration loads and the determination of the guidance and navigation requirements during these critical phases. Students will enroll concurrently in the two-week course in Algol 60, and selected homework problems illustrative of the methods essential to current vehicle performance analysis will be run on the B-5500 digital computer. Prerequisite: some knowledge of matrix algebra desirable.

3 units, Aut (Lange) MWF 8

275a,b. Statistical Theory of Navigation and Guidance — Introduction to stochastic processes as they apply to navigation and guidance. Least squares determination of orbits and trajectories. Kalman filters and recursive smoothing and prediction. Guidance laws for missiles and spacecraft. Cislunar and interplanetary trajectories and trajectory partial derivatives. Stochastic optimum control. Prerequisite: 279a (may be taken concurrently) or consent of instructor.

275a. 3 units, Win (Lange) MWF 8
275b. 3 units, Spr (Lange) MWF 8
277. Modern Control Theory—An intensive survey of the developments in the field of automatic control since 1955 with application to the guidance and control of aerospace vehicles. Topics will be selected from the state vector approach to linear system theory, the concepts of controllability and observability, stability theory of nonlinear systems via the Second Method of Lyapunov, contactor control systems, the theory of optimal control (the control variable formulation of the Calculus of Variations, Pontryagin’s Maximum Principle, and gradient techniques in both functional and finite dimensional spaces), statistical control theory, and filter theory. Students will enroll concurrently in the two-week course in Algol 60, and homework problems which apply the theory to such examples as inertial guidance systems, gyroscopic inertial instruments, space vehicle boost and entry problems, orbital guidance and navigation problems, etc. will be run on the B-5500 computer. Prerequisite: a general knowledge of linear algebra and matrix theory, differential equations, and classical servomechanism theory.

3 units (Lange) by arrangement

278. Mathematics of Trajectory Optimization — Trajectory error propagation; guidance; performance improvement; the maximum principle; optimal rendezvous and orbit transfer; constraints on control variables and on state variables; singular arcs; steepest descent methods; neighboring optimum control; 2d variation and the Jacobi condition. Prerequisites: 279a and E.E. 245 or consent of instructor.

3 units, Win (Breakwell) MWF 11

279a. Space Mechanics — Orbits of near-earth satellites and interplanetary probes; transfer and rendezvous; decay of satellite orbits; influence of earth’s oblateness. Stabilization by gravity gradient. Prerequisite: 242a or equivalent.

3 units, Aut (Breakwell) MWF 11

279b. Advanced Space Mechanics — Gravitational perturbations of satellite orbits by sun and moon; second-order effects of the earth’s gravitational field; motion in earth-moon space; trajectories launched perpendicular to the ecliptic; Hamilton-Jacobi theory; canonical perturbation theory; application to nonlinear oscillations and to accurate satellite orbits; methods of Brouwer, Garfinkel and Vinti-Izsak; critical inclination. Prerequisite: 279a.

3 units, Spr (Breakwell) MWF 11

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 M.E. 132 or M.E. 138a, or consent of instructor.

3 units, Win (Seifert) MWF 8

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) MWF 8

280c. Chemical Rocket Design and Technology — Comparative study for liquid and solid rockets of system optimization, liquid propellant feed systems, solid propellant charge design; plus nozzle, heat transfer, structural, thrust control, and ignition design problems of chemical rockets. Prerequisite: 280a.

3 or 4 units, Spr (Seifert, Colahan, Seymour) TTh 11:00-12:15

281. Electric Propulsion — Ballistics of low-thrust, long-duration propulsion. Introductory theory of reaction propulsion by electrostatic, electrothermal, and electromagnetic means. Sources of electrical power in space. Prerequisite: Equivalent of 285a or E.E. 270, or consent of instructor.

3 units, Aut (Seifert) MWF 8, alternate years, given 1966–67


3 units, Aut (Seifert, Staff) MWF 8, alternate years, given 1967–68


3 units, Win (Chang) MWF 10


3 units, Spr (Chang) MWF 10

296. Conducting Fluids in a Magnetic Field — Interactions of conducting fluids and electromagnetic fields in situations of aerodynamic interest: boundary layers, channel flows, upstream and downstream wakes, shock layers, lifting bodies. Primary emphasis will be on physical interpretation of continuum flow theory and electromagnetism. Prerequisite: 285b or equivalent familiarity with plasma theory.

2 units, Aut (Griffith), WF 3:15

298. Experimental Plasma Physics II — (Enroll in Engineering 213.) Continuation of 188. Prerequisites: 188 and 188A.

2 units, Spr (Staff)

298A. Experimental Plasma Physics Laboratory II — (Enroll in Engineering 213A.) Continuation of 288A. Prerequisites: 188 and 188A. Concurrent registration in 288 required.

2 units, Spr (Staff)

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

291. Linear Transforms and Their Applications to Engineering Problems — 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) TTh 11:00–12:15


3 units, Aut (Chao) MWF 3:15


3 units, Win (Lee) TTh 11:00–12:15, alternate years, given 1967–68


3 units, Spr (Lee) MWF 10, alternate years, given 1967–68

295. Seminar in Solid Mechanics — (Enroll in E.M. 295.) Problems in all branches of solid mechanics. All Ph.D. candidates in solid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for students presenting talks.

1 unit, Aut, Win, Spr (Goodier, Hetényi, Lee) Th 3:15

296. Seminar in Fluid Mechanics — (Enroll in E.M. 296.) Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for those students presenting talks.

1 unit, Aut, Win, Spr (Flügge-Lotz, Van Dyke, Vincenti) T 4:15
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 (Cannon) F 4:15

Seminar in Aerospace Technology — Study of recent advances in the design, operation and application of aircraft and spacecraft and their components. Guest lecturers.

1 unit, Aut, Win, Spr (Seifert, Staff) W 4:15


2 to 15 units, any quarter (Staff) by arrangement


2 to 15 units, any quarter (Staff) by arrangement

CHEMICAL ENGINEERING

Executive Head: David M. Mason
Professors: Andreas Acrivos, Michel Boudart, David M. Mason
Associate Professors: William H. Schwarz, Douglass J. Wilde
Assistant Professor: Robert J. Madix
Lecturers: Vaughan C. Hill, Pierre Van Rysselberghe

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The B.S. Chemical Engineering program supplemented with courses in chemistry, physics, mathematics, and engineering provides a broad preparation not only for design, operation, and management in the chemical, biological, pharmaceutical, and aerospace industries, but also for postgraduate research in Chemical Engineering leading to research positions in industry and to academic careers.

Transfer to Chemical Engineering from other engineering programs or from chemistry can be made without loss of time or credit during the first two years. Allowance of foreign language credit (12 units of German or 8 units of any other modern language) permits attendance at any of the overseas campuses with graduation at the end of the winter quarter of the fourth year, after completion of twelve quarters of residence, including one summer abroad. Nine hours of ROTC may be credited as elective by students to be commissioned upon graduation.

Two balanced programs of minimum requirements for graduation in 12 quarters are given below. Program 1 should be followed by students wishing to preserve the option of transferring from or to another engineering department; Program 2, by those desiring to transfer from or into chemistry. Chemical Engineering second-year course 10 may be taken in the autumn of the third year by persons entering the program in their junior year or going overseas as sophomores.

Program 1 permits attendance at an overseas campus during the spring quarter of the second year and omission of the senior spring quarter. Necessary language courses for absence in the second year can be scheduled by taking History 1, 2, and 3 freshman year.

Program 2 allows attendance at an overseas campus during the autumn quarter of the third year and omission of the senior spring quarter. One must shift History 1-3, and Chemistry 121-123, filling out gaps with engineering courses. Detailed overseas programs are available from Chemical Engineering advisers.

PROGRAM 1: ENGINEERING TRANSFER

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
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<tbody>
<tr>
<td>A</td>
<td>W</td>
</tr>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>3</td>
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<tr>
<td>Engr. 9. Engineering Drawing</td>
<td>4</td>
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<tr>
<td>Engr. 11. Engineering Mechanics (Statics)</td>
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</table>
Math. 41, 42, 43. Analytical Geometry and Calculus  5 5 5
Physics 51, 52, 53, 54. Mechanics and Electricity  — 5 5
General Studies  3 2 —
Totals .......................... 15 15 15

Second Year

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<th>Subject</th>
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<th>W</th>
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<tbody>
<tr>
<td>Ch.E. 10.</td>
<td>Introduction to Chemical Engineering*</td>
<td>—</td>
<td>—</td>
<td>3</td>
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<tr>
<td>Chem. 4, 5.</td>
<td>Chemistry</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Comp. Sci. 5.</td>
<td>Computer Programming (elective)</td>
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<td>2</td>
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<tr>
<td>Engr. 41, 41A.</td>
<td>Circuits and Electronics</td>
<td>—</td>
<td>5</td>
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<tr>
<td>History 1, 2, 3.</td>
<td>Western Civilization</td>
<td>4</td>
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<tr>
<td>Math. 24 or 44.</td>
<td>Calculus</td>
<td>3</td>
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<tr>
<td>Physics 55, 56.</td>
<td>Light and Heat</td>
<td>5</td>
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<tr>
<td>General Studies</td>
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<td>16</td>
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* May be deferred until autumn of third year.

Third Year

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<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 140a,b,c.</td>
<td>Fluid flow, heat, and mass transfer; stage operations</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Ch.E. 120a,b.</td>
<td>Chemical Engineering (Thermodynamics)</td>
<td>—</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Chem. 121, 122, 123.</td>
<td>Organic Chemistry and Laboratory*</td>
<td>3</td>
<td>6</td>
<td>—</td>
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<tr>
<td>Chem. 171, 173, 175, 176.</td>
<td>Physical Chemistry and Laboratory</td>
<td>3</td>
<td>3</td>
<td>6</td>
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<tr>
<td>Math. 130.</td>
<td>Differential Equations (elective)</td>
<td>3</td>
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<tr>
<td>Engr. 15.</td>
<td>Mechanics of Materials</td>
<td>—</td>
<td>3</td>
<td>—</td>
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<tr>
<td>Speech 20.</td>
<td>Public Speaking</td>
<td>3</td>
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<td>Totals. ..........................</td>
<td>15</td>
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* May be deferred until fourth year.

Fourth Year

<table>
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<tbody>
<tr>
<td>Ch.E. 130a,b.</td>
<td>Momentum and Energy Transport</td>
<td>3</td>
<td>3</td>
<td>—</td>
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<tr>
<td>Ch.E. 141a,b.</td>
<td>Chemical Engineering Laboratory</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Ch.E. 160.</td>
<td>Plant Design</td>
<td>—</td>
<td>2</td>
<td>—</td>
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<tr>
<td>Engr. 12.</td>
<td>Dynamics</td>
<td>—</td>
<td>4</td>
<td>—</td>
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<tr>
<td>Engr. 161.</td>
<td>Engineering Economy</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>General Studies</td>
<td>—</td>
<td>—</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Totals. ..........................</td>
<td>15</td>
<td>15</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

180 units total
20 elective units

Program 2: Chemistry Transfer

First Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch. 1, 2, 3.</td>
<td>General Chemistry (3 elective)</td>
</tr>
<tr>
<td>English 1, 2, 3.</td>
<td>Freshman English</td>
</tr>
<tr>
<td>German 1, 2, 3.</td>
<td>German (elective)</td>
</tr>
<tr>
<td>Math. 10, 11, 21.</td>
<td>Calculus (long sequence)</td>
</tr>
<tr>
<td>Totals. ..........................</td>
<td>14</td>
</tr>
</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 10.</td>
<td>Introduction to Chemical Engineering*</td>
</tr>
<tr>
<td>Chem. 121, 122, 123.</td>
<td>Organic Chemistry and Laboratory</td>
</tr>
<tr>
<td>History 1, 2, 3.</td>
<td>Western Civilization</td>
</tr>
<tr>
<td>Math. 22, 23.</td>
<td>Calculus</td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54.</td>
<td>Mechanics and Electricity</td>
</tr>
<tr>
<td>General Studies</td>
<td>—</td>
</tr>
<tr>
<td>Totals. ..........................</td>
<td>15</td>
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</tbody>
</table>

* May be deferred until spring or third year.

Third Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
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</thead>
<tbody>
<tr>
<td>Ch.E. 120a,b</td>
<td>Chemical Engineering (Thermodynamics)</td>
</tr>
<tr>
<td>Ch.E. 140a,b,c.</td>
<td>Fluid flow, heat, and mass transfer; stage operations</td>
</tr>
<tr>
<td>Chem. 171, 173, 175, 176.</td>
<td>Physical Chemistry and Laboratory</td>
</tr>
<tr>
<td>Engr. 11.</td>
<td>Engineering Mechanics (Statics)</td>
</tr>
<tr>
<td>Math. 24.</td>
<td>Calculus</td>
</tr>
<tr>
<td>Math. 130.</td>
<td>Differential Equations</td>
</tr>
<tr>
<td>Physics 55, 56.</td>
<td>Light and Heat</td>
</tr>
<tr>
<td>General Studies</td>
<td>—</td>
</tr>
<tr>
<td>Speech 20.</td>
<td>Public Speaking</td>
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<td>Totals. ..........................</td>
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</tbody>
</table>

Fourth Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 130a,b.</td>
<td>Momentum and Energy Transport</td>
</tr>
<tr>
<td>Ch.E. 141a,b.</td>
<td>Chemical Engineering Laboratory</td>
</tr>
<tr>
<td>Ch.E. 150.</td>
<td>Chemical Reactor Design</td>
</tr>
<tr>
<td>Ch.E. 160.</td>
<td>Plant Design</td>
</tr>
<tr>
<td>Engr. 9.</td>
<td>Engineering Drawing</td>
</tr>
<tr>
<td>Engr. 15.</td>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td>Totals. ..........................</td>
<td>14</td>
</tr>
</tbody>
</table>
CHEMICAL ENGINEERING

Engr. 41, 41A. Circuits and Electronics
Engr. 161. Engineering Economy
General Studies

<table>
<thead>
<tr>
<th></th>
<th>16</th>
<th>17</th>
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<tbody>
<tr>
<td>Totals</td>
<td>180 units total</td>
<td>20 elective units</td>
<td></td>
</tr>
</tbody>
</table>

MASTER OF SCIENCE AND DOCTOR OF PHILOSOPHY

The M.S. and Ph.D. degrees in Chemical Engineering are offered to students who are primarily interested in research or teaching. The University regulations for these advanced degrees are described in the section "Degrees" in this Bulletin. The departmental requirements are summarized below.

Basic Lecture Courses—A minimum of 30 units of graduate lecture courses are required which may include the following areas: (a) chemical engineering, (b) mathematics, (c) physical chemistry or physics, (d) Colloquium, Ch.E. 280 plus assigned research seminars. A grade point average of at least 3.00 must be maintained in these courses.

Additional Requirements for the M.S. Degree — To obtain some experience in research, approximately 9 units of work in Graduate Chemical Engineering Research, Ch.E. 290, is normally taken by the M.S. candidate. Although no formal thesis is required, satisfactory completion of Ch.E. 290 involves a formal written discourse which must be approved by the research adviser. Students continuing toward the Ph.D. degree will be eligible to receive the M.S. degree upon successful completion of the basic lecture courses and upon recommendation of the research adviser.

Additional Requirements for the Ph.D. Degree — A Ph.D. student, in addition to completing 30 units of the above basic graduate lecture courses, must take 30 additional units of lecture courses chosen from among the following five areas: (a) chemical engineering, (b) chemistry, (c) mathematics, (d) physics, (e) other engineering departments. Three courses each in at least two of these areas are required and a grade point average of at least 3.20 or higher in each quarter should be maintained. Undergraduate chemical engineering courses and colloquium may not be included in fulfilling the 60-unit requirement.

During the last quarter of his first year of residence, a doctoral candidate is expected to present orally to the chemical engineering faculty a comprehensive review and analysis of written technical material assigned to him. Upon satisfactory performance in this presentation the candidate will be permitted to proceed with his research and he should be prepared at this time to choose a research topic and research adviser.

A dissertation based on a successful investigation of a fundamental chemical engineering problem is required and the student will ordinarily register in Ch.E. 290 while pursuing his research.

Research investigations are currently being carried out in the following fields: applied chemical kinetics; catalysis; fluid mechanics; heat and mass transfer; optimization theory; and process dynamics and control. Further detailed descriptions of research programs are available upon request to the Department.

FELLOWSHIPS AND ASSISTANTSHIPS

Fellowships and assistantships are awarded to worthy candidates each year. Application forms may be procured by writing the Department of Chemical Engineering. Applications should be made as early as possible and no later than March 1 preceding the start of the academic year for which the award is to be made. By mutual agreement of the graduate schools of North America, the student need not commit himself to fellowship or scholarship award offers before April 15.


3 units, Aut, Spr (Wilde) MWF 10

120a. Chemical Engineering Thermodynamics — The thermal properties of matter; the first law; the second law; general conditions of equilibrium in thermodynamic systems; phase and chemical equilibrium. Applications to engineering systems.

3 units, Win (Acrivos) MWF 10

3 units, Spr (Boudart) MWF 10

130a. Transport Phenomena: Momentum Transport — An introduction to the field of transport phenomena. Viscosity and the mechanism of momentum transport; velocity distributions in laminar flow; equations of change for isothermal systems; turbulent flow.

3 units, Aut (Schwarz) MWF 10

130b. Transport Phenomena: Energy Transport — Thermal conductivity and the mechanism of energy transport; unsteady-state conduction in solids and fluids in laminar flow; the equations of change for non-isothermal systems; heat transfer in fluids in turbulent flow. Radiative heat transfer.

3 units, Win (Mason) MWF

140a. Unit Operations: Fluid Flow and Heat Transfer — The energy balance and fluid friction in laminar and turbulent flow systems; dimensional analysis flow measurement; pumps and compressors; phase separations based on fluid mechanics; heat transfer in forced and free convection; heat exchange equipment.

3 units, Aut (Acrivos) MWF 11

140b. Unit Operations: Mass Transfer — Theory of molecular diffusion; transfer of material between phases; simultaneous heat and mass transfer; principles of design in processes involving absorption, humidification, drying, evaporation, and crystallization; simultaneous absorption and chemical reaction; unsteady-state behavior of chemical processes.

3 units, Win (Madix) MWF 11

140c. Unit Operations: Stage Operations — 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; optimization.

3 units, Spr (Schwarz) MWF 9

141a. Chemical Engineering Laboratory — Experiments with discussion questions on the transport of momentum and energy. Measurements of viscosities; thermal conductivities; temperature profiles in solids; friction factors; and fluid efflux times.

3 units, Aut (Madix) TTh 1:15–5:00

141b. Chemical Engineering Laboratory — Experiments in mass transfer, distillation, absorption, extraction, thermodynamics, and reaction kinetics; computer solution of selected problems of interest to chemical engineers.

3 units, Win (Madix) TTh 1:15–5:00

150. Chemical Reactor Design — Use of rate theory and empirical relationships to develop chemical rate expressions for use in the design of homogeneous and catalytic static and flow reactors. Characteristics of the batch reactor, steady-state tubular and back-mix flow reactor, and semibatch reactor; choice of reactors for product discrimination; optimization of reactor design.

3 units, Aut (Mason) MWF

160. Chemical Engineering Plant Design — Application of unit operation fundamentals to the basic commercial installation. The course will embrace the principles of economic equipment design and practical plant layout. A number of petroleum and chemical processes will be surveyed with attendant considerations of materials, operating variables, and economics of equipment selection.

2 units, Win (Hill) by arrangement

190. Undergraduate Chemical Engineering Research — Laboratory or theoretical work for undergraduate students on assigned chemical engineering problems. It is advisable for National Science Foundation Undergraduate Research Participants to enroll in this course.

(Staff) by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

control by the Optimum Principle. Open to undergraduates with consent of instructor.

3 units, Win (Wilde) TTh 1:15–2:30


3 units, Spr (Schwarz) MWF 2:15

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) MWF 2:15

205. Transport in Reacting Systems—Discussion of specialized topics; diffusion in multicomponent systems; non-isothermal kinematics; reactor optimization; combustion kinetics; heat and mass transfer in chemically reacting systems; photochemical reactions; corrosion and electrode kinetics.

3 units, Spr (Mason) MWF 11

210a. Advanced Transport Phenomena—An intensive course dealing with the fundamental principles of momentum, heat and mass transfer, and their application to processes of interest to chemical engineers. Derivation and analysis of the Navier-Stokes equations, the energy equation, and the equation for mass transport; creeping flow phenomena and Stokes law; the method of singular perturbation expansions; motion of drops and influence of surface active agents.

3 units, Aut (Acrivos) MWF 8

210b. Advanced Transport Phenomena—A continuation of 210a. Laminar boundary layer theory and its application to problems in heat and mass transfer; the effect of chemical reactions on transport phenomena; hydrodynamic stability and the Orr-Sommerfeld equation; interfacial instability.

3 units, Win (Acrivos) MWF 8

210c. Advanced Transport Phenomena—A continuation of 210b. Elements of turbulent transport of heat and mass. Phenomenological theories; self-preserving flows; the law of the wall; homogeneous turbulence and statistical theories; mixing and chemical reaction in a turbulent field.

3 units, Spr (Acrivos) MWF 8


3 units (Schwarz) by arrangement, alternate years, given 1966–67

230a. Thermodynamics of Irreversible Processes—A course dealing with the main developments in the thermodynamic treatment of irreversible chemical and electrochemical processes, transport processes, coupling phenomena, etc., with special emphasis on topics and methods of interest to students of chemical engineering, materials science, physical chemistry, biophysics, etc.

3 units Aut (Van Rysselberghe) by arrangement, alternate years, given 1967–68

230b. Thermodynamics of Irreversible Processes—Complements 230a; separately open to qualified students.

2 units Win (Van Rysselberghe) by arrangement, alternate years, given 1967–68

231. Electrochemical Concepts and Conventions—(Enroll in Chemistry 276.) A survey of the fundamentals of electrochemistry, sign conventions, etc.

1 unit, Win (Van Rysselberghe) by arrangement, alternate years, given 1967–68

232a. Electrochemical Thermodynamics and Kinetics—(Enroll in Chemistry 277a.) Thermodynamic treatment of reversible cells, electrodes; irreversible phenomena in electrochemical systems, kinetics of electrode processes, polarization and overvoltage Tafel law, etc.; electrochemical procedures in physical, analytical chemistry.

2 units, Win (Van Rysselberghe) TTh 9, alternate years, given 1966–67


2 units, Spr (Van Rysselberghe) TTh 9, alternate years, given 1966–67
270–275. Seminar—Discussion of recent developments and current research in specialized fields. One unit per quarter to a maximum of six; open to qualified students with consent of instructor, by arrangement, Aut, Win, Spr.

270a,b,c. Fluid Mechanics (Acrivos)

271a,b,c. Catalysis (Boudart)

272a,b,c. Applied Chemical Kinetics: Heat Transfer in Non-Equilibrium Systems; Electrode Kinetics in Fuel Cell Systems (Mason)

273a,b,c. Non-Newtonian Fluid Mechanics and Turbulence (Schwarz)

274a,b,c. Optimization and Control (Wilde)

275a,b,c. Intermolecular Interactions and Molecular Beams (Madix)

280. Colloquium—Students enrolled in this course will be expected to attend the weekly colloquia of the Department of Chemical Engineering as well as selected colloquia of other departments recommended by the colloquium chairman. Must be taken every quarter by candidates for advanced degrees in Chemical Engineering.

1 unit, Aut, Win, Spr (Staff)

290. Graduate Chemical Engineering Research—Laboratory or theoretical work for graduate students on chemical engineering problems leading to partial fulfillment of requirements for M.S. or Ph.D. degrees. Credits are not given until a satisfactory report is received for M.S. students or until a dissertation is approved for Ph.D. students. (Staff) by arrangement

CIVIL ENGINEERING

Emeriti: Eugene L. Grant, Alfred S. Niles, Stephen P. Timoshenko, James B. Wells, Harry A. Williams (Professors); Eugene V. Ward (Lecturer)

Executive Head: Ray K. Linsley

Associate Executive Head: Joseph B. Franzini

Assistant Executive Head: Robert L. Street

Professors: Jack R. Benjamin, Rolf Eliassen, Wilhelm Fliigge (on leave autumn and winter quarters), John W. Fondahl, Joseph B. Franzini, James M. Gere, Miklos Hetyeni, Ray K. Linsley, Julius Margolis, Clarkson H. Oglesby, John K. Vennard (on leave 1966-67), Donovan H. Young

Associate Professors: James Douglas, En Y. Hsu, Paul Kruger, Perry L. McCarty, Henry W. Parker, Byrne Perry, Vincent J. Roggeveen, Cedric W. Richards, Robert L. Street, William Weaver, Jr.

Assistant Professors: Norman H. Crawford, Philip M. Hoyt, Robert R. Lee.


Offerings and Facilities

The undergraduate Civil Engineering program provides a well-balanced program stressing the fundamentals common to all special fields of civil engineering. Elective units permit the student to make a further selection of general courses or, if his interests are well defined, to specialize slightly in a definite branch, such as construction, highways, hydraulics, public works administration, or structures. Well-equipped laboratories are available to supplement the lecture courses. A student's professional competence will be greatly enhanced by a year of graduate study following receipt of the B.S. degree. Students interested in advanced work in special fields should consider further graduate study.

The Civil Engineering Department, in collaboration with other departments of the University, offers graduate programs with particular strength in:

- Construction Engineering
- Engineering-Economic Planning
- Transportation
- Water Resources
- Hydraulic Engineering
- Fluid Mechanics
- Hydrology
- Public Works Administration
- Sanitary Engineering
- Soil Mechanics and Foundations
- Structural Engineering

Research work under these programs is carried out in three major facilities — the newly renovated hydraulics laboratory, the George Havas Building which houses water
quality, sanitary and structural laboratory facilities and the materials laboratory complex that houses the mechanics of materials, concrete, and soil mechanics laboratories. Office space is provided for most of the graduate students who are acting as research or teaching assistants.

The Program in Engineering-Economic Planning is directed toward preparation for planning and management positions in the public works area. The program is supported by a grant from the Ford Foundation which provides fellowships for graduate students, support of faculty and funds for visiting faculty. In addition one-year internships with the Federal Government are available for students in the advanced stage of a Ph.D. program.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

In addition to the basic University requirements for the B.S. degree, students in civil engineering must complete the specific course requirements for all engineers and for Civil Engineering. Because of the considerable amount of time allotted to other than civil engineering in the undergraduate program, qualified students should seriously consider graduate study to equip themselves for advanced professional work.

MASTER OF SCIENCE

Programs are available leading to the degree of M.S. in civil engineering with special designation on the diploma as follows: Construction, Engineering-Economic Planning, Hydraulic Engineering, Public Works Administration, Sanitary Engineering, Soil Mechanics, and Structural Engineering. 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 grade point average of 2.75 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 students 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 grade point average of 3.00 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 Qualifying Examination and to complete a substantial amount of the required foreign language work in order 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 $5,000. Teaching assistantships carry stipends for one-third time work as teaching aides during the academic year. Research assistantships are also available; research results may be used as a basis for a doctoral thesis. Assistantships and other basic support may be supplemented by fellowship and scholarship awards. Continued support is available for further study toward the Engineer or Doctor of Philosophy degree when performance justifies such support. Detailed information may be obtained by writing to the Department of Civil Engineering.

**UNDERGRADUATE COURSES**

20. **Elementary Surveying** — Care and use of instruments; leveling; transit-tape and stadia traverses; topographic surveying; triangulation; plotting and adjusting of field data; computing of areas and topographic mapping. (Limited to 36 students per section.)

3 units, Spr (Staff) MW 1:15-5:05


3 units, Aut (Vennard) TTh 9; lab. Th 1:15-4:05

114. **Mechanics of Materials** — Continuation of Engineering 15; combined loads and stresses, bending of curved bars, two-dimensional axially symmetric stress problems, strain energy, statically indeterminate systems, beams of two materials, special problems. Prerequisite: Engineering 15.

3 units, Aut (Richards) MWF 8
Spr (Gere) MWF 11

116. **Plain Concrete** — Physical properties of concrete and its constituents. (Limited to 16 students per section.)

3 units, Aut (Parker) T 1:15-5:05 and Th 1:15-4:05
Win (Parker) W 1:15-5:05 and F 1:15-4:05

118. **Materials Engineering** — Mechanical behavior of solids; effects of stress distribution; dynamic and thermal effects; creep and relaxation; fatigue; statistical methods. Prerequisites: Engineering 15, Chemistry 2, and Engineering 50.

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

126. **Advanced Surveying** — Highway reconnaissance and location, horizontal and vertical curves, earthwork computations, photogrammetry, construction surveys, adjustment of instruments, city and land surveying, plane table, engineering astronomy. Prerequisite: 20.

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

138. **Specifications and Contracts** — Principles of contract law as applied to civil engineering; varieties of construction contracts; specification writing; composition, arrangement of typical sets of specifications; legal problems in administering construction contracts; engineering ethics. Prerequisite: junior standing.

3 units, Aut (Oglesby) MWF 11
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 8
Win (Parker) TTh 8 and M 1:15-2:05

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 150 or 151.)

3 units, Aut (Douglas) TTh 8;
lab. W 1:15-4:05
Spr (Parker) TTh 9;
lab. M 1:15-4:05
150. Transportation Engineering — Basic principles of planning and design of highways, airports, railroads, mass transit, etc. Trip generation, desires, capacity, geometric design, pavements, tracks, finance, economy, relationships with land use, interrelationships between modes, etc. Open to engineering students having 90 quarter-units of credit and to other students by permission. 

3 units, Win (P. Kruger) TTh 11

151. Highway Engineering—Soils, soil conditioners, asphalts, and concrete as highway materials; design and construction procedures for highway embankments, undercourses, and pavements. Prerequisite: junior standing.

3 units, Spr (P. Kruger) Th 1:15 and one lab by arrangement

160. Hydrology and Hydraulic Structures — Introduction to hydrologic measurements, runoff computations, groundwater, water law, reservoir design, frequency analysis, dams, spillways, conduits, economy of water-resources development. Prerequisite: 107.

4 units, Win (Franzini) MTThF 9


2 units, Win (Franzini) TTh 11

170. Man and His Environment—Man's interaction with the air, water, and land environment in which he lives; the role of engineering in environmental control of pollution for the health and welfare of mankind.

3 units, Spr (Eliassen) MWF 8

171. 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. Prerequisites: 170, or Chemistry 3, or Physics 57, or equivalent with consent of instructor.

3 units, Aut (P. Kruger) TTh 11

172. Nuclear Chemistry — (Enroll in Engineering 172.) Properties of nuclei and radioisotopes; nuclear reactions; fission, fusion, reactors and accelerators; radiation detection and measurement; radiation safety; radiation chemistry, radio-tracers, radioactivation analysis, and their applications. Prerequisites: Chemistry 3, Mathematics 23, or Physics 57.

3 units, Win (P. Kruger) TTh 11

176. Radiochemistry Laboratory — (Enroll in Engineering 176.) Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisite: Engineering 172 or 175 or consent of instructor.

3 units, Spr (P. Kruger) Th 1:15 and one lab by arrangement

180. Elementary Structural Analysis—Analysis of beams, trusses, frames; influence lines for beams, girders, trusses; 3-dimensional trusses; cable structures; deflections by virtual work, moment-area, elastic loads; indeterminate analysis by superposition equations, slope-deflection, moment distribution; introduction to matrix methods of analysis. Prerequisite: Engineering 15.

4 units, Spr (Young) MTThF 10

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, Aut (Weaver) MWF 9

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, Win (Weaver) MWF 8

183. Design of Timber Structures — Loads, structural elements, fastenings, connectors; design of timber trusses, glued-laminated frames and arches, plywood shell roofs; lateral analysis using sheathed diaphragms. Prerequisites: 180 and 181.

2 units, Spr (Weaver) TTh 11

190. Soil Mechanics and Foundations—Soil as an engineering material; application of soil mechanics to foundation design; footings, retaining walls; various types of foundations. Prerequisite: 182.

4 units, Aut (Hoyt) MWF 9; lab. T or W 1:15–4:05
197. Engineering Synthesis — Utilization of students' previous course work and creative abilities with objective of producing problem solutions and workable designs for a comprehensive project. Stress placed on job planning, coordination and efficient use of group talent. Prerequisite: senior standing.
   4 units, Spr (Douglas, Staff)
   MW 2:15-4:05

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

COURSES PRIMARILY FOR GRADUATE STUDENTS

205. Hydromechanics Laboratory—Prerequisite: 107 or equivalent. Enrollment is limited.
   2 units, Win (Hsu) by arrangement

206. Advanced Mechanics of Fluids — Similarity and dimensional analysis; fluid friction for incompressible fluids in tubes, boundary layers, and through granular media; lubrication theory; cavitation. Prerequisite: 107.
   3 units, Aut (Hsu) MWF 10

207. Advanced Hydraulic Laboratory — Prerequisite: 107, or equivalent. Enrollment is limited.
   2 units, Spr (Hsu) by arrangement

   3 units, Win (Staff) MWF 11

209. Hydraulics of Open Channels—Varied flow, hydraulic jump, hydraulics of open-flow structures; intakes, transitions, measuring flumes, spillways, culverts, etc. Prerequisite: 107.
   3 units, Spr (Street) MWF 8

   3 units, Win (Hetényi) TTh 8 and one lab. by arrangement

   3 to 6 units, Spr (Hetényi) by arrangement

   3 units, Spr (Richards) TTh 10 and one lab. by arrangement

222. Water Resources Planning — Integration of technical, economic, political and social factors in decisions relating to water resources. Prerequisite: E.E.S. 211 or consent of instructor.
   3 units, Spr (Linsley) TThF 2:15

223. Highway Planning—A study of the decision process in highway planning as influenced by engineering, economic, political and social problems. Prerequisite: E.E.S. 211 or consent of instructor.
   3 units, Spr (Oglesby) MWF 9

   3 units, Spr (Roggeveen) MWF 10

225. The Institutional Setting for Public Works Planning—The role of administrative organization, interest groups, legislative bodies and technical experts in democratic decision-making.
   3 units, Win (Lee) TTh 11
231. Problems in Engineering Economy — Independent study or research of a selected problem in engineering economy of public utilities or public works. Prerequisite: permission of instructor.

2 or more units, Aut, Win, Spr (Staff) by arrangement

233. Statistical Models in Civil Engineering — (Formerly 297.) 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. Open to graduate students only.

3 units, Win (Benjamin) MWF 8

234. Decision Making in Civil Engineering — Applications of statistical decision theory in civil engineering practice; decision theory; value; prior, posterior; expected value; model of engineering office practice; formulation of problems; economic analysis. Prerequisite: 233.

2 units, Spr (Benjamin) MW 8

235. Stochastic Process Models in Civil Engineering — Introductory course in applications of stochastic processes to problems in Civil Engineering; the traffic model; generalized transportation models; structural dynamics models; creep and one-cycle problems; diffusion models; fitting of data to models and the estimation problem. Prerequisite: 233, 234, or equivalent.

2 units, Aut (Benjamin) TTh 11

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 2-3; lab. T or Th 3:15-5:05

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, Spr (Fondahl) WF 9 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, C.E. 243, and computer programming.

2 units, Spr (Douglas) TTh 10


4 units, Win (Fondahl) MWF 10 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.

2 units, Win (Fondahl) TTh 10

245. Advanced Construction Equipment and Methods — Methods and equipment selection and application in heavy construction. Excavation, tunneling, conveyors, rigging, underwater foundations, pile driving, contractor’s temporary facilities. Prerequisite: 145.

4 units, Aut (Parker) TTh 10; lab. M 1:15-4:15 and 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, Win (Peugh) 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. Lim-
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ited enrollment. Prerequisites: 138 and 144. Graduate standing in construction option.

3 units, Spr (Staff) by arrangement

248. Human Factors in Construction Management — Seminar dealing with the problems of working and communicating with individuals and groups. Enrollment limited to students in the graduate construction program.

2 units, Spr (Staff) S 8–10

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 (Staff) by arrangement

251. Transportation Problems — Individual investigation. Prerequisite: permission of instructor.

2 or more units, Aut, Win, Spr (Staff) by arrangement

260. Advanced Hydrology — Meteorology, climatic data, precipitation, evapotranspiration, and streamflow, techniques of measurement and interpretation.

4 units, Aut (Crawford) MWF 9; lab. T1:15-4:05

261. Advanced Hydrology—Methods of applied hydrology: runoff relationships, unit hydrographs, flood routing, frequency analysis, etc. Prerequisite: 260.

4 units, Win (Linsley) MWF 9; lab. T 2:15–5:05

262. Advanced Hydraulic Engineering — Integration of procedures in hydraulic projects illustrated by discussion, student reports, and design problems. Prerequisite: 261.

4 units, Spr (Crawford) TTh 10 and two afternoons by arrangement

263. Sedimentation Problems — Erosion, character of sediments, sediment transport and deposition. Regimen of rivers, reservoir sedimentation. Effects of watershed management and engineering control works. Prerequisite: 107 or equivalent.

2 units, Spr (Franzini) MW 9

264. Oceanographical and Coastline Engineering—Fundamentals of water waves and their effects. Wave generation, storm swell, tsunamis, coastal processes. Effects of structures on waves and functional design of marine structures including sea water intakes and ocean outfalls. Prerequisites: 107, equivalent, or consent of instructor.

3 units, Spr (Street) MWF 11

265. Flow in Permeable Media—Fluid mechanics of subsurface flow. Basic concepts, Darcy’s law, potential flow theory with application to groundwater and seepage flow, effects of varying permeability and capillary action. Formulation of boundary-value problems and solution by analytical and computer techniques. Prerequisite: knowledge of ordinary differential equations.

4 units, Aut (Street) MWF 1:15


3 units, Win (Perry) MWF 2:15

267. Engineering Hydrodynamics—(Enroll in E.M. 247.) Continuation of E.M. 246. Selected theoretical topics from naval hydrodynamics, hydraulic engineering, and oceanography. Possible topics include forces on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, density currents, flow over weirs and spillways. Prerequisite: E.M. 246.

3 units, Spr (Perry) MWF 2:15

269. Hydraulic Engineering Seminar—Discussions on all phases of hydraulic engineering.

1 unit, Aut (Franzini) T 4:15–6:05
Spr (Crawford) W 3:15–5:05

270. Water Quality Control I—Natural and man-made characteristics of water quality; effect of quality on the use of water; unit operations and processes of water quality control, including desalination, for municipal and industrial use. Prerequisite: 170 or equivalent.

3 units, Aut (Eliassen) MWF 8

271. Water Quality Control II—Characteristics of waste waters; chemical and biological unit processes for the treatment of sewage and industrial wastes; water quality re-
requirements in stream pollution control. Prerequisite: 270.

272. Design of Water Quality Control Systems — Application of physical, biological, and chemical unit operations and unit processes to the functional design of treatment plants for water, sewage, and industrial wastes. Prerequisites: 270 and 271.

2 units, Spr (Eliassen) M 1:15–5:05

273. Water Resources Chemistry — Application of basic principles of analytical, physical, and organic chemistry to the analysis and treatment of water, sewage, and industrial wastes.

3 units, Aut (McCarty) TTh 8; lab.

M 1:15–4:05

274. Water Resources Microbiology — The ecology of streams, lakes and other water resources; identification and control of microorganisms in water and wastes; fundamental aspects of microbiology and biochemistry as related to stream pollution and water quality control. Prerequisite: 273.

3 units, Win (McCarty) TTh 10; lab.

W 1:15–4:05

275. Water Quality Control Processes — Laboratory and pilot plant studies of physical, chemical, and biological processes for the treatment of water, sewage, and industrial wastes. Prerequisite: 274.

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


2 units, Spr (McCarty) TTh 8


2 units, Win (P. Kruger) TTh 4:15

278. Radioactivation Analysis — 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.

2 units, Spr (P. Kruger) TTh 11

279. Water Quality Control Seminar — Discussions on all phases of sanitary engineering.

1 unit, Aut (Staff) Th 4:15–5:15

Win (Staff) W 4:15–5:15


3 units, Aut (Young) MWF 8

281a. Matrix Analysis of Structures — Introduction to matrix algebra; use of matrix methods in the analysis of statically and kinematically indeterminate structures; flexibility and stiffness methods. Prerequisite: 114.

3 units, Aut (Gere) MWF 9

281b. Matrix Analysis of Structures — Continuation of 281a. Emphasis on the stiffness method, including implementation of the method on a digital computer. Prerequisite: 281a.

3 units, Win (Weaver) MWF 11

283. Advanced Structural Analysis — Membrane stresses in tank, roof shells; discontinuity stresses in domes, tanks; barrel shell roofs; introduction to plane plate theory. Prerequisite: 281.

4 units, Spr (Flügge) TTh 11 and M 2:15–5:05 and F 1:15–4:05

284. Design of Prestressed Concrete Structures — Analysis and design of prestressed slabs, beams, and columns; special problems; design and testing of beam in laboratory. Prerequisite: 182.

2 units, Aut (Staff) TTh 10

285. Advanced Structural Design — Structural geometry; analysis of structures by deformed structures, statics; structural models; bridge analysis, design; bridge types, characteristics; design problems.

4 units, Aut (Benjamin) TTh 10;

lab. W 1:15–4:05
4 units, Win (Benjamin) TTh 9;
lab. W 1:15–4:05

287. **Advanced Structural Design**—Continuation of 286. Design of buildings in steel, timber; lateral load analysis, design; shear walls; diagonal sheathing; framing problems. Prerequisites: 285 and 286.
4 units, Spr (Benjamin) TTh 8;
lab. W 1:15–4:05

288. **Structural Engineering Seminar** — Problems in all phases of structural engineering.
1 unit, Aut, Win, Spr (Staff) alternate
W 4:15

290. **Soil Mechanics**—A re-examination of fundamentals of soil mechanics; advanced theory and current practice in problems primarily concerned with foundations of structures. Prerequisite: 190.
3 units, Win (Hoyt) TTh 11 and M 4:15

291. **Soil Mechanics**—Problems concerned with earth dams, embankments, soil composition and its relation to soil properties. Prerequisite: 190.
3 units, Spr (Hoyt) TTh 9 and one hour
by arrangement

292. **Advanced Soil Mechanics Laboratory**—Experiments on the mechanical properties of soils. Topics can be selected to suit individual and class interests. Open by permission only. Prerequisite: 190 or 290.
1 unit, Spr (Hoyt) by arrangement

293. **Foundation Design**—Design, construction of foundations for buildings, bridges. Prerequisite: 190.
3 units, Aut (Hoyt) MWF 10
Win (Hoyt) MWF 11

295. **Harbor Structures**—Wharves; piers of timber, concrete; sea walls, bulkhead walls; factors affecting design, life of marine structures. Prerequisite: 190.
3 units, Spr (Douglas) MWF 10

296a. **Structural Dynamics**—Vibration theory, particular reference to structures; response of structures to pulse loads and earthquakes, vibration of beams. Prerequisites: Engineering 12 and C.E. 280.
3 units, Win (Young) MWF 9

296b. **Structural Dynamics**—Dynamics of framed structures having many degrees of freedom using matrix methods, normal mode analysis, and digital computer solutions. Prerequisites: 281b and 296a.
3 units, Spr (Weaver) TTh 9

2 units, Spr (Young) W 9 and F 8

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 9

299. **Directed Reading and Special Studies in Civil Engineering**—Graduate students by special permission.
Aut, Win, Spr (Staff) by arrangement

300. **Thesis**—Investigation of some engineering problems; required of candidates for degree of Engineer.
Aut, Win, Spr (Staff) by arrangement

301. **Thesis**—Dissertation; required of candidates for degree of Doctor of Philosophy.
Aut, Win, Spr (Staff) by arrangement

322. **Introduction to Regional Planning**—Concepts and criteria of regional and urban land use planning, including preparation of master plans, zoning, urban renewal and area redevelopment.
3 units, Spr (Roggeveen) MWF 1:15, alternate years, given 1966–67

323. **Transportation Planning**—Planning of facilities for all modes of transportation with emphasis on current developments in systems analysis, application of computers, urban land use—transportation models, etc.
3 units, Spr (Roggeveen) MWF 1:15, alternate years, given 1967–68

324. **Public Works Problems of the Developing Nation**—Study of the special problems involved in planning public works in the developing nations.
3 units, Aut (——) MWF 1:15, alternate years, given 1966–67

3 units, Spr (Lee) TTh 11, alternate years, given 1967–68


2 units, Aut (Hetényi) TTh 10

391. Predoctoral Seminar—Required of all post-masters students to serve as orientation to the selection of a research topic.

1 unit, Aut (Staff) by arrangement

Civil engineering graduate students with interests in special fields will also take appropriate courses in other schools and departments of the University including the Graduate School of Business, Division of Engineering Mechanics, Division of Engineering-Economic Systems, the Departments of Electrical Engineering, Industrial Engineering, Mechanical Engineering, Mathematics, Geology, Geophysics, Materials Science, Statistics, Political Science, Architecture, Biology and Chemistry.

PROGRAMS OF STUDY

UNDERGRADUATE

Students desiring to specialize in electrical engineering during their undergraduate period may do so by following the curriculum given earlier in the general discussion of the School of Engineering. Variations of this curriculum are encouraged if there is good reason for change. Attention is also called to the Engineering Science curriculum in the same general section.

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 skill in working with men. Curricula at Stanford are planned to offer the breadth of education and depth of training necessary for leadership in the profession. For those who wish to engage in this profession with competence, four years of undergraduate study and
at least one year of postgraduate study are strongly recommended.

The Electrical Engineering Department offers graduate courses in the following fields:

Systems Theory
Communication Theory
Control Systems
Network Theory
Solid State Materials and Properties
Solid State Circuits and Devices
Quantum Electronics
Radio Science
Plasmas
Electromagnetic Theory
Microwaves
Medical Electronics

Descriptions of courses will be found in the following pages.

A one-year program of graduate study in electrical engineering may lead to the degree of Master of Science. A two-year program, offering wider selection of engineering course work, more opportunity for study in the related fields of physics, mathematics, and engineering, and in particular more independent work and individual guidance, may lead to the degree of Engineer.

The degree of Doctor of Philosophy is offered under the general regulations of the University. The doctoral program, requiring a minimum of three years (nine quarters) of graduate study, 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. 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 Executive Head for 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. 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 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 is done before completion of the first 15 units of graduate study (modifications may be made later).

Programs of at least 45 quarter units which include the following will normally be approved.

1. At least 21 units of electrical engineering courses numbered above 200 and in which letter grades are given.
2. A sequence of three or more electrical engineering courses numbered above 200 to provide depth in one area.
3. At least one course in each of the three major areas of Fields, Systems, and Electronics to provide breadth.
4. At least three courses in departments other than Electrical Engineering.
5. At least three quarters of E.E. 200, Seminar (unless there is a schedule conflict) and not more than six additional units of plus grades.

However, 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. A supplementary sheet providing detailed information on the preparation of degree applications is available in the Department Office.

Students with high aptitude for study in the physical sciences but without formal preparation in electrical engineering may 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.

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. It is the student's responsibility, in consultation with his adviser, to determine whether he has met the prerequisites for advanced courses. Prerequisites 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 45 to 50 units, and the time required to meet the degree requirements may be increased.

**Engineer**

University regulations governing the degree of Engineer are described in the “Degrees” section in this Bulletin.

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.

The Engineer degree requires a minimum of three quarters of graduate study beyond the Master's degree. In addition to advanced course work, an acceptable thesis is required.

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.

**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.

In the first quarter after receiving the Master of Science degree the student should submit to the Department 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 passing an examination of reading knowledge of one foreign language.

Not later than the first autumn quarter after receiving the Master of Science degree he 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, beginning in the second year of graduate study; (3) an examination to show reading knowledge of a foreign language (usually French, German, or Russian, although another language may be substituted if it is of greater value in the student's research); (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 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. He will take and pass a specified portion of the qualifying examination.

**Special Programs**

**Medical Electronics Program**—The Master of Science degree carrying the designa-
tion "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 45 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.

Electrical Engineering Administration — By a special arrangement, graduate students of engineering may take courses in the Graduate School of Business. This may be done to an extent that depends on the interests of the student, and three arrangements may be distinguished.

While working toward the degree of Master of Science in electrical engineering, it is possible to take about one course each term in the School of Business without interfering with completion of the technical studies necessary for the degree. Industrial engineering courses are also useful. (Please note that in the present year the classes in the School of Business have different times from those in the rest of the University and are often difficult to schedule.)

The Master's degree carrying the distinction "Electrical Engineering: Administration" on the diploma is conferred upon students who combine not less than 30 units of study in electrical engineering with 30 or more units of study in industrial engineering or business. Four or five 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.

FELLOWSHIPS, SCHOLARSHIPS, AND ASSISTANTSHIPS

The Department each year awards a number of fellowships, scholarships, and assistantships which are available to graduate students. Detailed information concerning these may be obtained by addressing the Assistantship Committee of the Electrical Engineering Department.

AREAS OF RESEARCH

QUANTUM ELECTRONICS
Lasers
Masers
Interaction of Acoustic and Electromagnetic Waves

PLASMAS
Plasma Waves and Diagnostic Techniques
Electrodynamical Astrophysics
Plasma Containment Systems
Magnetohydrodynamics
Thermionic Energy Conversion

SOLID STATE
Semiconductors and Solid State Physics
Electronic, Magnetic, and Optical Properties of Solids
Crystal Preparation: Epitaxy and Ion Implantations
Integrated Circuits
Solid State Devices

RADIOSCIENCE
Radio Studies of Ionized Media
Solar-Terrestrial Physics
Radio Telescopes and Interferometers
Radar Astronomy
Space Experiments
COURSES PRIMARILY FOR UNDERGRADUATES

41, 42. Circuits, Electronics, and Electromechanics—(Enroll in Engineering 41, 42).
41A. Laboratory I—(Enroll in Engineering 41A.)
42A. Laboratory II—(Enroll in Engineering 42A).

100. Circuits I—Analysis of simple circuit models, with a view to discovering their fundamental characteristics as transmission networks. Forced and natural components of response, natural frequencies, the complex-frequency plane, resonance; transfer functions and the roles of their poles and zeros. Introduction to the use of analog and digital computers in circuit analysis. Elementary signal-flow graphs. Impulse response: its calculation and its use in obtaining response to other excitations; the superposition (convolution) integral. Prerequisites: Engineering 41 and Mathematics 44.

3 units, Aut (——) MWF 10
Win (——) MWF 8

101. Circuits II—The Laplace transformation, development and application of Fourier series. The sinusoidal steady state: plots, charts and loci that exhibit frequency dependence, impedance matching, transformers. Circuit theorems and analytical techniques, including the use of digital computers. Prerequisites: E.E. 100 (or, by permission, Engineering 104 plus supplementary reading) and Computer Science 136 or equivalent.

3 units, Win (——) MWF 10
Spr (——) MWF 8


4 units, Aut (——) MTThF 9
Spr (——) MTWF 10

110. Electromagnetic Fundamentals—The field concept, vector analysis, boundary-value problems, electrostatics, images, conformal mapping, magnetostatics, dielectric and magnetic media, time-varying fields, Maxwell’s equations, plane waves. Prerequisite: Engineering 41.

3 units, Aut (——) MWF 8
Win (——) MWF 9

111. Electromagnetic Waves—Plane waves in various media; reflection and refraction, wave guides, cavities, transmission lines, standing waves, antennas, radiation. Should be taken immediately after E.E. 110. Prerequisites: E.E. 110, and E.E. 102 (E.E. 102 may be taken concurrently).

3 units, Win (——) MWF 8
Spr (——) MWF 9

112. Electrodynamics—Motion of charged particles and current-carrying conductors in prescribed electric and magnetic fields, relativity concepts, fluid and discrete-charge models of electron beams and plasmas, space-charge waves, applications to d-c and a-c rotating machinery, mhd generators; klystrons, ion propulsion, beam-plasma amplifiers, electron and plasma diodes. Prerequisite: E.E. 111.

3 units, Spr (——) MWF 9

124. Electromechanics—Theory of electro-mechanical energy conversion and its applications in common use. Rotating machines d-c and a-c, both steady and dynamic operation), electromagnets, loudspeakers, microphones, and vibration pickups are considered as elements of systems. The dynamic
response of such systems is also considered. Prerequisites: E.E. 101 and Engineering 42.

3 units, Aut (—) MWF 9


3 units, Aut (—) MWF 10
Win (—) MWF 8
Spr (—) MWF 11


3 units, Win, Spr (Staff) Th 1:15 and one 3-hour lab. weekly by arrangement

150, 151, 152. Electronics—Basic electronic devices and circuits and an introduction to their applications in electronic systems. Physical principles of charge motion in conductors, semiconductors, vacua and plasmas, and their application to the development of the operating principles and terminal characteristics of electronic devices, particularly semiconductor diodes and transistors. Development of various modeling techniques which are useful in electronic circuit theory (piecewise-linear, graphical, and analytical). Applications of electronic devices in rectification, detection, modulation, amplification, oscillation, switching, and wave-shaping circuits. Prerequisite: previous or concurrent registration in E.E., 100 (or consent of the instructor, in special cases).

150. 3 units, Aut (—) MWF 8
Win (—) MWF 11

151. 3 units, Win (—) MWF 8
Spr (—) MWF 11

152. 3 units, Aut (—) MWF 11
Spr (—) MWF 8


156. 2 units, Win (—) T 1:15 and 3-hour lab. weekly by arrangement

157. 2 units, Spr (—) T 1:15 and 3-hour lab. weekly by arrangement

159. Electron Tubes and Associated Circuits—Problems and requirements in modern applications of electron tubes in high-frequency and high-power systems. Short review of fundamentals of vacuum triodes and tetrodes; introduction to electron guns and beams. Tuned power amplifier circuits; klystron amplifiers, reflex klystrons, and traveling-wave tubes. Prerequisites: E.E. 102 and 152 (may be concurrent).

3 units, Aut (—) MWF 8

161. Information Transmission and Modulation—Signals and circuits for information transmission in electronic systems; signal processing, 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: E.E. 102 and E.E. 152.

3 units, Win (—) MWF 8

162. Radio Engineering—Systems applications of electronic circuits; propagation of radio waves, antennas, transmitters, receivers, etc. Engineering decisions involved in design of system components with examples in communication and radar. Prerequisite: E.E. 111.

3 units, Spr (—) MWF 8

163. 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: E.E. 101.

3 units, Aut (—) MWF 2:15
Spr (—) MWF 2:15

164. Principles of Pulse and Timing Circuits—Tube, transistor circuit techniques for diversity of waveforms, functions needed in pulse systems, instrumentation, computers. Prerequisite: E.E. 152 or equivalent.

3 units, Aut (—) MWF 10
Spr (—) MWF 10
Sum (—)

165. Random Signals and Noise—Introduction to the random process model for undetermined signals and noise waveforms, statistical descriptions of signals, power spec-
tral density and autocorrelation function, analysis of linear networks with random inputs, some elementary results with nonlinear elements, physical sources of noise, noise figure. Prerequisites: E.E. 101 and Statistics 116 or equivalent.

3 units, Win (———) MWF 2:15

167. Electric and Magnetic Properties of Solids—The electrical 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 E.E. 150 or Engineering 50.

3 units, Spr (———) MWF 1:15


3 units, Aut (———) TTh 9 and 3-hour lab. weekly by arrangement

171. Electronic Measurements and Design — Continuation of E.E. 170, with emphasis on design, construction, and testing. Topics include noise, modulation, feedback, and design problems. Prerequisite: E.E. 170 (E.E. 111 and 161 are suggested in addition).

3 units, Win (———) TTh 9 and 3-hour lab. weekly by arrangement

172. Microwave Measurements — Power sources, modulation; crystal and bolometer characteristics and their use in standing-wave detectors and power meters. Measurements of VSWR, impedance, attenuation, and coupling. Resonators; wavemeters, measurement of Q, frequency, and radiation from horns. Prerequisite: E.E. 111.

3 units, Spr (———) TTh 9 and 3-hour lab. weekly by arrangement

180. Design Project — Individual or team projects that emphasize the creative use or design of electrical devices or systems to meet specifications. Prerequisite: senior standing.

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

191. Special Studies in Electrical Engineering—Special studies, laboratory work, reading, etc. under direction of a faculty member. Student must find faculty sponsor and have approval of his adviser. A term paper is required.

2 to 3 units (———) by arrangement

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

Courses Primarily for Graduate Students

200. Seminar—Weekly discussion of special topics of current interest in electrical engineering. Speakers from faculty and from outside the University. Normally taken each quarter for 3 quarters by graduate students.

1 unit, Aut, Win, Spr (Pritchard, Smith) Th 11

201. Introduction to Solid State Quantum Theory—(Enroll in Materials Science 233.)

202. Electrical Transport Processes in Crystals—(Enroll in Materials Science 234.)

203. Photoelectronic Processes in Crystals —(Enroll in Materials Science 235.)

205. 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.

2 units, Aut (Thompson)

211A. Electron Dynamics of Active Devices—(Enroll in Applied Physics 250.)

212A. Electron Dynamics of Active Devices —(Enroll in Applied Physics 251.)

213A. Electromagnetic Measurements I — (Enroll in Applied Physics 350.)

214A. Electromagnetic Measurements Laboratory I — (Enroll in Applied Physics 351.)

215A. Electromagnetic Measurements Laboratory II — (Enroll in Applied Physics 352.)

216A. Electromagnetic Measurements Laboratory II — (Enroll in Applied Physics 353.)

For description of Courses 211A–219B, see Applied Physics 250–378.
217A. Electromagnetic Measurements III—
(Enroll in Applied Physics 354.)

218A. Electromagnetic Measurements Laboratory III—(Enroll in Applied Physics 355.)

219A. Theory of Solids—(Enroll in Applied Physics 377.)


220. Topics and Methods in Solid State Research — Discussion of technical topics in solid state electronics and related mental processes and thinking tools.

(Shockley) by arrangement

224. Integrated Circuits — A combination laboratory and lecture course in the fundamentals of semiconductor monolithic integrated circuits: guidelines for integrated-circuit design, laboratory instruction in photolithographic techniques, electrical measurements by student on monolithic circuits; minimum of report preparation. Registration by permission of instructor. Prerequisite: general familiarity with p-n junction devices, e.g., E.E. 227; working knowledge of chemistry and/or photographic laboratory techniques is desirable.

3 units, Aut, Win (Pritchard)

225. Solid State Circuits Laboratory—Experimental projects, usually of 10-weeks duration, on electrical properties, performance, and circuit design for various state-of-the-art solid state devices (including transistors, field-effect transistors, varactors, tunnel diodes), with emphasis on relationship of performance to physical mechanisms, instrumentation techniques, and a realistic minimum of report preparation. Prerequisites: previous or concurrent registration in any one of the following: E.E. 226, 227, 228, 231, 232, and permission of the instructors.

3 units, Aut, Win, Spr (Pritchard)

226. Two-Port Network Theory—Representation of linear two-port models by different sets of parameters. Relations between parameters and network functions. Combination of active and passive two-ports (generalized feedback). Design of passive terminations, interstages. Equalization and the approximation problem. Development of canonic forms of regenerative pulse circuits from active elements, piecewise linear elements, and storage elements. Prerequisite:
familiarity with mathematics of complex variables.

3 units, Aut, Win (J. Linvill, Newcomb, Tuttle)

227. 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 a range of circuit models of transistors and diodes, including the commonly encountered models. Emphasis is placed on lumped models applicable to small- and large-signal cases. Prerequisite: E.E. 152 or graduate standing in electrical engineering.

3 units, Aut, Win (Angell, J. Linvill)

228. Transistor Electronics — Discussion of linear amplifiers, active circuits, nonlinear switching and regenerative circuits based on the network theory of E.E. 226 and the circuit models developed for transistors in E.E. 227. Prerequisites: E.E. 226 or 236 with approval of instructor, and 227.

3 units, Spr (Angell, J. Linvill)

230. Solid State Electronics Seminar—Discussion by faculty, students, and guest specialists of research topics and current literature in the physical, device and circuit aspects of solid state electronics.

1 unit, Aut, Win, Spr (Spicer, Moll)

231. Amplifier Circuit Theory — Representation of tubes and transistors over wide frequency ranges. Amplifier design based on steady state and transient performance. Relationships between steady-state and transient behavior. D-c amplifiers. Background in undergraduate electronics and basic complex variable theory required. E.E. 227 is useful but not necessary in understanding the models used.

3 units, Win (McWhorter, Staff)


3 units, Spr (McWhorter, Staff)

233. Network Theory Seminar—Discussion of recent results in network theory. Prerequisite: E.E. 236 or permission of instructor.

1 unit, Spr (Newcomb)
234. *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 techniques. Resonance. The describing function. Oscillators (waveshapes, amplitude limitation), elementary control systems. Use of the digital computer in appropriate cases. Prerequisites: E.E. 102, 128, 152, and Computer Science 136 or equivalent.

3 units, Spr (Tuttle)

235. *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. (The study of network synthesis is continued in E.E. 236 and 237 for those interested in advanced work in the subject.) Prerequisite: E.E. 102; Computer Science 136 or equivalent recommended.

3 units, Aut (Tuttle)

236. *Advanced Network Analysis* — An investigation of analysis methods needed for modern synthesis: n-ports and properties; linear, time-variable, and nonlinear descriptions; scattering concepts; positive and bounded-real matrices; topological methods; Hilbert transforms; Manley-Rowe relations; stability; appropriate topics in synthesis. Prerequisites: E.E. 235 and E.E. 240.

3 units, Win (Newcomb) alternate years, given 1966–67

237. *Advanced Network Synthesis* — A continuation of the work of E.E. 235 with more extensive coverage based upon E.E. 236: Formal n-port synthesis; topological and transformerless synthesis; distributed, variable parameter, active and nonlinear synthesis; approximation; filter design; equivalent network theory. Prerequisite: E.E. 235.

3 units, Spr (Newcomb) alternate years, given 1966–67

238. *Contactor Control and Optimal Control* — (Enroll in Engineering Mechanics 236.)

239a,b,c. *Mathematical System Theory* — (Enroll in Engineering Mechanics 239a,b,c.)

240. *Introduction to the Theory of Linear Systems* — Delta functions, impulse response and convolution for continuous and discrete time, time-invariant, linear systems. Finite-state constant differential difference and systems: state variable descriptions, state analog computer realizations and transfer functions, controllability and observability, natural modes. Operational calculus for linear systems: Fourier, Laplace, and Z-transforms for general time-invariant systems, sampling representations for bandlimited systems. Random processes: definitions, power spectral density. Examples may vary with field of instructor. Prerequisites: Statistics 116 or equivalent (may be taken concurrently) and familiarity with transforms.

3 units, Aut, Spr (W. Linvill, Kailath, Staff)

241a,b. *Dynamic Probabilistic Systems* — (Enroll in Engineering-Economic Systems 251a,b.)


3 units, Win (Franklin, Widrow)


3 units, Spr (Franklin, Widrow)


3 units, Aut (Franklin)

248. *Seminar on the Theory of Systems* — Discussion of research problems and current
literature in the theory of systems as applied to control, communication, and computation by faculty, students, and outside specialists. Prerequisite: E.E. 240 or equivalent.

1 unit, Aut, Win, Spr (Flügge-Lotz, Franklin)


3 units, Win (Widrow)

250a,b. Analysis of Dynamic Multivariable Systems — Analytical concepts on model-making and optimization necessary for system engineering. The geometrical aspects of matrices and determinants, eigenvalue analysis, the normal coordinates for dynamic systems, iterative procedures for solving simultaneous equations. Least square procedures, Markov processes. Mixed systems involving both continuous and discrete signals. Errors in numerical solutions to differential equations. Introduction to optimization procedures: Lagrange multipliers, introduction to linear programming, dynamic programming. Prerequisite: E.E. 240 or permission of instructor.

3 units, Win, Spr (W. Linvill)


3 units, Win (Kailath, Cover)


3 units, Spr (Kailath, Cover)

252. Communication Channels — Channel capacity; calculation of channel capacity and error probability for Gaussian channels and discrete memoryless channels; application of error-probability bounds to problems of signal design, input and output quantization, and probabilistic decoding; primary emphasis on continuous channels. Prerequisite: second-year graduate standing or consent of instructor.

3 units, Aut (Kailath, Cover)


3 units, Win (Kailath, Cover)

253b. Estimation Theory and Pattern Recognition—Fundamentals of statistical decision theory stressing its application to estimation; device oriented and decision theory oriented approach to learning generalization, and pattern recognition; nearest neighbor rules, Robbins’ compound Bayes learning, stochastic approximation and optimization; optimum estimation of signal parameters in the presence of Gaussian noise; synthesis of communication and pattern recognition systems using learning observations. Prerequisite: E.E. 253a.

3 units, Spr (Cover, Kailath)

254. 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.

3 units, Aut (Cover, Kailath)

254a. Information Theory Seminar — Student-faculty discussion of research problems in the general field of information theory, communication theory, pattern recognition, coding theory.

1 unit, Spr (Kailath, Cover)


3 units, Aut, Win (Moll)

256. Semiconductor Theory — Physical basis for carrier mobility in semiconductors as limited by lattice and impurity scattering, nonlinear high field mobility, negative differential mobility, secondary ionization, and avalanche breakdown of junctions and the theory of tunnel or Zener breakdown and Esaki diodes, semiconductor surfaces. Prerequisite: E.E. 255.

3 units, Spr (Moll)

257a,b,c. 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, etc. Registration by permission of instructor. Prerequisite: E.E. 255 or Physics 172, or Mat.Sci. 121.

3 units, Aut, Win, Spr (Pearson)

258. 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, CdS, NaCl, ruby Cu, and Al. Prerequisites: One group of the following: E.E. 259a and 259b (may be concurrent); Physics 230 and 231 (may be concurrent); or Materials Science 233.

3 units, Win (Spicer)

259a. Basic Quantum Mechanics — Introduction to the concepts 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: Physics 57, 110, 111. Mathematics 130, and 131, or equivalent.

3 units, Aut (White)

259b. 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: E.E. 259a.

3 units, Win (White)

260. Applications of Quantum Mechanics — A unified approach involving the density matrix will be used to study lasers, semiconductors, Raman effect, field quantization, and multiple quanta effects. Emphasis will be placed upon the techniques for obtaining the appropriate equations of motion, rather than upon detailed investigation of specific devices. Some of the topics to be included are photoconductivity, rate equations, spontaneous emission, laser action, infrared absorption, and multiple photon absorption. Prerequisite: E.E. 259b or Physics 231.

3 units, Spr (Pantell)


261. Theory of Switching — Analysis and synthesis of combinational switching circuits; threshold functions; cellular structures and iterative nets; Mealy and Moore models of sequential machines; regular expressions; state minimization for complete and incomplete sequential machines; the state assignment problem; elementary results on asynchronous switching networks. Prerequisite: Graduate standing in Electrical Engineering.

3 units, Aut (Peterson, Arbib)

263a,b. Optimization of Linear Systems — (Enroll in Engineering-Economic Systems 263a,b.)

264. Advanced Automata Theory — Algebraic theory of automata, basic notions of semigroups, theorems of Krohn-Rhodes and
273. Guided Waves — Review of uniform wave guide theory. Wave guide modes; 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 guides filled with anisotropic media. Prerequisite: E.E. 271 or equivalent.

3 units, Spr (Kino)


3 units, Aut (Siegman)

274c. Seminar in Quantum Electronics and Optics—Discussion by staff and students of selected topics, such as optical coherence theory; electro-optic, electro-acoustic, and nonlinear optical effects; optical resonators; lasers; light modulation and demodulation. Units by arrangement, Aut, Win, Spr (Siegman, Staff)

275. Magneto-Ionic Theory and Its Applications—Introduction to magneto-ionic theory, including the whistler mode; applications to propagation in the ionosphere, from very low to high frequencies; measurement techniques. Prerequisite: E.E. 271, or permission of instructor.

3 units, Win (Helliwell, Staff)


3 units, Aut (Bracewell)

277. Theory and Application of Radio Wave Scattering—Theory of radio wave scattering from electron ensembles (e.g., meteor trails),
and from turbulent and thermal fluctuations in a plasma. Scattering from metallic and dielectric spheres, cylinders, and laminas, of small and large size. Emphasis on physical descriptions and on applications to communications, radar astronomy, and space probes. Prerequisite: E.E. 271 or permission of instructor.

3 units, Spr (Eshleman)

278. Ionospheric Processes—Brief description of neutral atmosphere; production, loss and diffusion processes in the ionosphere; some aspects of geomagnetism; dynamo theory and ionospheric storms. Prerequisite: E.E. 270 or equivalent.

3 units, Spr (——) alternate years, given 1967-68

280. Radioscience Seminar—Student-faculty discussion of research problems in general field of radio propagation, ionospheric physics and radio astronomy.

1 unit, Aut, Win, Spr (Bracewell)

281a,b. Satellite System Engineering—(Enroll in Engineering 235a,b.)

3 units, Win, Spr (Lusignan)

283. Experimental Plasma Physics I—(Enroll in Engineering 212.)

283A. Experimental Plasma Physics Laboratory I—(Enroll in Engineering 212A.)

284. Experimental Plasma Physics II—(Enroll in Engineering 213.)

284A. Experimental Plasma Physics Laboratory II—(Enroll in Engineering 213A.)

285. Plasma Physics Seminar—Discussion of research problems and current literature in plasma physics is offered by faculty, students and outside specialists.

1 unit, Aut, Win, Spr (Staff)

286. Introduction to Plasma Physics—Plasma as a new medium; its significance in space and fusion research, individual and collective phenomena; ionization, charged particle orbits, collisions, mirroring, drifts; oscillations, Debye length, instability, electrostatic and electromagnetic waves, magneto-ionic propagation and dispersion, Maxwell-Boltzmann distribution, magneto-gas-dynamics, confinement. Prerequisite: E.E. 271 or equivalent.

3 units, Spr (Buneman)

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


3 units, Win (Buneman)

289a. Introduction to Astrophysics I: Solar-Terrestrial Relations—(Enroll in Engineering 207.)

289b. Introduction to Astrophysics II: The Sun—(Enroll in Engineering 208.)

289c. Introduction to Astrophysics III: Stars and Galaxies—(Enroll in Engineering 209.)

289d. Astrophysics Seminar—(Enroll in Engineering 210.)

290. Special Studies and Reading in Electrical Engineering—Special studies, under direction of a faculty member, for which academic credit may properly be allowed. (This course number is used to give credit for laboratory work, directed reading, etc. A grade of + indicates satisfactory work; no letter grade will be assigned.)

By arrangement

291. Special Studies and Reports in Electrical Engineering—Special studies, under direction of a faculty member, leading to written report or end-quarter examination. Letter grade indicates quality of written work; if letter grade based on written work is not applicable, student should enroll in E.E. 290.

By arrangement

292. 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.

295. Electrical Engineering Instruction: Practice Teaching—Open to a very limited number of Electrical Engineering students who plan to make teaching their career. (Harman) by arrangement

296a,b. Electrical Engineering Instruction Seminar—(Enroll in Engineering 296a,b.)
297. Faculty Seminar—Discussion meetings arranged by certain faculty members.

1 unit, by invitation

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.

By arrangement

DIVISION of ENGINEERING MECHANICS

Emeriti: Stephen P. Timoshenko, Lydik S. Jacobsen (Professors)

Executive Committee: Miklos Hetényi (Chairman), Wilhelm Flügge, Irmgard Flügge-Lotz, James N. Goodier, Rudolf E. Kalman, Thomas R. Kane, Erastus H. Lee, Donovan H. Young (Professors)

Affiliated Faculty


Associate Professors: Max Anliker, Chichang Chao, Krishnamurty Karamcheti, Byrne Perry, William C. Reynolds, Cedric W. Richards, Alan S. Tetelman

Assistant Professor: Robert L. Street

OFFERINGS AND FACILITIES

The Division provides one, two, or three years of advanced training in solid and fluid mechanics leading to abundant career opportunities in industrial and governmental research establishments, in technical development in industry, and in the universities and institutes of technology. It also offers programs of study 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 Engineering Mechanics provides facilities for special experimentation in conjunction with the laboratories of the Departments of Civil and Mechanical 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.

The Division also conducts government-sponsored research projects. 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, vibrations and nonlinear dynamics, controls and system theory, and the flow dynamics of liquids and gases.

PROGRAMS OF STUDY

BACHELOR OF SCIENCE

The Division 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 curriculum of Engineering Science, in the option Engineering Mechanics of the Department of Civil Engineering, and in the option Mathematics, Physics, and Engineering Mechanics of the Department of Mechanical Engineering.

MASTER OF SCIENCE

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin. The following are Divisional requirements.

To secure the recommendation of the Division for the Master's degree, a candidate must include a minimum of 6 graduate units in each of the four subdivisions: (1) Advanced Dynamics, (2) Elasticity and Plasticity, (3) Fluid Mechanics, and (4) Mathematics. (Candidates who have a strong interest in Control Engineering may be allowed to substitute appropriate Electrical Engineering courses for one of the subdivisions "(2)" and "(3)" above.) In addition to these 24 units of required courses, the program calls for a minimum of 12 units in approved electives and 9 units in free electives, making in all 45 units of course work. No
thesis is required. In all of this work a minimum grade point average of 2.75 is required.

The program assumes that, at the time of admission, the student is adequately prepared for graduate study in Engineering 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 required 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. A minimum grade point average of 3.00 is required in courses. The program of courses and thesis are arranged in consultation with the student's adviser, and require the approval of the Executive Committee of this Division. The requirements for the M.S. degree (see above) must be met.

DOCTOR OF PHILOSOPHY

The University’s basic requirements for the Ph.D. degree are discussed in the section “Degrees” in this Bulletin. The requirements of the Division include one or more qualifying oral examinations early in the second year of graduate study, and the presentation of a satisfactory program after consultation with the faculty member who will direct the dissertation research. Preparation for research usually requires that this second year be devoted mainly to courses. The requirements for the M.S. degree (see above) must be met. The language requirement of the Graduate Division must be fulfilled by either German or Russian.

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 by the Division. Information and application forms (due March 1) may be obtained through the Secretary, Division of Engineering Mechanics.

COURSES


3 units, Aut (Young) MWF 8


3 units, Aut (Chao) MWF 9


3 units, Win (Chao) MWF 10


2 units, Win (Goodier) TF 3:15


2 units, Spr (Goodier) TF 3:15

204. Advanced Theory of Elasticity—Topics from stress concentration, crack propagation, contact stress, thermal stress, instability and finite deformation, selected in relation to current research. Prerequisites: 202a, b.

2 units, Spr (Chao) TTh 11


3 units, Win (Hetényi) TTh 8 and one lab by arrangement

206a. Elastic-Plastic Instabilities—Instabilities of structural elements under steady or
sudden loading. Types of elastic buckling analysis in small and large deformations. Compressed bars. Dynamic instability within the longitudinal pressure wave. Prerequisites: C.E. 114 and Mathematics 130.

2 units, Aut (Goodier) TTh 11, alternate years, given 1966–67


2 units, Win (Goodier) TTh 11, alternate years, given 1966–67


2 units, Spr (Goodier) TTh 11, alternate years, given 1966–67


3 units, Win (Flügge) MWF 9


3 units, Spr (Flügge) MWF 9


3 units, Aut (Flügge) MWF 11


3 units, Aut (Chao) MWF 3:15


3 units, Aut (Flügge) MWF 10


3 units, Win (Flügge) MWF 11, given 1967–68


3 units, Win (Lee) TTh 11:00–12:15 alternate years, given 1967–68


3 units, Spr (Lee) MWF 10, alternate years, given 1967–68


3 units, Spr (Richards) TTh 10 and one lab. by arrangement


3 units, Aut (Tetelman) TTh 10 and T 11

216b. Fracture of Solids—(Enroll in Mat Sci. 238.) Engineering and Microscopic ...
proaches, fracture testing, nucleation and propagation of cleavage and shear cracks. Effect of notches, fracture of steels, creep and fatigue failure, stress corrosion cracking and hydrogen embrittlement. Prerequisite: 216a or Mat.Sci. 130.

3 units, Win (Tetelman) M 2:15–4:05 and W 2:15–3:05


3 units, Aut (Lee) MWF 2:15

218a. Advanced Theory of Viscoelasticity—Equivalent mathematical representations of stress-strain relations for linear response and connections between them. Stress analysis problems for simple boundary conditions, mixed conditions, and consideration of moving boundaries. Temperature effects. Prerequisites: 202a, 217, and 250.

3 units, Win (Lee) MWF 2:15, alternate years, given 1966–67


3 units, Spr (Lee) MWF 2:15, alternate years, given 1968–69

221. Dynamics—Generalized particle and rigid body kinematics. Generalized forces for holonomic and nonholonomic systems.

3 units, Aut (Kane) T 2:15 and Th 9–11

222. Dynamics—Inertia properties, energy functions, Lagrange’s form of D’Alembert’s principle, Lagrange’s equations of motion.

3 units, Win (Kane) T 2:15 and Th 9–11

223. Dynamics—Impulsive motions. Ignoration of coordinates, energy integrals. Hamilton’s canonical equations, canonical transformations, the Hamilton-Jacobi partial differential equation, the method of variation of parameters.

3 units, Spr (Kane) T 2:15 and Th 9–11


3 units, Spr (Kane) T 9–11 and Th 2:15


3 units, Aut (Anliker, Staff) MWF 12


3 units, Win (Anliker, Staff) MWF 12


3 units, Aut (Kane) T 9–11 and Th 2:15


3 units, Win (Kane) T 9–11 and Th 2:15

for a given performance criterion. Criteria which lead to contactor control. Synthesis of suboptimal controls. Application to flight control. Prerequisite E.E. 128 or equivalent.

3 units, Win (Flügge-Lotz) MWF 9


3 units, Aut (Kalman) TTh 11:00–12:15


3 units, Win (Kalman) TTh 11:00–12:15


3 units, Spr (Kalman) TTh 11:00–12:15

239d. Mathematical System Theory: Stochastic Optimization—Markovian realization of random processes. Construction of optimal predictors and filters. Applications to stochastic control and information theory. Prerequisites: Probability; 239c or consent of instructor.

3 units, Aut (Kalman) alternate years, given 1967–68

241. Advanced Mechanics of Fluids—(Enroll in C.E. 206.) Similitude and dimensional analysis; fluid friction for incompressible fluids in tubes, boundary layers, through granular media; lubrication theory; cavitation. Prerequisite: C.E. 107.

3 units, Aut (Hsu) MWF 10


3 units, Aut (Flügge-Lotz) MWF 1:15


3 units, Win (Flügge-Lotz) MWF 11

244. Mechanics of Viscous Flow—Navier-Stokes equations. Very slow motion. Boundary layer equations for incompressible laminar flow. Energy equation for thermal boundary layers; compressible laminar boundary layer flow. Stability of boundary layer flows; introduction to turbulent flow. Prerequisites: 242 and either A.A. 210a, or M.E. 238b, or permission of the instructor.

3 units, Spr (Flügge-Lotz) MWF 11


3 units, Win (Perry) MWF 1:15

247. Engineering Hydrodynamics—Continuation of E.M. 246. Selected theoretical topics from naval hydrodynamics, hydraulic engineering, and oceanography. Possible topics include forces on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, density currents, flow over weirs and spillways. Prerequisite: 246.

3 units, Spr (Perry) MWF 2:15

250. Mathematical Methods in Engineering Mechanics—Development of the basic concepts of analytic functions and conformal mapping, and application to problems in several engineering disciplines. Use of the Laplace transform with particular emphasis on vibration and wave problems. Prerequisite: Mathematics 43 or equivalent.

3 units, Aut (Lee) MWF 11

tions, spherical harmonics and other tabulated functions. Variational methods, principles. Prerequisite: Mathematics 43 or equivalent.

3 units, Win (Street) MWF 8


3 units, Spr (Flügge) M 1:15 and TTh 8


2 units, Aut (Hetényi) TTh 10

270. Special Problems in Engineering 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 (Hetényi) 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. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for students presenting talks.

1 unit, Aut, Win, Spr (Goodier, Hetényi, Lee) Th 3:15

296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for those presenting talks.

1 unit, Aut, Win Spr (Flügge-Lotz, Van Dyke, Vincenti) T 4:15

297. Seminar on the Theory of Systems—(Enroll in E.E. 248.) Discussion of research problems and current literature in the theory of systems as applied to control, communication, and computation by faculty, students, and outside specialists. Plus is given for attendance only; a letter grade is given to students presenting talks. All Ph.D. candidates in Controls and Systems Engineering are expected to attend. Prerequisite: E.E. 240 or equivalent.

1 unit, Aut, Win, Spr (Flügge-Lotz, Franklin, Staff) Th 4:15


Aut, Win, Spr (Staff) by arrangement


Aut, Win, Spr (Staff) by arrangement

ENGINEERING SCIENCE

Program Advisers: James M. Gere (Chairman), Andreas Acrivos, Richard H. Bube, Robert H. Eustis, David F. Tuttle

The undergraduate curriculum is a program in applied science, leading in most cases to further study at the graduate level, and designed for those individuals whose interests extend outside the areas covered by the other engineering programs. Courses in the physical sciences, mathematics, the social sciences, and the engineering sciences are given precedence over those which deal more specifically with professional engineering practice. Thus the student is given the opportunity to develop the ability to approach problems overlapping departmental boundaries, both those which are purely technical and those which involve considerations of social and economic analysis. Each student should arrange his program in consultation with one of the Program Advisers for Engineering Science.

A petition must be filed with the School of Engineering outlining the student's objectives, plans, and proposed program of courses. The petition will be approved by the committee of Program Advisers only if it provides for a coherent plan and is ade-
quate in quantity and quality of work. All petitions must be filed not later than the middle of the third quarter preceding graduation. Petitions received later will normally be acted upon unfavorably.

Graduate programs leading to the Master of Science degree in Engineering Science may be arranged also. Address inquiries to the Dean of Engineering.

INSTITUTE in ENGINEERING-ECONOMIC SYSTEMS

Advisory Committee: Joseph M. Pettit (Chairman), Ernest C. Arbuckle, Hubert Heffner, Robert R. Sears

Executive Committee
Professors: William K. Linvill (Chairman), Ronald A. Howard, Julius Margolis
Acting Associate Professor: George R. Murray, Jr.
Assistant Professors: Roy E. Lave, Jr., David G. Luenberger, Richard D. Smallwood

Affiliated Faculty

Associate Professors: Gerald K. Boon, Thomas Kailath, Robert W. Newcomb, Vincent J. Roggeveen, Arthur F. Veinott, Jr., Douglass J. Wilde

Assistant Professors: Thomas M. Cover, Benjamin O. Lange, Robert R. Lee

Offerings and Facilities

The Institute in Engineering-Economic Systems is devoted to instruction and research in the phenomena characteristic of the planning, operation, and control of large scale technological-economic systems. A program of study is available through Graduate Division Special Programs leading to the degree of Doctor of Philosophy in Engineering-Economic Systems.

Techniques for the analysis of systems are now sufficiently powerful to have important application in the planning and operation of the complex systems that modern society requires. The field is active, and in order that the training received today be useful over a period of many years, fundamental mathematical methods form a central part of the program.

A unique feature of the program is the internship, which is intended to develop in the student a facility for applying systems analysis to the design and operation of actual complex systems. Internship experience is held to be of vital importance in formulation of meaningful research problems.

Problems of the type studied in the Institute in Engineering-Economic Systems are found in almost every large scale activity today. A partial list includes:

**Public Works**
- Air traffic regulation
- Water resources development
- Transportation planning
- Economic development
- Electric power systems planning and control
- Defense systems analysis (detection, communications, logistics)
- Space systems planning, analysis, control

**Industry**
- Long range planning
- Investment decision making
- System coordination
- Production scheduling
- Marketing
- Process control
- Systems stimulation

**Background Required**

To be suited for graduate study in the Engineering-Economic Systems area, students 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. Although not a requirement, most students entering the E.E.S. Ph.D. program will have completed a Master's degree in engineering, science, or business. Undergraduate course work in economics is not required, but will prove helpful in graduate study in this field.
PROGRAMS OF STUDY IN ENGINEERING-ECONOMIC SYSTEMS

The "Degrees" section of this Bulletin discusses the University's basic requirements for the Ph.D. degree. To be admitted to the Graduate Special Program leading to the Ph.D. degree in Engineering-Economic Systems, students must pass an examination given during the spring quarter of the first graduate year and must satisfy the requirements of Graduate Division Special Programs. Later, in addition to the University oral examination, comprehensive area examinations are given covering the candidate's graduate systems courses.

INTERNSHIPS

The Engineering-Economic Systems program requires that the student demonstrate his ability to solve complex system problems in the field environment. Since such system problems cannot be captured within a university setting, those students who have not had previous experience in solving system problems satisfy this requirement by serving one or more internships under the general supervision of the Engineering-Economic Systems faculty on the Executive Committee.

Problems of broad scope requiring a systems viewpoint, and thus suitable for the internship experience, are found in large industrial firms, in companies and research groups concerned with the design and employment of 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 internship will normally be between six and fifteen months, but depends upon the time required to complete the project successfully. While interning, the student will live and work as an employee responsible to the company or agency concerned. The Engineering-Economic Systems faculty endeavor to locate and screen suitable internship opportunities in a variety of areas, but the student bears the responsibility for selecting an appropriate problem and arranging a suitable employment situation. The Engineering-Economic Systems faculty will review each proposed project to verify its educational value.

The student's internship work in the field is largely project-oriented; that is, it is directed toward the successful solution of an actual problem. 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 a given casework phase of his program by re-examining his field work in the light of the fundamental principles of system analysis, pointing out 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. 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.

Students whose field experience is gained prior to admission to graduate school and students who participate in the internship program during their graduate years will in either case enroll in the seminar course E.E.S. 291, satisfactory completion of which fulfills the formal internship requirement.

COURSES OF STUDY

Study programs are selected to give a broad coverage as well as work in depth in one or more specific areas. There are four categories of courses: (1) foundation courses from physical sciences, social sciences, and mathematics; (2) general core courses in Engineering-Economic Systems; (3) casework courses for the various practical areas; and (4) other elective courses.

FOUNDATION COURSES

The solution of complex engineering-economic system problems uses system analysis, a young discipline that draws many of its models and methods from mathematics, physical sciences, economics, and social sciences. Future developments in system anal-
ysis will often be an outgrowth of concepts born in these foundation fields. The course program includes a selection of foundation material so that the systems student will have the breadth to contribute to the growth of his profession both now and for years to come. By and large, 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. The list of relevant foundation courses is very long, including a wide variety of mathematics as well as the basic material of the physical and social sciences. A partial list includes:

**MATHEMATICS**
113, 114. Linear Algebra
115, 116. Analysis
120, 121. Modern Algebra
136, 137, 138. Numerical Analysis
205a,b,c. Real Variables
206a,b,c. Complex Variables
220a,b,c. Methods of Mathematical Physics

**PHYSICS**
210, 211, 212. Introductory Theoretical Physics

**ECONOMICS**
202. Price and Allocation Theory
241. Public Finance and Taxation

**BUSINESS**
200, 201. Business Economics

**CORE COURSES IN SYSTEMS**

Engineering is distinguished from science by its emphasis on decisions concerning commitment of resources. The Engineering-Economic Systems field is characterized by its broad concern with the physical, economic, social, and political implications of systems decisions. The central focus of graduate study in system problems is a set of portable concepts or tools 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. Decision analysis—logical balancing of the factors that affect a decision;
3. System analysis—development of the models for structuring and procedures for optimizing that formalize the selection among systems alternatives. Core concept courses are divided into these categories; although students are not required to take any specific courses, material relevant to these categories is covered in comprehensive area examinations and will be found in the following courses.

1. **Intersystem Relationships**: E.E.S. 210, 211.
2. **Decision Analysis**: E.E.S. 231a, b.
3. **System Analysis**—
   a) **Modeling**—
      1) Static and Dynamic Multivariable Systems: E.E.S. 240, 250a, b.
      2) Probabilistic Models for Problems of Uncertainty: E.E.S. 221, 251a, b.
   b) **Concepts of Optimization**: E.E.S. 243, 263a, b.
   c) **Computer Analysis and Simulation**: E.E.S. 220.

**CASEWORK COURSES IN ENGINEERING-ECONOMIC SYSTEMS**

These courses will provide the student with a view of some of the applications of the previously listed courses to particular problem areas. They are by nature more transitory; consequently, the courses offered may vary from year to year. Often these courses are offered in engineering departments rather than in the Engineering-Economic Systems division. Some representative examples include:

- E.E.S. 304, 315. Development of Electric Power Industry
- C.E. 223, 251, 322, 323. Transportation Planning
- C.E. 322, Arch. 292. Introduction to City and Regional Planning
- I.E. 255. Markov Modeling
- E.E.S. 290. Casework Seminar (290a Seminar in Man-Machine Systems)
- E.E.S. 291. Internship Seminar

**Courses**

**CORE COURSES**

**Intersystem Relationships**

210. Introduction to Price Theory and Resource Allocation—Theory of economic organization, operations of markets, prices as guides for a decentralized economy, criteria for evaluation of performance, planning
rules for efficient organization and operation.

3 units, Aut (Margolis) MWF 10

211. Economics of Public Works—Analysis of government production of services, criteria for investment, price and non-price rationing of services, financing of services, particular attention to resources development, transportation and public planning. Prerequisite: 210 or consent of instructor.

3 units, Win (Margolis) MWF 11

DECISION ANALYSIS

231a,b. Statistical Decision Theory — Development of a basic theory of decision making under uncertainty. Rationales of decision makers, utility, the concept of the value of perfect information. The Bayesian approach to decision making; its relationship to classical statistics. Pre-posterior analysis and experimental design for common random processes. The place of dynamic programming and game theory in statistical decision. Examples drawn from a variety of operational systems. Prerequisite: 221.

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

SYSTEM ANALYSIS

MODELING

221. Probabilistic System Analysis—A subject serving both as a self-contained development for students wishing to become familiar with the theory and application of probabilistic concepts and as a foundation for graduate subjects in engineering, science, and management. Theory of probability presented on an axiomatic basis. Topics ranging from algebra of events to stochastic processes and simulation. Heavy emphasis on sample space concept for both discrete and continuous transform techniques, common distributions, limit theorems, statistics, renewal processes, and computer analysis. Consideration of implications of probability theory for decision making, data analysis, and system modeling. Applications present concurrently with development of the theory.

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

240. Introduction to the Theory of Linear Systems—(Enroll in E.E. 240.) Delta functions, impulse response and convolution for continuous and discrete time, time-invariant, linear systems. Finite-state constant difference and differential systems; state-variable descriptions, state analog computer realizations and transfer functions, controllability and observability, natural modes. Operational calculus for linear systems: Fourier, Laplace, and Z-transforms for general time-invariant systems, sampling and representations for bandlimited systems. Random processes: definitions, power spectral density. Examples may vary with field of instructor. Prerequisites: E.E. 100 or Engineering 104, E.E. 163, Statistics 116 or E.E.S. 221 (may be taken concurrently); or consent of instructor.

3 units, Aut, Spr (W. Linvill, Kailath, Staff)
CONCEPTS OF OPTIMIZATION


3 units, Spr (Luenberger) TTh


263a. 3 units, Aut (Luenberger) MWF 2:15

263b. 3 units, Win (Luenberger) MWF 2:15

COMPUTER ANALYSIS AND SIMULATION

220. Computer-Aided System Analysis — Formulation and computer-aided solution of system problems. Lectures by faculty and guests on examples of practical system problems and their solution. Team projects on system problems which may be discussed include: solution of partial differential equations by overrelaxation, Monte Carlo or direct methods; simulation of dynamic processes, scheduling of operation; optimization in decision situations. Prerequisite: knowledge of elementary computer programming and applied mathematics.

2 or more units, Aut (Smallwood)

CASEWORK, SEMINARS, RESEARCH

290. Casework Seminar—Each quarter several seminars will be held on casework areas of immediate interest. Topics which have been considered recently are: electric power resources, regional development planning, transportation planning, government and natural resources, water resource planning, small business development. Topics will be announced on a quarterly basis.

1 unit, Aut, Win, Spr (Staff) W 4:15–6:05

290a. Seminar in Man-Machine Systems—Delineates specific system areas in which the role of man in the system operation requires a systematic analysis of the human component in the system. Discusses areas in which this analysis will be of paramount importance to future systems. Emphasizes quantitative modeling of the human operator. Specific system areas discussed include: control, monitoring, decision making, automated instruction, problem-solving, information retrieval, and medical diagnosis. Participating students will give one or more presentations during the quarter on appropriate topics.

1 unit, Win (Smallwood) by arrangement

291. Internship Seminar — Enrollment is limited to students presenting evidence of extensive and significant field experience. Active participation in the seminar is required, including an examination of the environment of the problems attacked, the process of problem formulation, the solution methods attempted, and the eventual results. Emphasis will be on the isolation of those facets of field work that call for further development of system analysis. Satisfactory completion of this course fulfills the internship requirement.

1 or more units, Aut, Win, Spr (Staff) by arrangement

292. Directed Reading and Research in Engineering-Economic Systems — Directed study and research on subject of mutual interest to student and staff member. Required of all doctoral candidates prior to their qualifying examination.

1 or more units, Aut, Win, Spr (Staff) by arrangement

293. System Research Seminar — Research in general theory and methodology of system analysis and decision. Doctoral research reports and faculty and visitors’ research reported. Enrollment limited to advanced students. Active group participation expected.

1 unit, Aut, Win, Spr (Staff) T 4:15–6:05

300. Thesis and Thesis Research—Limited to students who have established candidacy for the degree of Ph.D. A grade of + indi-
cates satisfactory work; no letter grade is assigned.

By arrangement

GENERAL ENGINEERING

Program Advisers: James M. Gere (Chairman), Robert H. McKim, William H. Schwarz, Ralph J. Smith, Alan S. Tetelman, David A. Thompson

PROGRAM OF STUDY

The program for the Bachelor of Science degree in General Engineering, without designation of a field of specialization, is intended to prepare students for appropriate, definite career objectives involving engineering. It is well suited for those who desire a general engineering education as preparation for a management or a military career, or who wish to incorporate more humanities before specializing in an engineering field later. It is also for students who desire a background involving unusual combinations in engineering that do not fit into the other professional curricula, e.g., Product Design or Resource Strategy (see "Supplementary Requirements" for General Engineering).

The curriculum requires completion of the "Courses Normally Taken by All Engineering Students," as well as sufficient additional units to bring the total to at least 180. The same standards of academic performance are required as for other curricula; there are no special sections or courses for students in General Engineering.

Entering freshmen or sophomore transfer students who have not decided on some other engineering curriculum will be listed automatically as enrolled in General Engineering. They may transfer at any time into one of the other curricula, and must do so by the end of the sophomore year unless they plan to earn the B.S. degree in the general curriculum. In the latter case they must file a petition with the School of Engineering, outlining their objectives, plans, and a program of courses. Each petition should be arranged in consultation with one of the Program Advisers for General Engineering, and will be approved by the committee of Program Advisers only if it provides for a coherent plan and is adequate in quantity and quality of work. Students transferring to General Engineering from another curriculum must also petition to do so. All petitions of this nature must be filed not later than the middle of the third quarter preceding graduation. Petitions received later will normally be acted upon unfavorably. Students following the program in Product Design (see "Supplementary Requirements" for General Engineering) need not submit a petition.

INDUSTRIAL ENGINEERING

Emeritus: Eugene L. Grant (Professor)
Executive Head: W. Grant Ireson.
Professors: W. Grant Ireson, Gerald J. Lieberman, Robert V. Oakford
Associate Professors: David V. Heebink, Frederick S. Hillier, David A. Thompson, Arthur F. Veinot, Jr.
Assistant Professors: Roy E. Lave, Jr., Linus E. Schrage. Acting: James V. Jucker

PROGRAMS OF STUDY

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 administrative work in enterprises where a scientific and engineering background is necessary or desirable. The fundamentals of engineering are stressed; 68 per cent of the program is common to all of the engineering curricula and an additional 22 per cent is of technical nature in engineering, mathematics, and statistics. The remaining 10 per cent consists of courses in a number of fields that are important as preparation for management activities.

Some of the courses listed under Industrial Engineering are introductory courses in management subjects. These are appropriate electives for students in the more technical fields of engineering as well as in certain other departments of the University.

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 En-
gineering. The programs emphasize the analytical approach to industrial engineering problems using quantitative measures. Specialized work is available in operations research, engineering statistics (including quality control) and data processing; this includes a number of courses in the Departments of Statistics and Mathematics. Special emphasis may also be given to engineering economy, biotechnology, production and related fields.

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.

Applicants for admission as graduate students in Industrial Engineering must submit the results of the Graduate Record Examination.

Other graduate programs that appropriately may follow undergraduate work in industrial engineering include the Graduate School of Business and Department of Statistics.

MASTER OF SCIENCE

Programs are available leading to the degree of M.S. in Industrial Engineering without specialization or with specialization in one of the following seven fields: Biotechnology, Data Processing, Engineering Economy, Engineering-Economic Planning, Engineering Statistics and Quality Control, Operations Research, Production. Detailed statements of the general requirements for the Master's degree and the specific course requirements for the special fields may be secured by request to the Industrial Engineering Department.

Students having Bachelor's degrees in industrial engineering normally can satisfy requirements for the M.S. degree in a year of graduate work of satisfactory quality. Those students who have the Bachelor's degree in some other field of engineering will be required to make up certain basic undergraduate industrial engineering courses, and should enter in the summer quarter if they wish to complete the requirements in one calendar year.

DOCTOR OF PHILOSOPHY

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 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 $3,500 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 Information Bulletin should be consulted for a description of the procedure for making application.

UNDERGRADUATE COURSES

100. Industrial Organization and Behavior —Organization theory; research in organizational behavior; relationships among organizational functions; the industrial engineer in organizations.

4 units, Aut (Thompson) MWF 8
Win (Thompson) TWThF 11
108. Work Design and Measurement —Concepts and techniques of designing and improving work performance and productivity of men and man-machine systems. Flow sequences, human physiological information processing capabilities and resultant work design principles, and measurement and evaluation of work with respect to time and wages. Prerequisite: 120 (or concurrent registration).

3 units, Aut (Thompson) MWF 9
Spr (Thompson) MWF 11

3 units, Aut (———) MWF 8
Win (———) MWF 11

133. Industrial Accounting — Principles of financial and cost accounting, fixed asset accounting, cost control, standard costs, taxes. Interpretation and use of accounting information for engineering decisions. (Students who have taken or are taking a university course in elementary accounting are not admitted to this course.)

4 units, Aut (———) MTWF 11
Win, Spr (———) MTWF 8
Sum (———) MTWThF 10


3 units, Aut (Schrage) MWF 9
Win, Spr (Oakford) MWF 1:15
Spr (Schrage) MWF 8

141a. Utilization of Computers — Same content as 141 with additional basic material on programming. Intended primarily for graduate students who have had no prior computer programming experience.

4 units, Aut (Schrage) MWF 1:15
and F 2:15

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. Not open to graduate students. See 252. Prerequisite: Differential Calculus.

3 units, Win (Wagner) MW 4:15–5:30


3 units, Spr (Wagner) MWF 4:15–5:30

161. Design of Production Systems — First of a two-quarter sequence on the design, scheduling, and control of production systems based on mathematical, computational, and other modern analytical techniques. The first quarter will be devoted to the design and selection of production systems including: creation of new facilities, the expansion or modernization of existing facilities, and the determination of plant location and size. Not open to graduate students (see I.E. 260). Prerequisites: 141, 153, and Statistics 110.

3 units, Aut (Jucker) MWF 8

162. Scheduling and Control of Production Systems — Continuation of I.E. 161. Operational problems of production systems including: control of purchased materials inventory; scheduling of job shop, batch, and continuous production processes for single and multi-item product lines; planning of work force and inventory under seasonal and stochastic demand. Not open to graduate students (see I.E. 260). Prerequisite: I.E. 155.

3 units, Win (Jucker) MWF 1:15

199. Senior Seminar — Includes a major term project by each student. Class discussion of projects and problems, case studies, guest speakers, industrial visits. Emphasis on broad problems requiring initiative, ingenuity, the judicious selection and integration of analytical techniques from all previous course work. Prerequisites: senior standing and 162.

3 units, Spr (Jucker) TTh 1:15–3:15

COURSES PRIMARILY FOR GRADUATE STUDENTS

208. Biotechnology — Design and analysis of human and man-machine physiological information processing systems. Subjective de-
cision making. Physical fatigue. Prerequisite: consent of instructor.

3 units, Aut (Thompson) MWF 10

220. Quality Control Applications — Current practices in quality control and reliability in both industry and government. Plant visits to local industry. Economic considerations in quality control. Prerequisite: 120.

3 units, Spr (Ireson) TTh 10; lab. Th 1:15–4:05


3 units, Spr (Veinott) MWF 2:15


2 units, Aut (—) TTh 12

230. Advanced Engineering Economy — Discussion of the theoretical basis for decision criteria used in engineering economy. Application of linear programming in engineering economy. Application of engineering economy to problems of competitive industry. Prerequisite: 229 or Engineering 60, 61, or 161.

2 units, Win (Oakford) TTh 10
Spr (Oakford) TTh 8

231. Problems in Engineering Economy — Independent study of selected problem in engineering economy. Prerequisites: Engineering 161 or I.E. 229 and consent of instructor.

1 or more units (Staff) by arrangement

232. Capital Budgeting — Choosing among various possible criteria for decision making about proposed investments in fixed assets in business and government. Implementing chosen criteria in engineering design and investment authorization. Post audit of engineering economy studies. Prerequisite: 133 or equivalent, and Engineering 161, or consent of instructor.

3 units, Win (Heebink) TTh 1:15–2:30

241. Electronic Computation and Data Processing — Advanced programming techniques, computer systems design, problem formulation and industrial engineering application of digital computers. Prerequisites: 141 or equivalent.

3 units, Win (Lave) MWF 2:15
Spr (Lave) MWF 11

243. Computation and Data Processing Laboratory — Application of electronic computation machinery to problems related to Industrial Engineering, business management, management science, and systems design. Student will choose problem, program solution, test program, prepare data input, obtain and analyze output. Prerequisite: 241.

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

249. Engineering Climatology — Effects of weather on engineering operations and the use of climatic data as an aid in engineering design and operations.

2 units, Spr (Linsley) TTh 11

252. Operations Research — For graduate students who have not had the equivalent of I.E. 152 and 153. See I.E. 152 and 153 for course content. Prerequisites: Calculus and Statistics 27 or 110 or 116.

4 units, Aut (—) MTWF 10;
(Hillier) MW 4:15–6:05
Win (—) MW 4:15–6:05


3 units, Win (—) MWF 11

254. Seminar in Operations Research — Case studies and papers appearing in the operations research literature. Student teams work in local industry on problems in operations research. Special topics, including some presentations by guest specialists. Prerequisites: at least two courses in operations research.

3 units, Spr (Lieberman) MW 4:15–5:30

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: 141 and at least two courses in Operations Research. (Concurrent registration in one permitted.)

3 units, Win (Winters) MW 4:15–5:30

258. Queueing Theory—A survey of queueing theory and its application. Birth-death process. Other useful models where the inter-arrival or the service-time distributions, or both, are non-exponential. Special service disciplines. Statistical estimation of model parameters. Prerequisites: 252, Statistics 217a, and 217b or basic knowledge of market processes.

3 units, Spr (Hillier) TTh 4:15–5:30

260. Design of Production Systems — For graduate students who have not had the equivalent of I.E. 161 and 162. See I.E. 161 and 162 for course content. Not open to undergraduates. Prerequisites: 141, 153 or 252, and Statistics 110.

4 units, Win (Hillier) MWF 10 plus one hour by arrangement

261. Advanced Production Engineering — Advanced problems in factory planning, materials handling, production-line techniques, automation, plant facilities. Prerequisite: consent of instructor.

3 units, Aut (Ireson) TTh 9 and Th 1:15–4:05, alternate years, given 1967–68

262. Advanced Production Systems Design — Methods of modeling using Markov chains; illustrated with a wide range of applications with special emphasis on control systems. Use of the statistics obtainable from the Markov formulation, estimation methods, tests of hypotheses for fitting data, state reduction techniques, model validation and control, optimization with policy iteration and linear programming. Prerequisites: 152 and Statistics 110 and 116 or 27.

3 units, Aut (Lave) TTh 9; lab. Th 1:15–4:05

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 organization, financing and financial planning, design of management organization. Inputs from practicing small businessmen are obtained. Students, including qualified undergraduates, from all appropriate disciplines are encouraged to enroll. May serve as an orientation for a summer economic development project. Prerequisite: consent of instructor.

3 units, Win (Lave) MW 3:15; lab. T 2:15–5:05

264. Models for Production Planning — Technical analysis of production planning problems, including long-range planning of production, workforce, inventory levels, capacity scheduling, location of facilities, design of assembly lines and materials handling systems, and inspection-maintenance-replacement policies, based on analytical techniques. Prerequisites: 252 and 260 or equivalent.

3 units, Spr (Hillier) MWF 10

265. Planning and Control of Production and Inventory—Planning production, workforce, and inventory in the fabrication, process, style-goods, job shop, and project-type industries. Existing models and their limitations will be discussed in the context of problems to which they apply. Procedures for obtaining workable solutions to complex industrial problems will be illustrated by practical examples. Prerequisites: 252 and 260 or equivalent.

3 units, Spr (Murray) MWF 1:15

280. Seminar in Biotechnology — Special topics concerning the biological technological interface, particularly compatible man-machine systems. May be taken twice for credit. Prerequisite: consent of instructor.

2 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

300. Dissertation — Required for degree of Engineer.

Aut, Win, Spr (Staff) by arrangement
SCHOOL OF ENGINEERING

301. Dissertation — Required for degree of Doctor of Philosophy.

Aut, Win, Spr (Staff) by arrangement

312. Decision Problems in National Defense—A study of national defense planning and the factors controlling decision.

3 units, Spr (——) by arrangement


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

MATERIALS SCIENCE

Emeritus: Welton J. Crook (Professor)

Executive Head: O. Cutler Shepard


Associate Professors: William D. Nix, John C. Shyne, David A. Stevenson, Alan S. Tetelman

Assistant Professor: Craig R. Barrett

Lecturers: Claus G. Goetzel, Donald J. Lyman

Members of the faculties of other divisions of the University giving courses or cooperating in the offerings of the Department of Materials Science are Norman A. Parlee and George A. Parks.

OFFERINGS AND FACILITIES

Materials science 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 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 program provides training in solid state funda-
mentals and in physical metallurgy. In addition to the General Studies requirements, the curriculum includes the “Courses Normally Taken by All Engineering Students” and the Materials Science supplementary requirements. Electives are available so that students with broad interests can combine Materials Science with work in another science or engineering department.

**ADVANCED DEGREES**

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

- Materials Science—Electronic Materials Science
- Materials Science—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. Deficiencies in previous training should be made up and not more than 15 units of such work may be counted as part of the minimum total of 45 units.

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 minimum of 20 units of advanced courses in the general area of Materials Science (excluding research and special problems), including 3 of the following:
     - Mat.Sci. 222. Statistical Thermodynamics
     - Mat.Sci. 232. Point Defects in Crystals
     - Mat.Sci. 233. Introduction to Solid State Quantum Theory
     - Mat.Sci. 237. Dislocations in Crystals
   - A minimum of 9 units of courses outside of the Materials Science Department.

3. Passing a comprehensive written examination to test the candidate's proficiency in Materials Science and related fields of knowledge.

**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.

2. Completion of an acceptable thesis and 30 units of approved advanced course work beyond the requirements of the Master of Science 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:

1. Complete the substantial equivalent of the requirements for the Master of Science degree in Materials Science.

2. Obtain a high score on a comprehensive Materials Science written examination.

3. Pass a Departmental oral qualifying examination.

4. Satisfactorily complete one of the Modern European Language courses, German 10 or Russian 10 or French 10, before being admitted to candidacy for the Ph.D. degree. Subsequently, candidates must translate three technical papers and present an approved copy of each to the Department (with less than 4 units of a foreign language, additional translations are required).

5. The candidate must present the results of his dissertation at a Departmental seminar. The complete graduate program must have the approval of the major professor and one other faculty member. It should include at least 18 course units outside of the Materials Science Department, of which at least
6 must be taken at Stanford. A minimum of 60 course units beyond the B.S. degree requirements must be included in the program.

**COURSES**

50. Introductory Science of Materials — (Enroll in Engineering 50.) 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 (Huggins) MWF 9
Win (Tetelman) MWF 11
Spr (Nix) MWF 10
Sum (—–) MTWTh 11

104. Crystallography — Analytical and graphical representation of crystal geometry. Symmetry elements and the crystal classes. Structural arrangements of common crystalline materials. Prerequisite: 50.

2 units, Aut (Shyne) TTh 1:15


3 units, Aut (—–) MWF 9

106. Extractive Metallurgy Processes — (Enroll in Mineral Engineering 106.) Introduction to metallurgical 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. In addition, Chemistry 171 is recommended.

2 to 3 units, Win (Parlee) by arrangement

107. High Temperature Laboratory — (Enroll in Mineral Engineering 107.) Lectures and laboratory experiments relating to high temperature processes, atmosphere control and vacuum technology; thermodynamic and kinetic measurements. Prerequisite: Mineral Engineering 105 or Chemistry 173.

2 units, Spr (Parlee) TTh 1:15–4:05, alternate years, given 1967–68

120. Industrial Report — Report covering at least two consecutive months of industrial experience related to Materials Science.

1 unit, any quarter (Staff) by arrangement


3 units, Win (Stevenson) MWF 9


3 units, Aut (Stevenson) MWF 9


3 to 4 units, Win (Sherby) TTh 10 and W 1:15; lab. W 2:15–5:05


3 to 4 units, Win (Shyne) MWF 10; lab. Th 1:15–4:05

126. Materials Engineering Design — Properties of Engineering materials. Fabrication problems, economic and design factors relating to the selection of materials for particular service conditions. Prerequisite: 50 or equivalent.

2 units, Spr (Shepard) TTh 9

3 units, Win (Barrett) TTh 11; lab. by arrangement

128. Materials Design—Application of the principles of Materials Science to the development of solids having optimum properties for practical applications. Case studies of the development of materials for structural, electrical, optical, or magnetic usage. Prerequisites: 125, 130, and 152.

3 units, Spr (Tetelman) MWF 10


3 to 4 units, Aut (Sherby) MWF 10; lab. 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 units, any quarter (Shepard) and by arrangement


3 to 4 units, Spr (Bube) MWF 9; lab. by arrangement

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, Spr (———) MWF 9

203a. Crystalline Solids—Crystal structure and imperfections, use of X-ray and electron diffraction for the examination of materials, influence of crystal geometry and crystalline defects on properties. (Note: 203a, 203b and 203c provide an accelerated treatment of Materials Science fundamentals for students registered in other departments and for students who enter the Materials Science program with an M.S. degree in some other field. Open to others by permission.)

2 units, Aut (Shyne) MWF 11

203b. Thermodynamics and Phase Equilibria — Application of thermodynamics to the properties and behavior of materials. Heterogeneous equilibria with emphasis on solids. Prerequisite: Elementary thermodynamics.

3 units, Win (Stevenson) MWF 11

203c. Rate Processes in Materials — Diffusion in solids, structural transitions including recrystallization and liquid-solid and solid-solid phase transformations, property control by microstructural control. Prerequisite: 203b.

3 units, Spr (———) MWF 11

204. Physical Chemistry of Metal Refining—(Enroll in Mineral Engineering 204.) Refining processes and the physical chemistry underlying them. A systematic treatment of unit processes based on types of impurity phases, deals effectively with fundamentals of such widely different methods as the zone refining of semiconductors, the industrial refining of copper, steel making and the vacuum refining of high temperature alloys. Prerequisite: Mineral Engineering 105 or Chemistry 173 or equivalent.

3 units, Aut (Parlee) by arrangement

205. Microstructure and Mechanical Strength—(Enroll in E.M. 216a.) Atomic structure of solids. Imperfections. Dislocation theory and applications to problems of yielding, strain hardening, recovery, recrystallization, fiber composites. Prerequisites: 130 or 203a.

3 units, Aut (Tetelman) T 10 and Th 10-12

Prerequisite: Chemistry 2.

2 units, Win (Lyman) WF 4:15-5:05


2 units, Spr (Goetzl) M 2:15-4:05, alternate years, given 1967-68


2 units, Spr (Goetzl) M 2:15-4:05, alternate years, given 1966-67


2 units, Spr (Goetzl) M 2:15-4:05, alternate years, given 1967-68


2 units, Spr (Goetzl) M 2:15-4:05, alternate years, given 1966-67


3 units, Spr (Shyne) MWF 10

222. Statistical Thermodynamics — Systematic development of the methods of statistical mechanics. Applications to problems in Materials Science. Prerequisite: 122.

3 units, Spr (Stevenson) MWF 11

225. Surfaces and Interfaces — (Enroll in Mineral Engineering 225.) A general study of solid-gas and solid-electrolyte interfaces. Applications in froth flotation and other topics selected by the individual such as surface conduction and the role of surfaces in mechanical behavior. Prerequisites: Chemistry 175 and Mat.Sci. 122.

3 units, Spr (Parks) three lecs. by arrangement, alternate years, given 1966-67

226. Corrosion and Electrometallurgy — (Same as Mineral Engineering 226.) Electrochemical principles with applications to corrosion, electrolytic processes and energy conversion cells. Prerequisite: Chemistry 173.

3 units, Win (Shepard) MWF 11

230. Materials Science Colloquium.

1 unit, Aut (Shepard) M 4:15

Win (Sherby) M 4:15

Spr (Nix) M 4:15

Sum (Shepard) M 4:15

232. Point Defects in Crystals — Structure of both single and complex point defects. Defect equilibria; influence of temperature, chemical and electrical potentials, interfaces, dislocations. Association; relaxation effects. Effects of point defects on selected physical properties. Prerequisite: 105 or 203a.

3 units, Win (Huggins) MWF 10

233. Introduction to Solid State Quantum Theory — Elements of wave mechanics, simple non-interacting systems, elementary interacting systems, free electron theory, energy bands in one and three dimensions, time-dependent wave mechanics. Prerequisite: 152.

3 units, Aut (Bube) MWF 1:15

234. Electrical Transport Processes in Crystals — Lattice vibrations, electrical conductivity, mobility and scattering mechanisms, localized levels in the imperfect crystal, galvanomagnetic effects, thermal effects. Prerequisite: 233.

3 units, Win (Bube), MWF 1:15, alternate years, given 1967-68


3 units, Win (Bube) MWF 1:15, alternate years, given 1966-67

236. Advanced Diffraction and Spectroscopy — Electron microprobe analysis, X-ray diffraction, structure analysis, diffraction from non-crystalline materials, use of Fourier analysis, advanced X-ray techniques. Prerequisite: 127.

3 units, Aut (Barrett) TTh 9; lab. by arrangement

237. Dislocations in Crystals — Isotropic elastic theory of isolated dislocations, elastic properties of dislocation arrays, kinetic behavior of dislocations, structure of dislocations, interaction of dislocations with impurities and precipitates. Prerequisite: 105 or 203a.

3 units, Win (Nix) MWF 8

238. Fracture of Solids — (Same as E.M. 216b.) Engineering and microscopic approaches, fracture testing, nucleation and propagation of cleavage and shear cracks. Effect of notches, fracture of steels, creep and fatigue failure, stress corrosion cracking
and hydrogen embrittlement. Prerequisite: 130 or 205.

3 units, Win (Tetelman) M 2:15-4:05
and W 2:15-3:05

239. Seminar in Advanced Mechanical Metallurgy—Prerequisite: 238.

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


3 units, Spr (Tiller) MWF 8


3 units, Spr (Barrett) lec. TTh 10; lab. by arrangement

246. Crystalline Anisotropy—Seminar on the application of tensor notation to the description and analysis of the properties of crystalline materials.

2 units, Aut (Shyne) TTh 9, given 1967-68

248. Magnetic Phenomena in Solids—Physical basis of magnetic phenomena in solids. Emphasis on the microscopic and atomic origin of the magnetic parameters characterizing magnetic materials, with special attention to ferromagnetic and ferrimagnetic materials. Prerequisite: 152.

3 units, Spr (White) MWF 9

249. Time-Dependent Plasticity—Theories and mechanisms of creep. Temperature and strain rate effects on plastic flow of solids. Relation of high temperature strength and ductility of materials to structure. Prerequisite: 130.

3 units, Spr (Sherby) TTh 1:15-2:45

250. Seminar in Advanced Materials Science.

3 units, Sum (——) TTh 2:15-3:45

258. Optical Properties of Solids—(Enroll in E.E. 258.) 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, CdS, NaCl, ruby, Cu and Al. Prerequisite: One group of the following: E.E. 259 and 260a (may be concurrent); Physics 230 and 231

3 units, Aut (Tiller) TTh 3:15-4:35, alternate years, given 1966-67
267. Seminar in Interface Morphology Control During Phase Transformation—Quantitative determination of growth rate, shape and perfection of crystals. Stability of planar, cylindrical and spherical crystals; dendritic growth; spherulite formation; eutectic and eutectoid transformations; volume change effects; interface attachment kinetic dominated growth forms. Prerequisites: 264 and 266.

3 units, Win (Tiller) TTh 3:15-4:35, alternate years, given 1966-67

300. Research.

Any quarter (Staff) by arrangement

MECHANICAL ENGINEERING

Emeriti: Boynton M. Green, Lydik S. Jacobsen, Stephen P. Timoshenko
Executive Head: William M. Kays
Division Directors: Stephen J. Kline (Thermosciences), Thomas J. Connolly (Nuclear), Peter Z. Bulkeley (Design)
Associate Professors: Peter Z. Bulkeley, Joel H. Ferziger, James P. Johnston, Charles H. Kruger, Robert H. McKim, Morton Mitchnner, Rudolph Sher
Assistant Professor: Bernard Roth
Lecturers: Frank R. Arnold, Donald H. Gage, Carl G. A. Rosen

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, energy conversion, fluid mechanics, and heat transfer. The Design Division is concerned with comprehensive systems design, product design, mechanical analysis and mechanisms design, and design components. 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 Division of Engineering Mechanics section of this Bulletin. However, students studying for any of the degrees offered by the Department will ordinarily take courses in engineering 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 for both student instruction and construction of research apparatus, drafting rooms, an analog computer, 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 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** — The Master's degree program requires 45 units of course work. No thesis is required, although many students include some research work in their course program. The program is designed to provide considerable breadth in applied mathematics and the engineering sciences which are used in the professional practice of engineering. Although considerable depth may be attained in a few areas, 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 Departmental requirements which must be met for the degree of Master of Science are:

1. 6 units of mathematics from E.M. 250, 251, 252 (or Computer Science 137.) 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 4 below.)

2. Two courses in each of two of the following three categories, or two courses, in one category and one course in each of the other two categories (11 to 13 units total).
   a) Design and Solid Body Mechanics
      M.E. 214a, 217a, 218a, 219, 222; 
      E.M. 202a, 205, 208, 221.
   b) Nuclear Engineering and Physics
      M.E. 271a, 175, 282, 285; Physics 130, 140
   c) Thermosciences
      M.E. 211a, 231a (or 231b), 233a, 
      237a, 238a, 251; E.M. 242
3. **21 units** of approved electives (approved by adviser); these should ordinarily be in mathematics, physics, chemistry, or engineering, and may include any courses in the above lists not used to satisfy area minimum requirements. 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, 171, 172, 175; M.E. 114c, 116b, 116c, 123, 133, 134, 161. 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 M.E. 291, 292, and **3 units** in credit seminars may be included in this category.

Students who have already fulfilled in full, or in part, any of the area requirements as a result of their undergraduate work, or work elsewhere, may place the released units in the approved elective category.

4. **5 to 7 units** of free electives, to make a total of **45 units**.

Although it is possible to fulfill most of the above requirements with courses taken outside of the Department, or transferred from elsewhere, it is the policy of the Department that a student must present for the degree at least **15 units** of course work in courses presented in the Department.

Candidates for the degree of Master of Science will be expected 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.)

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 special Master's program is available to those interested in the field of Product Design and 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 **47 units** of work specified below are all that is required. For students with other undergraduate backgrounds, one or two years may have to be spent in removing undergraduate deficiencies before starting the graduate program. A special program is available in cooperation with the Art Department of the School of Humanities and Sciences for students who have a Bachelor of Arts in Fine Arts. They will register with the Art Department and, while they will take many of the courses listed below, they will receive the degree of Master of Arts in Art.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.E. 114b.</td>
<td>Mechanical Engineering Design</td>
<td>4</td>
</tr>
<tr>
<td>M.E. 214a.</td>
<td>Philosophy of Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 214b.</td>
<td>Design in the Corporate Environment</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 215.</td>
<td>Design Seminar</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 299a,b,c.</td>
<td>Design Project</td>
<td>12</td>
</tr>
<tr>
<td>Art 261.</td>
<td>Graphic and Product Design</td>
<td>4</td>
</tr>
<tr>
<td>Art 341d.</td>
<td>Master's Project: Industrial Design</td>
<td>6</td>
</tr>
<tr>
<td>Approved electives</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Free electives</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Total.</strong></td>
<td><strong>47</strong></td>
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</tr>
</tbody>
</table>

The grade point average requirements for this program are the same as for the ordinary Mechanical Engineering Master's Degree.

**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 a minimum scholastic grade point average of 3.00 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 is offered in the field of Product Design which leads to the degree of Engineer in Mechanical Engineering. It is intended for students who wish to augment their engineering background with training in the aesthetic and human qualities essential in new product development. University requirements for the degree of Engineer are satisfied. Admission to the program follows the same standards as for the Master’s degree. Course work requirements are divided into two components. Approximately 54 units are devoted to engineering and product design and about 21 units are devoted to course work in the Department of Art and Architecture. The program requires a design thesis of 15 units. The total of 90 units can normally be completed in two academic years. Students deficient in prerequisite areas will normally take more time. Students who fulfill requirements for this program are awarded the degrees M.S. in Mechanical Engineering (Product Design) and Engineer in Mechanical Engineering (Product Design) simultaneously at its completion.

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 degree requires a minimum of two years beyond the Master’s degree, with three years being the most common time.

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, solid body mechanics, 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 (M.E. 301) to fulfill University residence requirements, 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. However, post-Master's degree applicants for research assistantships are advised to contact directly the faculty member under whom they would like to work, because of the individual nature of these awards, and if they are successful they need not apply to the Department for assistance. Formal applications to the Department for research assistantships will be referred to the individual faculty research supervisors.

Research assistants can, and normally do, carry out their thesis research work and
write their thesis as an integral part of the commitments of their assistantship.

**UNDERGRADUATE COURSES**

*Note.*—Laboratory sections in experimental engineering will be assigned in groups. Insofar as the laboratory schedule permits, students will be allowed, with due regard to priority of application, to arrange their own sections and laboratory periods. Enrollment with the instructor concerned, on registration day or the first day of University instruction, is essential in order that the laboratory schedule may be prepared. Enrollment later than the first week will not be permitted under any circumstances.

4. *Manufacturing Processes*—Fundamental considerations in the selection of materials according to process and part function. Description of fundamental manufacturing processes — casting, forging, extrusion, stamping, drawing, machining, etc. Selection of process according to part geometry and function. Design considerations. Prerequisite: Engineering 9.

3 units, Win, Spr (Staff) T,Th 9; lab. TWTh, or Fl 1:15-4:05

50. *Engineering Kinematics* — Application of graphical and analytical techniques to the kinematic and dynamic analysis of linkages, cams, and gears. While analysis will be stressed, some attention will be paid to the synthesis of mechanical elements. Prerequisites: Engineering 9 and Physics 51.

3 units, Spr (Staff) W 1:15; lab. F 2:15-5:05


3 units, Aut (Cannon) MWF 11
Win (———) MWF 11

**112a. Rapid Visualization** — Systematic development, through lecture and laboratory exercise, of visual presentation skills essential to the designer. Emphasis upon quickly executed, freehand orthographic and perspective sketches of concepts which exist only in imagination. Rapid visualization utilized as catalyst for fluent idea production.

3 units, Aut (McKim) MW 1:15-4:05

**112b. 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: 112a.

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

**112c. Aesthetics in Product Design** — The aesthetic qualities of manufactured objects explored through example, analysis, and inventive laboratory exercises. Design problems stress development of ability to make aesthetic judgments and skill in using perspective, color, and rendering techniques to communicate design concepts to others. Prerequisite: 112b.

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

**114a. Mechanical Engineering Design** — Analysis and design of machine elements and assemblies. Synthesis, practical workability, and ease of manufacture will be emphasized through several short projects. Prerequisites: 4, 50, Engineering 9, 15, and C.E. 114 concurrently.

3 units, Aut (Staff) T,Th 10; lab. T or Th 2:15-5:05

**114b. Mechanical Engineering Design** — During this course the emphasis will be placed on the actual process of design, and the lecture and laboratories will be devoted to the design of a complete and complex machine. The project is so chosen that it will demand the application of knowledge learned in other courses and act as a synthesizing agent. Prerequisite: 114a.

4 units, Win (Staff) T,Th 10; lab. T or Th 1:15-4:05

**114c. Design of Mechanical Engineering Systems** — Analog computation including analysis of computing circuits, scaling of

3 units, Spr (Staff) TTh 10 and third lec. by arrangement

116a. Human Factors in Product Design—Design of products and/or systems with emphasis upon human factors. Study of dimensional and strength characteristics of human anatomy, capabilities and limitations of senses, responses to sensory stimuli and effects of environmental conditions, motivation, and fatigue. Primary emphasis will be upon design that satisfies human needs of ultimate user of product or system. Human factors knowledge actively incorporated into the design of working models. Prerequisite: 112a (may be taken concurrently).

3 units, Aut (Staff) TTh 12:00-2:05

116b. Materials and Structures in Product Design—Direct laboratory experience with materials and structures with emphasis upon concrete, sensuous regard for wood, metal and plastics and aesthetic-intuitive approaches to new structural configurations. Concepts developed into three-dimensional mockups and finished models. Prerequisites: 112a, 112b (may be taken concurrently), 116a.

3 units, Win (Staff) TTh 12:00-2:05

116c. Advanced Product Design—Integration of knowledge, methodology, and skills obtained in 114a, 112a, b, c, and 116a, b. Extension of knowledge related to energized products which incorporate moving parts. Quarter-long design project carried through phases of research, analysis, programming, alternative concepts, concept selection, iteration, prototype and working model construction, and formal presentation to professional jury. Prerequisites: 112a, b, 112c (may be taken concurrently), 114a, 116a, b.

3 units, Spr (McKim) TTh 12:00-2:05

122. Mechanical Engineering Laboratory—Laboratory experiments on hydraulic and thermal power apparatus: (1) to introduce student to experimental methods in field of mechanical engineering, (2) to demonstrate validity of principles, techniques described in Engr. 31, M.E. 132, (3) to give student experience of analyzing own experimental work, presenting results in acceptable engineering report, and (4) to provide experience in joint group effort. Prerequisites: Engineering 21, 31, and preferably M.E. 132.

4 units, Win (Staff) one afternoon by arrangement

123. Mechanical Engineering Laboratory—More advanced laboratory experiments in thermal and nuclear engineering, and in mechanics, in which students participate to an increasing degree in the design of experiments. Prerequisites: 122 and 132.

4 units, Spr (Staff) one afternoon by arrangement


3 units, Aut (London) MWF 10

133. Engineering Thermodynamics—Continuation of 132; further work on availability, minimum work in separation processes, chemical thermodynamics, thermodynamics of combustion, analysis of combustion engines. Prerequisite: 132.

3 units, Spr (——) MWF 9

134. Introduction to Kinetic Theory and Statistical Mechanics—Equilibrium kinetic theory and transport processes, velocity distribution. Statistical mechanics and energy distribution: entropy, energy, pressure in terms of partition function. (Available for graduate student credit, but graduate students intending to complete the M.E. 211 series should take M.E. 211a rather than this course.) Prerequisite: 132.

3 units, Win (——) MWF 8

135. Heat, Mass, and Momentum Transfer—Introductory treatment of conduction, convection, and radiation heat transfer, mass diffusion, boundary layer theory including the velocity, temperature, and concentration boundary layers. Prerequisites: Engineering 31 and concurrent registration in Mathematics 130.

3 units, Aut (Staff) MWF 11

4 units, Spr (——) MWF 8; one lab. by arrangement


3 units, Spr (Bulkeley) MWF 11

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

Courses Primarily for Graduates

ENGINEERING DESIGN

214a. 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, Win (Staff) M or T 2:15-5:05

214b. Design in the Corporate Environment—A discussion of the respective contributions of engineering, research, marketing, manufacturing, finance, and other corporate functions to comprehensive design. Studies will center upon the relationship of the design engineer to the corporate design team and the organization and control of this team for great effectiveness. Limited registration. Prerequisite: 214a.

3 units, Spr (Staff) M or T 2:15-5:05

215a,b,c. Design Seminar — Open to all graduate students. Each quarter seminar develops a theme which bears upon design (e.g., Innovation, Design Frontiers). In typical format, prominent guest speaker discusses theme for 15 minutes; remaining time is devoted to a structured question-answer discussion between speaker and students. Registration for one unit of credit, with + or — grade, is optional; letter grade is given to students who write paper related to seminar theme.

215a. 1 unit, Aut (Staff) W 4:15
215b. 1 unit, Win (Staff) W 4:15
215c. 1 unit, Spr (Staff) W 4:15


3 units, Aut (Bulkeley) MWF 10


3 units, Spr (Bulkeley) MWF 8

218a. Control System Components — Electronic components. General considerations in the characterization of system components. Steady-state analysis of systems containing strongly nonlinear components. Application of the above material to the study of electronic systems. Laboratory consisting of construction, on the analog computer, of vibrators, modulators, other basic electronic devices; no reports required. Prerequisite: E.E. 128 or equivalent (may be taken concurrently).

3 units, Aut (Staff), TTh 8; one lab. by arrangement

218b. Control System Components — Hydraulic and pneumatic components and systems. Reading of descriptive material concerning fluid power control. Techniques for the simulation of dynamic systems by digital computer. Project consisting of the development and use of a digital computer simulation of a complex hydraulic power control system. Prerequisite: E.E. 128 or equivalent,
218a recommended. No prior digital computer work necessary.

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

218c. Control System Components—Instrumentation and computation. The description of static and dynamic accuracy and precision of instrumentation devices. The design of optical and magnetic instrumentation equipment. The application of digital equipment to control systems. Analog to digital conversion, binary codes, switching devices, logical design. The description and measurement of component reliability, and the influence of component reliability on system reliability. Laboratory organized as in M.E. 218a. Prerequisite: 218b.

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

219. Development Engineering—Study of methods used in developing new products beyond initial design and in improving existing types. Similitude and physical modeling of mechanical systems. Simulation of service environment. Methods of development testing compared to methods of experimental research and acceptance testing. Case studies and analysis will be used. Actual development of student designs is optional subject to instructor's approval. Prerequisites: 114a and 122 or equivalent.

3 units, Spr (Fuchs) TTh 3:15-4:30

220. Space Mechanisms—Constraints and pairing in three-dimensional mechanisms; spatial velocity and acceleration analysis. The spherical 4-bar. The spatial 4-bar. Synthesis of spatial mechanisms for path and function generation. Prerequisite: 50.

3 units, Aut (Roth) MWF 12

221. Kinematic Analysis—The relative motion between links in a mechanism is studied in terms of rolling centrodes. The kinematical forms of the Euler-Savary equation are derived and the path curvature of points on a moving link are rigorously determined. The properties of the coupler curves are analyzed in terms of the theory of higher plane curves. Prerequisite: 50.

3 units, Win (Roth) MWF 12

222. Kinematic Synthesis—The problem of determining linkage proportions from prescribed input-output conditions is considered for both path and function generating mechanisms. Critical comparison of graphical, analytical, and computer oriented methods. The techniques are applied to the synthesis of various machines and computers. Prerequisite: 50.

3 units, Spr (Roth) MWF 12

299a,b,c. Design 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.

299a. 5 units, Aut (Staff) by arrangement
299b. 5 units, Win (Staff) by arrangement
299c. 5 units, Spr (Staff) by arrangement

THERMOSCIENCES

211a. Physical Gas Dynamics—(Enroll in A.A. 211a.) 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 (C. Kruger) MWF 2:15

211b. Physical Gas Dynamics—(Enroll in A.A. 211b.) High-speed, high-temperature flows of gas mixture in local thermodynamic and chemical equilibrium; physical and chemical basis of rate equations; flows with vibrational and chemical nonequilibrium. Prerequisites: 238b (or A.A. 210b) and 211a (or consent of instructor).

3 units, Spr (Vincenti) MWF 2:15

211c. Physical Gas Dynamics—Kinetic theory of gases in translational nonequilibrium: concepts from statistical mechanics; Boltzmann equation; molecular encounters and related concepts; conservation equations; H-theorem; Maxwell distribution; Chapman-Enskog method; viscosity and thermal conductivity for different molecular force mo-
212. Kinetic Theory of Transport Processes — The Chapman-Enskog development of the Boltzmann equation, its relation to the macroscopic fluid mechanics equations, the transport coefficient. Emphasis will be on the calculation of transport properties (viscosity, thermal conductivity, diffusivity of pure gases, and gas mixtures) from molecular interactions and on the molecular interaction potentials. Ionized gases will also be treated. If time permits other topics such as the Grad and Wang Chang-Uhlenbeck solutions of the Boltzmann equation will be discussed. Prerequisites: 211a or consent of instructor.

3 units, Win (Ferziger) MWF 2:15

231a. Heat Transmission — Application of principles of heat transfer and thermodynamics to solution of steady-state, transient heat transfer problems with combined mechanisms. Classical heat conduction theory. Radiation heat transfer analysis. Prerequisites: graduate standing and at least concurrent registration in Mathematics 130.

3 units, Aut (London) 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. Prerequisites: 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. Experimental Problems in Heat Transmission — Laboratory for investigation of problems of heat transmission. Approximately five problems involving analytical prediction of performance of an idealized heat transfer system, experimental determination of behavior of actual system, rationalization of difference. No formal laboratory reports required. Prerequisite: 231b.

3 units, Spr (——) by arrangement

233a. Advanced Thermodynamics — Fundamentals of thermodynamics. Review of First Law, Second Law, relations among properties of systems. Different treatments of principles are studied, compared. Applications given to engineering problems, including development of availability concept.

2 units, Win (——) TTh 2:15

233b. Advanced Thermodynamics — Continuation of 233a. Further study on relationships among properties of systems. Introduction to chemical thermodynamics; theorems of Onsager, Prigogine. Prerequisite: 233a.

2 units, Spr (——) TTh 2:15, alternate years, given 1966–67

237a. Thermodynamics of Propulsion Systems—Analysis of the performance of propulsion prime movers from a thermodynamic and dynamic point of view, including rocket, ramjet, and turbojet systems as well as piston, gas turbine, and compound piston-turbine type engines. Thermodynamics and kinetics of combustion reaction as applied to internal combustion engine systems. Prerequisites: 132 and graduate standing.

4 units, Win (London) MWF 10 and 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


3 units, Win (Staff) MWF 11

238c. Continuum Fluid Mechanics — Continuation of 238b. Tensor notation. Turbulent shear flows: boundary layer, channel, pipe, wake and jet flows. Transition to tur-

3 units, Spr (Staff) MWF 9

239a. Internal Flow — The fluid mechanics and thermodynamics of flow inside ducts, bends, diffusers, nozzles, cascades, fluid logic elements, etc. Basic concepts are applied to analysis of these devices and the current empirical knowledge of, and experimental techniques for, study of internal flows will be stressed. The course is recommended for students considering concurrent and/or subsequent registration in 291, 292, 300 or 301 under the Internal Flow Program. Prerequisites: 238a, b, c or equivalent.

3 units, Aut (Kline) alternate years, given 1967–68

239b. Fluid Dynamics of Turbomachinery —Analysis of the fluid dynamics and thermodynamics of flow in turbomachinery. Basic equations for flow in rotating coordinates. Effects of Coriolis and centrifugal forces on boundary layers. Flow in, and design problems of, the centrifugal compressor stage used as vehicle for discussions of concepts and general methods. Prerequisites: 238a (required), 238b, c (recommended).

3 units, Win (Johnston) MWF 11, alternate years, given 1966–67

239c. Hydrodynamic Stability—Linear and nonlinear theories of hydrodynamic stability by classical, variational and numerical methods. Applications to laminar shear layer stability, transition to turbulence and structure of turbulent shear flows. Prerequisites: 238a, b (required), 238c, 260a, b (recommended).

3 units, Spr (Reynolds) alternate years, given 1967–68

240. Current Topics in Fluid Mechanics—This course will consist of a series of lectures by invited experts from outside the University on some topics of current interest in the general area of fluid mechanics.

2 units, Sum (——) by arrangement

249. Experimental Plasma Physics I—(Enroll in Engineering 212.) Lecture course which, together with 249A, is intended to introduce the student to selected basic plasma phenomena, with emphasis on the production and characteristics of d.c. and r.f. discharges, and plasma diagnostics using d.c., r.f. and optical methods. Prerequisite: 251 or Engineering 210 or permission of instructor.

2 units, Win (Staff)


2 units, Win (Staff) by arrangement

250. Experimental Plasma Physics II—(Enroll in Engineering 213.) Continuation of 249. Prerequisites: 249 and 249A.

2 units, Spr (Staff)

250A. Experimental Plasma Physics Laboratory II—(Enroll in Engineering 213A.) Continuation of 249A. Prerequisites: 249 and 249A. Concurrent registration in 250 required.

2 units, Spr (Staff) by arrangement

251. Physics of Partially Ionized Gases —Fundamental equations and physical principles underlying properties and dynamics of partially ionized gases. Elements of electromagnetic theory, motion of a single charged particle, Hall effect, Debye length, plasma frequency, properties and solutions of the MHD equation, collision cross-sections for atomic processes, classical theory of collisions, Rutherford scattering, nonequilibrium relaxation times, electrical conductivity. Prerequisites: Familiarity with elementary vector analysis and electricity and magnetism.

3 units, Win (——) MWF 1:15

252. Magnetohydrodynamic Energy Conversion—Application of basic principles to MHD generators and accelerators. Thermodynamics of partially ionized gases, Saha equation, calculation of electrical conductivity for equilibrium and nonequilibrium plasmas. MHD one-dimensional channel flow, d.c. and a.c. power generation, engineering problems in power generation and propulsion. Prerequisite: 251.

3 units, Spr (Eustis) MWF 10

Chapman-Enskog theory to the calculation of transport properties of partially ionized gases in a magnetic field with a weak electric field. The electrical and thermal conductivities for very weakly ionized and fully-ionized gases. The effect of strong electric fields on the electron velocity distribution and on the values of the transport coefficients. Prerequisites: 251 and 211c or permission of instructor.

3 units, Spr (Kruger) MWF 1:15

254. Microscopic Processes at High Temperatures — This course will be primarily concerned with providing an introduction to fundamental concepts in electromagnetic theory of radiation and in quantum mechanics. Topics to be covered will include radiation from an accelerated charge, bremsstrahlung, black-body 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. Prerequisites: 251 or A.A. 285a, or equivalent, and Mathematics 132 concurrently or equivalent.

3 units, Spr (——) MWF 3:15


3 units, Win (Leppert) TTh 8


3 units, Spr (Leppert) MWF 11

260a. Mathematical Methods in the Thermosciences — Advanced topics in the solution of ordinary and partial differential equations with application in a variety of physical problems, including viscous flows, hydrodynamic stability, liquid sloshing, conduction, convection, and radiation heat transfer. Prerequisites: Mathematics 106 and 132, or equivalent.

3 units, Aut (Reynolds) MWF 11


3 units, Win (Reynolds) MWF 8

296. Seminar in Fluid Mechanics—(Enroll in E.M. 296.) Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for those presenting talks.

1 unit, Aut, Win, Spr (Flügge-Lotz, Van Dyke, Vincenti) T 4:15

NUCLEAR ENGINEERING

For a listing of the courses in Nuclear Engineering, see “Division of Nuclear Engineering” below.

DIRECTED STUDY

291. Engineering Problems—Directed study for graduate engineering students on subject of mutual interest to student and staff member. May be used to prepare for experimental research during a later quarter under 292. Student must find faculty sponsor.

1 to 15 units, any quarter (Staff) by arrangement

292. Experimental Investigation of Engineering Problems — Graduate engineering student may undertake experimental investigation under guidance of staff member. Previous work under 291 may be required to provide background for experimental program. Student must find a faculty sponsor.

1 to 15 units, any quarter (Staff) by arrangement


2 to 15 units, any quarter (Staff) by arrangement


2 to 15 units, any quarter (Staff) by arrangement

DIVISION OF NUCLEAR ENGINEERING

Professor: Thomas J. Connolly (Director)
Associate Professors: Joel H. Ferziger, Rudolph Sher
Lecturer: George Safanov
Affiliated Faculty: Paul Kruger, George Leppert
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.

Graduate Program — To secure the recommendation of the Division for the Master's degree, a candidate must complete 45 units of course work distributed as follows: 6 units of mathematics, 33 units of restricted electives which will include several of the courses described below as well as other engineering or science courses, and 6 units of free electives.

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 degree requires a minimum of two years beyond the Master's
degree, with three years being the time usually required.

The Division of Nuclear Engineering is administered within the Department of 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


3 units, Win (Staff) MWF 9

172. Nuclear Chemistry—(Enroll in Engineering 172.) Properties of nuclei and radioisotopes; nuclear reactions; fission, fusion, reactors and accelerators; radiation detection and measurement; radiation safety; radiation chemistry, radiotracers, activation analysis, and their applications. Prerequisites: Chemistry 3, Mathematics 23, and Physics 57.

3 units, Win (P. Kruger) TTh 11

175. Nuclear Measurements Laboratory — (Enroll in Engineering 175.) 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: Concurrent registration in 171 or 172, or consent of instructor.

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

176. Radiochemistry Laboratory — (Enroll in Engineering 176.) Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisite: Engineering 172 or 175, or consent of instructor.

3 units, Spr (P. Kruger) Th 1:15 and one lab. by arrangement

in nucleate boiling. Flow in boiling systems. Critical flow with relative velocity between phases. Prerequisite: M.E. 231b.

3 units, Spr (Leppert) MWF 11


3 units, Aut (Sher) MWF 10


3 units, Win (Sher) MWF 10


3 units, Spr (Staff) MWF 10


3 units, Win (Staff) one afternoon by arrangement


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: 217b and Mathematics 106.

3 units, Spr (Ferziger) MWF 9, alternate years, given 1967–68

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) MWF 9, alternate years, given 1966–67

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 1967–68


3 units, Win (Ferziger) MWF 1:15
Dean: Robert R. Sears
Associate Deans: Richard W. Lyman, Lincoln E. Moses
Assistant Dean: Donald R. Price

Organization

The School of Humanities and Sciences includes all members with the rank of instructor or above of the Departments of Aerospace Studies, Anthropology, Art and Architecture, Asian Languages, Biological Sciences, Chemistry, Classics, Communication, Computer Science, Economics, English, French and Italian, History, Humanities, Mathematics, Military Science, Modern European Languages, Music, Naval Science, Philosophy, Physics, Political Science, Psychology, Sociology, Speech and Drama, 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 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, 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 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.

ROTC—Reserve Officers’ Training Corps are maintained at Stanford by the Army, the Navy, and the Air Force (see Aerospace Studies, Military Science, and Naval Science in this Bulletin). Students enrolled in Chemistry or Physics who are also enrolled in an ROTC program will usually require more than the usual four years (twelve quarters) in the University to obtain a baccalaureate degree. Because of the 36 units of credit required for the Aerospace Studies, Military Science, and Naval Science, the Chemistry or Physics courses require additional time for graduation which will vary from one to three quarters depending upon the circumstances in each case.

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.
AEROSPACE STUDIES

Executive Head: Harry H. Matthews (Major, USAF)
Professor: Harry H. Matthews (Major, USAF)
Assistant Professor: John W. Dodds, Jr. (Major, USAF)

GENERAL

The Department of Aerospace Studies offers a program of Air Force ROTC instruction and pre-commissioning training which, in conjunction with a baccalaureate degree, qualifies a student for a commission in the United States Air Force.

New applicants enter the Two-Year Program after completing sufficient university work to be within two academic years of their baccalaureate degree. The existing Four-Year Program will be phased out over the next two years.

Freshmen, sophomores, and other students not yet eligible for enrollment may join an Air Force sponsored Mitchell Flight. This is an extracurricular organization which takes part in the activities listed below, supplies useful preparatory Air Force orientation, and offers the activities credits required in the General Studies Program.

CURRICULUM

NEW TWO-YEAR PROGRAM (GRADUATE OR UNDERGRADUATE)

It is now possible for a student with two years remaining at Stanford University to participate in the AFROTC Program. Graduate students are especially invited to apply. The course covers the development of aerospace power from man’s early attempts to fly through our current space programs. Included is a detailed study of the military as a profession with particular emphasis on leadership and management training.

Throughout the AFROTC curriculum, major emphasis is placed on the development of the student’s communicative skills. All classes are taught by the seminar method, with active student participation required. All cadets attend one hour of Leadership Laboratory each week on Thursday.

Students will attend a six-week Field Training Course during the summer preceding their enrollment. Each student will experience living on an Air Force base and virtually become a part of the Air Force. He will learn about modern air and space weapons, participate in orientation flying, train in the use of weapons, and gain leadership experience and discipline through group drill.

Aerospace Studies courses satisfy the Group Activity requirement of the General Studies Program and the University's physical education requirement.

FOUR-YEAR PROGRAM

Students now enrolled in the Four-Year Program will complete the courses listed under the Two-Year Program. They will attend a four-week Field Training Course between their third and fourth years.

ACTIVITIES

In addition to the academic curriculum the AFROTC program offers many activities which help the student develop the qualities of an Air Force officer. Leadership training is held once each week and enables the cadet to practice skills he studied in the seminar. Tours of Air Force installations acquaint cadets with the facilities and operations required to accomplish the Air Force missions. Orientation flights, often in jet aircraft, are offered to selected students.

The Arnold Air Society, an honorary professional organization, sponsors social activities, service projects, and inter-ROTC competition.

SCHOLARSHIPS

Students who complete the Four-Year Program GCM with high achievement are eligible to compete for the Air Force Financial Assistance. Those selected will receive, during their junior and senior years, full tuition scholarships, allowances for fees and textbooks, and a retainer pay of $50 per month. Congressional action to authorize scholarships for the Two-Year Program has been requested.

DEFERMENT DELAY

Active participation in the AFROTC program authorizes deferment from selective service induction. This deferment can insure
completion of undergraduate or graduate courses of study. Upon graduation and commissioning, education delays (postponement of active duty) may be granted to students pursuing graduate studies.

Distinguished Graduate Program

The Air Force ROTC Distinguished Graduate Program provides an opportunity for highly qualified cadets to be selected for appointment in the Regular Air Force.

The Professor of Aerospace Studies may designate as Distinguished Graduates those seniors who possess outstanding qualities of leadership and have demonstrated these qualities both in military classwork and other campus activities. They must also maintain high academic standings in their military and University studies.

Twenty per cent of Air Force ROTC graduates may be designated as Distinguished Graduates annually, and become eligible to compete for regular commissions.

Pay and Benefits

All necessary military textbooks and uniforms are furnished without cost to the student. Cadets receive a retainer fee of $40 a month.

Students enrolled in the Two-Year Program receive approximately $120 while attending the six-week Field Training Course prior to entering the Two-Year Professional Officer Course. Students enrolled in the Four-Year Program receive approximately $135 while attending the four-week Field Training Course.

Flight Instruction Program

A light plane pilot training program is offered during the second year to cadets who plan to enter the USAF pilot training program following commissioning. Cadets may obtain a private license through this program.

Courses

Course numbers are assigned by the Air Force and do not correspond to the general University plan for numbering, i.e., none are graduate courses.

First Year


4 units, Aut (Dodds) MW 11;
Leadership lab. Th 3:15

302. Astronautics and Space Operations—United States space programs, administrative control, vehicles, systems, and problems in space exploration. Term paper required.

4 units, Win (Dodds) MW 11;
Leadership lab. Th 3:15


4 units, Spr (Dodds) MW 11;
Leadership lab. Th 3:15

Second Year

401. The Professional Officer—The foundations of the military profession. The channels of communications. Human relations as they apply to the leadership situation, and the theory of leadership.

4 units, Aut (Matthews) MW 3:15;
Leadership lab. Th 3:15


4 units, Win (Matthews) MW 3:15;
Leadership lab. Th 3:15

403. The Professional Officer—Air Force management, principles, and functions. The command and staff team. Data processing and controls. Performance standards. The junior officer as an administrator.

4 units, Spr (Matthews) MW 3:15;
Leadership lab. Th 3:15

Advanced Laboratory

199. Corps Training—Open to the AFROTC cadet staff and selected cadets. One hour each week.

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

Executive Head: George D. Spindler
Associate Professors: Clifford R. Barnett, Alan R. Beals, Charles O. Frake, Bert A. Gerow, James L. Gibbs, Robert B. Textor
Assistant Professors: Harumi Befu, Francis A. Cancian, Roy G. D'Andrade, John C. Hotchkiss, Paul deY. Kay
Research Associates: Louise Spindler, Gene McN. Stirling, Victor C. Uchendu

OFFERINGS AND FACILITIES

The courses offered by the Department of Anthropology are designed: (1) to provide undergraduate students who wish to add to their general education, or to supplement collaterally their major field, 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.

Undergraduate students wishing to enroll as majors in anthropology should apply to the Executive Head of the Department, who will assign them an adviser. Students wishing to change their majors to anthropology will be accepted if they have an average grade of C or higher in all courses counting toward a major in the field.

PROGRAMS OF STUDY

BACHELOR OF ARTS

For the Bachelor's degree in Anthropology, 45 units of work in the Department are a requirement. The program of courses can be arranged in consultation with the adviser to meet the special needs and interests of the student. The following basic course requirements will be included in the 45 units, unless specifically excepted: Anthropology 1; Anthropology 5; Sociology 1 or other approved sociology course; Psychology 1 or other approved psychology course; Anthropology 191 (Senior Seminar). To be recommended for the Bachelor's degree, the student must have an average grade of C or higher for work in the major field.

A Department Honors Program gives Department majors with superior scholastic records and outstanding ability in anthropology an opportunity to undertake more independent and creative work along the lines of their special interests. The privilege of entering the Honors Program applies to the junior and senior years, and culminates in the presentation of an honors thesis in the final quarter of the senior year. A student completing the program will graduate "With Departmental Honors."

Candidates for admission to the Honors Program should apply to the Executive Head of the Department by the third quarter of the junior year. In exceptional cases, a student may be admitted at the beginning of the first quarter of the senior year. To qualify for admission the student must have a grade average of B or better (normally based on at least 20 units of work) in courses within the anthropology major sequence, and an overall grade average of B or better in general University work. Each student will submit a proposed program of study, including his thesis topic, and this must be formally approved by the anthropology faculty. One faculty member will be assigned to act as an adviser to the student, and others will be available for consultation as the study program is developed.

The honors student will complete the regular major requirements of 45 units, either in course work or in approved individual study, plus a special study program of 12 units of honors work. These 12 units will be distributed as appropriate between (a) courses in or outside the Department which bear directly on the preparation of the honors thesis and (b) a special independent study course for honors. The honors thesis will be presented at least two weeks before the end of the final quarter of the senior year.

Students majoring in other social science fields or in education, and interested in taking an undergraduate minor or coordinated program in anthropology, may wish to consider a choice from the following courses as being particularly relevant: 1 (General Anthropology); 126 (Cultural Dynamics); 131 (Comparative Social Systems); 158 (Culture and Personality); 167 (Language and Culture).
For majors in humanities fields the following anthropology courses are correspondingly brought to special attention: 1 (General Anthropology); 5 (Development of Man); 135 (History of Anthropological Theory); 141 (Belief Systems); 145 (Political Anthropology); 151 (Economic Anthropology).

For students in the biological sciences the most relevant courses are: 5 (Development of Man); 175 (Physical Anthropology: by permission of instructor).

It will also be noted that regional courses are given, especially in fields where Stanford has strong teaching and research interests: Western Europe; South, Southeast, and East Asia; the Pacific Islands; North, Central, and South America; Africa; India.

Interested students may take part in fieldwork on local archaeological sites. They may also obtain training in museum methods by doing directed work relating to the Stanford Museum anthropological collections. See 180, 282.

**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 grants the Master of Arts and the Doctor of Philosophy degrees. Students who are interested in a professional career in anthropology are expected to apply for the Doctor of Philosophy degree. For these students the Master of Arts degree will be awarded at the satisfactory completion of initial preparation for the doctoral degree, as detailed below. Special programs are established for graduate students in Education, Medicine, and other fields who wish to take a Master of Arts degree in Anthropology.

**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 36 quarter units, plus a thesis, unless the thesis is waived by action of the Department. Course requirements are to be determined by the Department, depending on the student’s program.

**DOCTOR OF PHILOSOPHY**

Admission to candidacy constitutes the first step in fulfilling the requirements for the Doctor of Philosophy degree. For admission to candidacy the student must:

1. Have 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 the following courses with a grade of B or better:
   a) The proseminar sequence.
   b) An acceptable course in linguistics.
   c) An acceptable course in statistics.
   d) One course in either physical anthropology or prehistoric archaeology. (Both are required for completion of the doctoral degree.)

Students who submit satisfactory evidence of having had previous training in any of these fields are urged to take more advanced courses in the same topic areas, or to submit to the faculty a proposal for substitution of courses in other fields.

3. Pass a written examination covering a basic knowledge of general anthropology.
4. Submit a written paper of high quality.

The graduate program is designed so that these requirements will be completed within the student’s first year of residence. Students entering the Department with a Master's degree in Anthropology from other universities are expected to fulfill these requirements. Upon satisfactory completion of these requirements and with the recommendation of the Departmental faculty, the student will be encouraged to proceed to candidacy for the Doctor of Philosophy degree. Application for candidacy must be made to the Graduate Division of the University. Candidacy, when approved by the University, is valid for five years and may be re-
The further requirements for the Ph.D. degree consist of:

1. Submission and approval, normally at the beginning of the student's second year of residence, of a proposal for a plan of study. This proposal should develop an outline of courses which fulfills the requirements presented below.
   a) Completion of at least five graduate courses given by the Department, not including proseminar courses, reading courses or conceptual skills courses, taken with at least four different faculty members.
   b) Completion of the physical anthropology and prehistoric archaeology requirements.
   c) Completion of training outside the Department in areas related to the student's major topic of specialization. Fulfillment of this requirement will usually consist of a series of graduate courses taken in other departments. The number of courses is to be determined by the student's previous level of training and interests.
   d) Completion of training in a special conceptual skill, such as mathematics, linguistics, computer science, a second language, statistics, and special methods. Fulfillment of this requirement will usually consist of a series of graduate or intermediate courses, with the number of courses to be determined by the student's previous level of training and interests.

2. A written examination, normally taken at the end of the student's second year. The written examination will cover the candidate's major topic of specialization. Fulfillment of this requirement will usually consist of a series of graduate courses taken in other departments. The number of courses is to be determined by the student's previous level of training and interests.

3. The University oral examination that is taken after the written examination.

4. A dissertation based upon independent research. Preceding this research the student will present a dissertation proposal to the faculty for approval.

TEACHING ASSISTANTSHIPS AND FELLOWSHIPS

The Department annually nominates graduate students for appointment as teaching assistants. The service expected consists for the most part of conducting sections of 1 (General Anthropology). A teaching assistant devotes approximately a third of his time to the work, and receives $466 per quarter, plus a scholarship equivalent to one-third of the quarter's tuition cost. Research assistantships may also be available in connection with research programs in the Department, with stipends depending on the amount of work involved. Applicants for these appointments should address their requests to the Executive Head of the Department.

The University also assigns certain fellowship and scholarship funds to the Department. These are allotted initially on the basis of applications for financial aid received up to January 15 of each year, with payment starting at the opening of the following autumn quarter. Applications may be received either from graduate students already in residence or from prospective new students; the latter must also have their admission forms submitted by that date. A student submitting an application for financial aid automatically becomes eligible for consideration for various funds available for Department distribution. Students with first-class records should also ask their advisers about how to apply for outside awards, such as National Science Foundation, National Defense Education Act, and National Institutes of Health fellowships.

COURSES PRIMARILY FOR UNDERGRADUATES

#1. General Anthropology—Anthropological approaches and perspectives relating to man, his culture, and his society. Emphasis on fields of cultural anthropology.
5 units, Aut (L. Spindler, Staff) MTWThF 1:15
Spr (Gibbs) MTWThF 1:15
4 units, Sum (——) MTWThF 1:15

5. The Development of Man—Human evolution; early man; racial and other differ
ences in modern man; early development and differentiation of culture. Introduction to physical anthropology and prehistory.

5 units, Win (Gerow) MTWThF 11

Courses Open to Undergraduates and Graduates

(Except where prerequisites are specified, courses are open to all students. With consent of the instructor, an extra unit may be added to 4-unit courses by undertaking special project work.)

102. Indians of North America — History, cultural background, and contemporary situation of major tribes in North America. Prerequisite: 1 or consent of instructor.

4 units (Barnett) given 1967–68

103. Peoples of Middle America — Survey of cultural development of the peoples of Middle America during the last 3,000 years. Special emphasis is placed upon modern village studies. Prerequisite: 1 or consent of instructor.

4 units, Spr (Hotchkiss) MTWTh 9

104. Peoples of the Caribbean — Anthropological contributions to cultural and social adaptations in the area. Will be concerned with such problems as: ecology, community types and their relationships, family and kinship, stratification. Prerequisite: 1 or consent of instructor.

4 units (Siegel) given 1967–68

105. Peoples of Europe — A review of anthropological materials on rural (peasant) societies in Europe, with emphasis on Ireland, France, Spain, Italy, and Greece. Prerequisite: 1 or consent of instructor.

4 units (——) given 1967–68

109. Peoples of Africa — (Formerly 112.) Racial, linguistic, cultural backgrounds and characteristics; opportunities for special work on chosen areas. Prerequisite: 1 or consent of instructor.

4 units, Win (Gibbs) MTWTh 10

113. Peoples of South Asia — The social structure of the traditional community and its modification in response to changing conditions. Prerequisite: 1 or consent of instructor.

4 units, Win (Beals) MTWTh 9

116. Peoples of East Asia — Emphasis on Japan and relationship with other peoples of East Asia. Racial, linguistic, cultural backgrounds and characteristics; opportunities to read on special areas. Prerequisite: 1 or consent of instructor.

4 units, Spr (Befu) MTWTh 10

117. Traditional Chinese Society — The society, polity, economy, and religion of late traditional China analyzed as a total system. Secondary attention is given to the nature of premodern change. Prerequisite: 1 or Sociology 1 or consent of instructor.

4 units, Aut (Skinner) MTWTh 9

118. Modern Chinese Society — Sociocultural change in transitional and Communist China; the significance of the Chinese case for modernization theory. Secondary attention is given to a systemic analysis of Communist Chinese society. Prerequisite: 117.

4 units, Win (Skinner) MTWTh 9

119. Peoples of the Pacific — Racial, linguistic, cultural backgrounds and characteristics of the Oceanic islanders; opportunities to read on special areas. Prerequisite: 1 or consent of instructor.

4 units, Aut (Frake) MTWTh 10

121. Cultural Evolution — Examination of the nineteenth and twentieth century evolutionary theories. General and specific evolution. Cultural adaptation as an evolutionary process. Prerequisite: 1 or consent of the instructor.

4 units (Befu) given 1967–68

126. Cultural Dynamics — Processes of cultural growth and change, including independent development, diffusion and culture contact. Prerequisite: 1 or consent of instructor.

4 units (Paul) given 1967–68

131. Comparative Social Systems — Analysis of social structure, including kinship, community, other principles of organizing social life; comparison of non-Western with Western societies. Prerequisite: 1 or Sociology 1 or consent of instructor.

4 units, Aut (Befu) MTWTh 10

135. Introduction to the History of Anthropological Theory — A historical treatment of the chief theoretical trends in anthropology. Prerequisite: 1 or consent of instructor.

4 units (——) given 1967–68
141. Belief Systems—Methods for the utilization of personal documents and questionnaires in the study of belief systems will be discussed. Students will be expected to carry out independent research and analysis of particular aspects of belief systems. Prerequisite: 1 or consent of instructor.

4 units, Spr (Beals) MTWTh 10

145. Political Anthropology — This course will deal with the generation, allocation, and use of power in a variety of nonliterate and literate societies. Special emphasis will be placed on the politicization of populations in the new nations of the developing areas. Prerequisite: 1 or consent of instructor.

4 units, Win (Textor) MTWTh 11

151. Economic Anthropology—Data on economic systems of primitive and peasant societies and problems in its conceptualization will be reviewed. Prerequisite: 1 or consent of instructor.

4 units — given 1967–68

158. Culture and Personality — Anthropological contributions to understanding the role of culture in personality development; comparative studies; present status of problem. Prerequisites: 1 and Psychology 1 or consent of instructor.

4 units, Aut (Gibbs) MTWTh 11

160. Anthropological Linguistics — Formerly 260.) Descriptive linguistics, including phonemic and morphological analysis and comparative techniques. (Graduate students enroll in 260.) Prerequisite: 1 or consent of instructor.

4 units, Greenberg given 1967–68

165. Descriptive Linguistics—General theory of language with special reference to problems of linguistic description. (Graduate students enroll in 265.) Prerequisite: 1 or consent of instructor.

4 units, Win (Greenberg) MW 1:15–3:05

167. Language and Culture—Contributions of anthropology to study of linguistics; symbolic nature of language; structural and comparative studies; metalinguistic theory. Designed for students in language and other departments as well as in anthropology. Prerequisite: 1 or consent of instructor.

4 units, Win (Frake) MTWTh 10

170. Prehistoric Archaeology — (Formerly 270.) Methods, findings in this field; correlations of prehistory of Europe and Near East with that of other zones over the world. (Graduate students enroll in 270.) Prerequisite: 1 or consent of instructor.

4 units, Spr (Gerow) MTWTh 11

175. Physical Anthropology — (Formerly 275.) Methods, findings relating to human evolution, fossil man, racial differences, bodily growth; includes laboratory exercises. (Graduate students enroll in 275.) Prerequisite: 5 or consent of instructor.

4 units, Aut (Gerow) MW 1:15–3:05

180. Archaeological Field Methods — Studies, excavations of local archaeological sites, and related work in the Department archaeological laboratory. Prerequisite: 5 or consent of instructor.

4 units, Spr (Gerow) by arrangement

190. Directed Individual Study — For undergraduate students with special needs, and showing capacity to do independent work. Prerequisite: 1 or consent of instructor.

Any quarter (Staff) by arrangement

191. Senior Seminar — For undergraduate majors, to give experience in seminar techniques and afford opportunity to undertake special project work. Prerequisite: 1.

2 units, Spr (Beak) M 2:15–4:05

195. Honors Program — Directed independent study and honors thesis work for students admitted to this program.

Any quarter (Staff) by arrangement

200a. Proseminar — Presentations, discussion and reading in core topical areas in social and cultural anthropology. Required of all first-year graduate students.

4 units, Aut (Hotchkiss) TTh 1:15–3:05

200b. Proseminar—Continuation of 200a.

4 units, Win (Frake) TTh 1:15–3:05

200c. Proseminar—Continuation of 200b.

4 units, Spr (Staff) TTh 3:15–6:05

201a. Proseminar—This seminar will be devoted in considerable part to the presentation and discussion of current research interests of the faculty. Required of all first-year graduate students.

4 units, Aut (Spindler) W 3:15–6:05

201b. Proseminar—Continuation of 201a.

4 units, Win (Befu) M 3:15–6:05
201c. Proseminar—Continuation of 201b.
4 units, Spr (Staff) M 3:15–6:05

203. Middle American Research—Problems on social organization in Middle America. Students may utilize materials from current staff research projects. This seminar may also serve as a follow-up of work done by summer field trainees. Prerequisite: graduate standing or consent of instructor.
4 units, Aut (Hotchkiss) Th 3:15–6:05

209. Ethno-Law of Sub-Saharan Africa—Seminar analyzing the traditional legal systems of Sub-Saharan Africa, the relationship of legal beliefs and practices to other areas of culture and to other means of social control. Special attention to the changing role of law under colonialism and since independence. Prerequisite: graduate standing or consent of instructor.
4 units, Win (Gibbs) T 3:15–6:05

216. Comparative Studies on East Asia—This seminar will focus on selected topics in East Asian studies. Prerequisite: graduate standing or consent of instructor.
4 units, Win (Befu) W 3:15–6:05

223. Advanced Cultural Systems—Stress will be on a procedural approach to cross-cultural comparison with a special emphasis upon the maintenance of membership, conflict and change. Opportunities for individual research. Prerequisite: graduate standing or consent of instructor.
4 units, Aut (Beals) T 3:15–6:05

226. Advanced Cultural Dynamics—Seminar covering selected topics and problems, especially at the community level. Prerequisite: graduate standing or consent of instructor.
4 units (——) given 1967–68

227. Selected Problems in Cultural and Social Change—Consideration of sources and characteristics of new alternatives, the reorganization of choice behavior in relation to prevailing social structure, technology and cultural orientations. Special consideration of plantation systems, urbanization and industrialization. Prerequisite: graduate standing or consent of instructor.
4 units (Siegel) given 1967–68

228. Culture and Education in Developing Nations—(Same as Education 406a.) Concepts of culture and cultural relativism as analytical tools in defining and approaching problems of socio-economic development in Africa, Asia and Latin America. Relation of education to cultural and national development will be explored. Prerequisite: graduate standing or consent of instructor.
2 to 4 units, Spr (Textor) M 4:15–6:05

234. Comparative Peasant Societies—Seminar treating selected topics in the comparative analysis of traditional agrarian societies. The focus in 1966–67 is on marketing systems, trade, and the social position of traders. Cases may be drawn from any of the historical or contemporary peasant societies in Asia, the Middle East, Africa, Europe, or Latin America. Prerequisite: graduate standing or consent of instructor.
4 units, Spr (Skinner) T 1:15–3:05

244. Advanced Mythology and Folklore—Anthropological contributions to understanding of these fields of human activity; comparisons with Western literature. Prerequisite: graduate standing or consent of instructor.
4 units (Gerow) given 1967–68

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: graduate standing or consent of instructor.
3 units, Aut (Spindler) M 7–10 p.m.
4 units, Sum (——) MTWThF 9

257. Seminar—(Same as Education 416.) Special topics in cultural transmission.
3 units, Spr (Spindler) Th 3:15–6:05

258. Advanced Culture and Personality—Seminar following up Anthropology 158. Prerequisite: graduate standing or consent of instructor.
4 units, Spr (Spindler) W 3:15–6:05

262. Phonetics and Phonemics—Field-oriented training in linguistic analysis as applied to the sound systems of languages. Lecture-discussion and laboratory. Prerequisite: elementary linguistic course or consent of instructor.
4 units (Greenberg) given 1967–68

263. Morphology and Syntax—Field-oriented training in linguistic analysis as applied to grammatical systems. Lecture-discussion
264. 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 linguistic course or consent of instructor.

4 units Spr (Greenberg) MW 1:15–3:05

292. Metatheory — Using historical and contemporary materials, the seminar will explore a problem in the conceptual systems used by anthropologists. Prerequisite: graduate standing or consent of instructor.

4 units (Cancian) given 1967–68

300. Directed Project Work — Special research projects undertaken for course credit. Any quarter (Staff) by arrangement

302. Directed Individual Study — Provides opportunities for advanced students to explore special areas of interest. Any quarter (Staff) by arrangement

309. Directed Graduate Research — "Apprenticeship" plan. Research undertaken as alternative to Master's thesis. Any quarter (Staff) by arrangement

310. Thesis — Research in connection with Master's thesis or doctoral dissertation. Any quarter (Staff) by arrangement

Graduate courses offered in other departments and institutes within the University, such as in Anatomy, Geology, Sociology, Psychology, and the Hoover Institution, may also be elected for graduate credit provided the course concerned is approved by the adviser as fitting into the student's program. For the graduate statistics requirement in Anthropology, Statistics 7, Psychology 60, or Education 216 may be taken.

See also Senior Colloquia

DIVISION of APPLIED PHYSICS

Executive Head: Marvin Chodorow
Professors: Marvin Chodorow, Edward L. Ginzton (on leave), Walter A. Harrison, Hubert Heffner, Calvin F. Quate, Peter A. Sturrock
Associate Professor: Marshall S. Sparks

OFFERINGS AND FACILITIES

The program in Applied Physics offers to qualified students with backgrounds in physics or engineering the opportunity for
graduate course work and research in those areas of electron physics which may be relevant to technical applications, and natural phenomena. These areas include solid state, plasmas, quantum electronics, and studies of the electrodynamic aspects of geophysics and space physics. 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, 1967. Graduate students may normally enter the Division 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. Each candidate for this degree will be required to pass an examination. Forty-five 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, 172, 220 (or Electrical Engineering 272), Physics 130, 131, 132 (or Electrical Engineering 259, 259b, Applied Physics 237), Applied Physics 213, 214, 215 (or Physics 210, 211, 212), one quarter of advanced laboratory (chosen from Physics 200, 201, 202, Applied Physics 351, 353, 355, Electrical Engineering 257a, b, c, or Engineering 212A, 213A). Additional course requirements will be arranged in consultation with the major professor. Typically, these will include enough units either in applied physics, physics, or specialized courses in engineering to total approximately 80 units beyond the B.S. degree. A minimum grade average of B during the last five quarters is required in the courses taken toward the Ph.D. degree.

**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 Divisional requirements include a good reading knowledge in any one of the three languages: French, German, or Russian. Each candidate for this degree will be required to pass an oral qualifying examination before his candidacy for the Ph.D. degree is accepted. All graduate students majoring in Applied Physics who have not qualified for candidacy for advanced degrees will be required to take a comprehensive examination which is given annually in the winter quarter. Minimum subject matter requirements for the Ph.D. degree include: Physics 210, 211, 212 (or Applied Physics 213, 214, 215); Physics 220 (or Electrical Engineering 272); Physics 221; Physics 230, 231, 232 (or Electrical Engineering 259, 259b, Applied Physics 237); and two quarters of advanced laboratory (chosen from Physics 200, 201, 202, Applied Physics 351, 353, 355, Electrical Engineering 257a, b, c, or Engineering 212A, 213A). Additional course requirements will be arranged in consultation with the major professor. Typically, these will include enough units either in applied physics, physics, or specialized courses in engineering to total approximately 80 units beyond the B.S. degree. A minimum grade average of B during the last five quarters is required in the courses taken toward the Ph.D. degree.

**Fellowships and Assistantships**

Besides the University fellowships open to all students, there are available in the Division 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, 1967.
COURSES


213. 3 units, Aut (Sparks) TTh 11:00–12:15
214. 3 units, Win (Sparks) TTh 11:00–12:15
215. 3 units, Spr (Sparks) TTh 11:00–12:15

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: E.E. 259b or Physics 231.

3 units, Spr (Heffner) MWF 11

238. Applications of Quantum Mechanics—(Enroll in E.E. 260.) A unified approach involving the density matrix will be used to study lasers, semiconductors, Raman effect, field quantization, and multiple quanta effects. Emphasis will be placed upon the techniques for obtaining the appropriate equations of motion, rather than upon detailed investigation of specific devices. Some of the topics to be included are photoconductivity, rate equations, spontaneous emission, laser action, infrared absorption, and multiple photon absorption. Prerequisite: E.E. 259b or Physics 231.

3 units, Spr (Pantell)

250, 251. Electron Dynamics of Active Devices—Theory of electron behavior in active electromagnetic devices. Space charge waves and cyclotron waves on electron beams, coupled mode theory, traveling wave and parametric interactions. Applications to electron beam devices, solid state microwave devices, acoustic wave amplifiers, and negative resistance amplifiers such as masers and lasers. Prerequisites: Physics 110 and 122 or equivalent courses in mechanics and electricity and magnetism at the junior or senior level.

250. 3 units, Aut (Chodorow) TTh 9 and one hour by arrangement
251. 3 units, Win (Chodorow) TTh 9 and one hour by arrangement

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


3 units, Spr (Buneman)

324. The Laboratory Plasma — (Enroll in Engineering 211.) Methods of forming laboratory plasmas and measurement of their properties. Collision processes, velocity distributions, the Boltzmann transfer equation, concepts of temperature and pressure, non-equilibrium velocity distributions. Macroscopic averages of the Boltzmann equation. D.C. and r.f. breakdown and avalanche phenomena, the effect of a magnetic field, the positive column at low pressure and medium pressure, ambipolar diffusion, the plasma sheath, wave propagation in infinite and in bounded plasmas, probe theory, r.f. diagnostic techniques. Prerequisite: E.E. 271 or Physics 122 or equivalent.

3 units, Aut (——)

phenomena. Prerequisites: E.E. 286E; 287 recommended.

3 units, Win (Buneman)

326. Experimental Plasma Physics I—(Enroll in Engineering 212.) Lecture course which, together with 327, is intended to introduce the student to selected basic plasma phenomena, with emphasis on the production and characteristics of d.c. and r.f. discharges, and plasma diagnostics using d.c., r.f. and optical methods. Prerequisite: 324 or permission of instructor.

2 units, Win (Staff) by arrangement


2 units, Win (Staff) by arrangement

328. Experimental Plasma Physics II—(Enroll in Engineering 213.) Continuation of 326. Prerequisites: 326 and 327.

2 units, Spr (Staff) by arrangement


2 units, Spr (Staff) by arrangement


3 units, Aut (Siegman) MWF

335. Seminar in Quantum Electronics and Optics—(Enroll in E.E. 274c.) Discussion by staff and students of selected topics, such as optical coherence theory; electrooptic, electroacoustic, and nonlinear optical effects; optical resonators; lasers; light modulation and demodulation.

Units by arrangement, Aut, Win, Spr (Siegman, Staff)

350. Electromagnetic Measurements I — Lecture course which, together with 351, is intended to introduce fundamental measurement methods, and instruments in micro-

wave region. Measurement of impedance, power, frequency wavelengths; laboratory oscillators, methods of detection. Prerequisites: E.E. 270E and concurrent registration in E.E. 271 or equivalent.

2 units, Aut (Quate) TTh 8

351. Electromagnetic Measurements Laboratory I—Experimental work to accompany 350. Concurrent registration in 350 required.

2 units, Aut (Quate) by arrangement

352. Electromagnetic Measurements II — Theory of the properties of waves at microwave and optical frequencies and the related laboratory techniques for measuring these properties: attenuation, impedance concepts, dispersion, phase and group velocity, periodic systems. Selected topics from the following: waveguides for electromagnetic waves, microwave circuit representation, space harmonics, acoustic waves in solids at microwave frequencies, the gaussian modes of optical waves confined between dielectric mirrors, properties of materials, propagation and dispersion of ultra short pulses, experimental study of active microwave devices. Prerequisites: 350 and 351.

2 units, Win (Quate) TTh 8

353. Electromagnetic Measurements Laboratory II—Laboratory course to accompany 352. Prerequisites: 350 and 351. Concurrent registration in 352 is required.

2 units, Win (Quate) by arrangement

354. Electromagnetic Measurements III — A continuation of 350 and 352. Electromagnetic theory as related to laboratory practice; measurement of dielectric constant, properties of ferrites, characteristics of microwave devices (BWO, TWT, tunnel diodes, solid state oscillators, parametric amplifiers). Study of generation and modulation of coherent optical waves. Also selected topics of current interest. Prerequisites: 352 and 353.

2 units, Spr (Quate) TTh 8

355. Electromagnetic Measurements Laboratory III — Laboratory course to accompany 354. Prerequisites: 352 and 353. Concurrent registration in 354 is required.

2 units, Spr (Quate) by arrangement

360. Introduction to Astrophysics I: Solar-Terrestrial Relations—(Enroll in Engineer-
ing 207.) Origin and characteristics of the solar wind. Magnetosphere and bow wave; radiation belts; aurorae. Phenomena caused by solar flares: interplanetary shock waves; geomagnetic storms; Forbusch effect. Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent.

3 units, Aut (Sturrock) MWF 11


3 units, Win (Sturrock) MWF 11

362. Introduction to Astrophysics III: Stars and Galaxies—(Enroll in Engineering 209.) Radiative and convective energy transport; equation of state; opacity; nuclear processes. Hertzsprung-Russell diagram; stellar evolution. Galactic morphology; structure of our galaxy; spiral arms. Radio galaxies; quasistellar radio sources; cosmic rays. Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, Spr (Sturrock) MWF 11

363. Astrophysics Seminar—(Enroll in Engineering 210.) Discussion of research problems and current literature in astrophysics with contributions by faculty, students and outside specialists.

1 unit, Aut, Win, Spr (Staff)

377, 378, 379. Theory of Solids — Basic methods and concepts of solid-state physics, including classical and quantum theories of the electron gas, crystal symmetry and group theory, the pseudopotential method, band theory, lattice vibrations, superconductivity, tunneling in solids, optical properties, magnetism, properties of crystal defects, and liquid metals. Prerequisite: Physics 231 or E.E. 259b.

377. 3 units, Aut (Harrison) MWF 10

378. 3 units, Win (Harrison) MWF 10

379. 3 units, Spr (Harrison) MWF 10

380. Special Topics in Solid State Theory—Detailed treatment of specialized topics in solid state theory will vary from year to year. Including optical properties; magnetic properties; transport theory; relaxation phenomen-
a variety of technical processes. The collections of the Stanford Museum and the exhibitions program of the Stanford Gallery supplement the regular academic program of the Department.

**Programs of Study**

Undergraduates may major in Art History, the Practice of Art (Studio), or in Architecture studies. A freshman or sophomore intending to major in one of these areas should consult with an adviser appointed by the Department in order to plan his course of study.

Graduate programs are offered in Art History, Studio (including Industrial Design), Architecture, and Art Education.

**History of Art**

**Bachelor of Arts**

The major program in the history of art must include the following:

- 3 units—Art 1
- 27 units in courses in art history numbered from 100 to 130
- 12 units in courses in art history numbered from 200 to 237
- 3 units each—Art 40 and Art 50
- Total units—48

Each undergraduate major in the history of art shall, in consultation with his adviser, select a coherent and substantial minor program in anthropology, classics, history, literature, philosophy, or some other area approved by the adviser. He shall, furthermore, take at least eight units of beginning German, French, or Italian, or present proof of reading ability in one of these 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 the Graduate Division 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 51 units of graduate work, at least 36 of which must be in the history of art, including no fewer than 18 units in courses at the 200 level or above. At least 15 units must be taken in graduate courses in one or, at most, two supporting fields of study (such as history, literature, classics, anthropology or philosophy), determined in consultation with the Departmental adviser.
  3. Reading knowledge of two foreign languages, preferably German and French.
  4. Completion of two term papers of acceptable quality in courses in the history of art numbered 200 or above.
  5. Completion of a comprehensive written examination covering the main periods in the history of 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 the Graduate Division. Holders of the Master's degree from other institutions must (1) pass Departmental examinations in two foreign languages, preferably German and French; (2) spend one year in residence at Stanford, carrying 36 units of graduate credit in courses selected in consultation with a Departmental adviser, and (3) take a compre-
hensive examination covering the main periods in the history of art.

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 graduate work in the history of art, and must have spent at least one of them in residence at Stanford.

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. 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 and include the following:

3 units—Art 1
47 units in studio courses, including: Art 40, 50, 60; 9 units of drawing (140 or 141); 145; 6 units of 146; 148, 150, 151, 160, and at least nine units in art courses numbered 200 or above.
15 units of art history and architecture, 12 of which should be taken in courses numbered 100 or above.

Total units—65

MASTER OF ARTS

Graduate work leading to the Master's degree may be undertaken by students who wish to engage in advanced studio work. Admission to candidacy for the degree of Master of 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 a portfolio of work (slides or photographs acceptable) representing their strengths and range of abilities.
5. Applications and portfolios must be submitted by May 15.

The requirements for the degree of Master of Arts are:

1. Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.
2. Completion of the equivalent of 45 units of selected third- and fourth-year undergraduate and graduate courses. At least 30 units of this work must be in art with a grade of B or above and distributed as follows:
   a) 12 units in one of the four areas of concentration: (a) Drawing and Painting, (b) Sculpture, (c) Design, or (d) Printmaking.
   b) A total of 12 units in the remaining areas of concentration.
   c) 6 units of work on thesis or creative project.
   d) Students in the graduate program are required to take at least one-half of their unit loads each quarter in regularly scheduled courses which meet at hours specified in the Time Schedule.

Master of Arts candidates in the studio program are strongly advised to elect additional art history courses.

INDUSTRIAL DESIGN

A Master of Arts in Art with emphasis in Industrial Design is offered jointly by the Department of Art and Architecture and the School of Engineering (Department of Mechanical Engineering). For information concerning the requirements for this program, please direct inquiries to the Executive Head of this Department.
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. The degree is intended for teachers with one or more years of experience and/or a regular 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. 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.

ARCHITECTURE

The architecture program is concerned with the study of design disciplines which determine man’s physical environment. The program is developed on three levels within the University: the undergraduate curriculum; the graduate curriculum; and the advanced study center.

BACHELOR OF ARTS (PRE-ARCHITECTURE)

The undergraduate curriculum provides the opportunity for a broad liberal education combined with introduction to the architectural arts. Surveys of architecture, landscape architecture, and urban design develop an awareness of the nature of these arts and their relationship. The program emphasizes understanding of these arts, the basic design factors, and history and theory. After completion of 135 quarter units, students may enter the specialized architecture curriculum if all required courses are completed with a grade average of B.

Required Courses

| Architecture | 70, 71a, 71b, 72, 75, 171, 172 | 19 |
| Landscape Architecture | 80, 182 | 5 |
| Urban Design | 90, 192 | 8 |
| Physics | 21, Mathematics 10, 11, Art 1 | 13 |

BACHELOR OF ARCHITECTURE

The curriculum of this professional program reflects the varied nature of practice by permitting the student to select minor specialization from a number of areas related to architecture, in addition to training for the practice of architecture.

Graduate Admission — Candidates who have the degree Bachelor of Arts in Pre-Architecture from this University or its equivalent may apply, providing they have maintained a grade average of B— in all required courses. Provisional enrollment may be granted to candidates who hold an undergraduate degree but are deficient in undergraduate courses in architecture until all such requirements are completed with a grade average of B—.

Recommendation for the Degree—Completion of the following courses with a grade average of B—.

Required Courses

| Architecture 271a, b; 272a, b; 273; 274a, b, c, d, e; 275a, b, c; 276; 277; 278; 279a, b, c; 292; 301a, b, c; 392 | 90 |
| Civil Engineering 20, 116, 170; Computer Science 126; Engineering 161; Education 325 | 18 |

25 units selected with approval of adviser from:

Art 10, 40, 50, 100a, b; 105a, b; 110a, b, c; 150b; 259b; Mathematics 21, 22, 23; Engineering 5, 11, 15; Civil Engineering 138, 144, 145, 150, 151, 180, 181, 182, 183, 190; Industrial Engineering 100, 133; Mechanical Engineering 112a, b, c; 116a, b, c; 214a, b; Political Science 100, 104, 107; Geography 191; Biology 128

ADVANCED STUDY CENTER

The opportunity is provided for advanced study in architecture on an individual work basis. Advanced students may enroll in the center to pursue an independent course of
study. Students are encouraged to bring special problems which may be solved under the direction of selected faculty members. No formal curriculum or academic degree is offered. Admission to the Study Center is granted by the Department on the basis of a written application, a statement of purpose and objectives, and evidence of the student’s ability to undertake mature, independent study.

Courses in History of Art

BASIC COURSES

#1. Introduction to Art—A topical survey of problems in the interpretation of architecture, sculpture, and painting.

3 units, Aut, Win, Spr (Ackerman, Staff)

#5. Survey I—Main currents in the history of art from prehistoric time to the end of the Middle Ages.

3 units, Aut, Spr (Miller, Staff)

#10. Survey II—Main currents in the history of art from the Renaissance to the present.

3 units, Win, Spr (Ackerman, Staff)


71b. Architecture Since 1500—See Architecture 71b.

INTERMEDIATE COURSES

100a. Ancient Art I—The Pre-Hellenic Cultures: Egypt, Mesopotamia, Crete.

3 units, any quarter (Staff)

100b. Ancient Art II—Greece and Rome.

3 units, any quarter (Staff)


3 units, Aut (Ackerman)

105b. Medieval Art II—Romanesque to late Gothic periods.

3 units, Win (Eitner)

110a. Renaissance Art I—The early Renaissance in Italy.

3 units, Aut (Staff)

110b. Renaissance Art II—The High Renaissance and Mannerism in Italy.

3 units, Win (Staff)


3 units, Spr (Staff)

115a. Baroque Art I—Seventeenth and eighteenth century art in Italy and Spain.

3 units, Win (Miller)

115b. Baroque Art II—Seventeenth and eighteenth century art in the North.

3 units, Spr (Miller)

120a. Modern Art I—Neoclassicism, Romanticism, and Early Naturalism (1770-1850).

3 units, Aut (Eitner)

120b. Modern Art II—Realism, Impressionism and Postimpressionism (1850-1900).

3 units, Win (Ackerman)

120c. Modern Art III—Main currents of twentieth century art.

3 units, Spr (Ackerman)

#125a. Oriental Art I—The arts of India, China and Japan from the Neolithic through the sixth century A.D.

3 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).

3 units, Win (LaPlante)

#125c. Oriental Art III—The arts of India, China and Japan after the thirteenth century.

3 units, Spr (LaPlante)

126. Chinese Painting.

3 units, any quarter (Sullivan)

#130a. American Art I—Architecture, sculpture, painting and the household arts from pre-Columbian times to the Civil War (1860).

3 units, Aut (Mendelowitz)

#130b. American Art II—Architecture, sculpture, painting and the household arts from 1860 to today.

3 units, Win (Mendelowitz)

ADVANCED UNDERGRADUATE AND GRADUATE COURSES


3 units, any quarter (Staff)
201. Seminar in Ancient Art.
   3 units, any quarter (Staff)

205. Studies in Medieval Art.
   3 units, any quarter (Staff)

206. Seminar in Medieval Art.
   3 units, any quarter (Staff)

   3 units, any quarter (Staff)

211. Seminar in Renaissance Art.
   3 units, any quarter (Staff)

   3 units, any quarter (Miller)

216. Seminar in Baroque Art.
   3 units, any quarter (Miller)

   3 units, any quarter (Staff)

221. Seminar in Nineteenth Century Art.
   3 units, any quarter (Staff)

   3 units, any quarter (Staff)

223. Seminar in Twentieth Century Art.
   3 units, any quarter (Staff)

225c. Seminar in Oriental Art.
   3 units, Spr (LaPlante)

227a,b. Studies in Chinese Arts.
   3 units, any quarter (Sullivan)

227c. Seminar in Chinese Arts.
   3 units, any quarter (Sullivan)

228a,b. Studies in Japanese Arts.
   3 units, any quarter (Sullivan)

228c. Seminar in Japanese Arts.
   3 units, any quarter (Sullivan)

235. Methods of Art Historical Research.
   3 units, any quarter (Staff)

236. Readings in the Literature of Art.
   3 units, any quarter (Staff)

237. Methods of Museology.
   3 units, any quarter (LaPlante)

238a. Art of the Theater I — Classical and medieval.
   3 units, Aut (Russell)

238b. Art of the Theater II — Renaissance and baroque.
   3 units, Win (Russell)

238c. Art of the Theater III — Romantic through modern.
   3 units, Spr (Russell)

   Any quarter (Staff) by arrangement

   Any quarter (Staff) by arrangement

   Any quarter (Staff) by arrangement

   Any quarter (Staff) by arrangement

RELATED COURSES
Philosophy of Art—See Philosophy 8.
Aesthetics—See Philosophy 174.
For archaeological courses see “Classics” elsewhere in this Bulletin.

INTERDEPARTMENTAL SEMINAR
Senior Seminar in Humanities — The Relationship Between the Arts—See Humanities 192.

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 (Mullen, Staff)

#60. Basic Design—Basic laboratory problems in two-dimensional design with emphasis on color.
   3 units, Aut, Win, Spr (Faulkner, Kahn, Mullen)

INTERMEDIATE COURSES
140. Drawing I—Life drawing and composition. Prerequisite: 40. May be repeated for credit.
   3 units, Aut, Win, Spr (Oliveira)

141. Drawing II — Life drawing and com-
145. Painting I — Introduction to painting procedure. Still life, landscape, and figure studies in oil, watercolor, and varied media. Prerequisite: 40. May be repeated for credit.

3 units, Aut, Win, Spr (Boyle)

146. Painting II — Extended problems in pictorial organization and content, with stress on oil painting. Prerequisite: 145. May be repeated for credit.

3 units, Aut, Win, Spr (Staff)

148. Lithography — Introduction to lithography. Prerequisite: 140. May be repeated for credit.

3 units, Aut, Win, Spr (Oliveira)

150. Sculpture I — Introduction to figure modeling and human anatomy. Prerequisite: 50.

3 units, Aut, Win, Spr (Mullen)

151. Sculpture II—Introduction to carving, welding, and construction. Prerequisite: 50.

3 units, Aut, Win, Spr (Mullen)

160. Comprehensive Design I — Two- and three-dimensional laboratory problems basic to key areas of design practice (work in wood, paper, paint, metal, etc.). Prerequisite: 60.

3 or more units, Aut, Win, Spr (Kahn)

161. Comprehensive Design II—Advanced studio problems in practical and theoretical design, with fewer projects of a more complex nature. Prerequisite: 160.

3 or more units, Spr (Kahn)

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

240. Advanced Drawing and Painting Criticism I—Prerequisite: at least two quarters of 146.

Aut, Win, Spr (Oliveira) by arrangement

241. Advanced Drawing and Painting Criticism II—Prerequisite: at least two quarters of 146.

Aut, Win, Spr (Boyle) by arrangement

242. Advanced Drawing and Painting Criticism III—Prerequisite: at least two quarters of 146.

Aut, Win, Spr (Staff) by arrangement

245. Watercolor Landscape Painting—Prerequisite: 145.

4 units, Spr (Mendelowitz)

248. Advanced Lithography.

Aut, Win, Spr (Oliveira) by arrangement

250. Individual Work—Sculpture.

Aut, Win, Spr (Mullen) by arrangement

251. Advanced Figure Modeling—Prerequisite: 150.

3 units, Aut, Win, Spr (Mullen)

252. Advanced Carving, Modeling, and Construction — Prerequisites: 150 and 151.

3 units, Aut, Win, Spr (Mullen)

253. Metal Casting—By permission only.

3 units, Aut, Spr (Mullen)

257. Studio Seminar in Design and Color—Individual projects with emphasis on the relation of theory to practice.

4 units, Aut, Win (Faulkner)


Aut, Win, Spr (Kahn, Staff) by arrangement

261. Graphic and Product Design — Problems in advertising, display, and publication design, and laboratory projects in design of useful articles. Prerequisite: 161.

4 units, Win (Kahn)

263. Jewelry Design—Laboratory problems in jewelry and small sculpture. Prerequisite: 160.

4 units, Win (Kahn) alternate years, given 1967–68

264. Textile Design — Laboratory projects in various types of fabrics with concentration in screen printing. Prerequisite: 160.

5 units, Aut (Kahn)


Any quarter (Staff) by arrangement

341. Master's Project (Studio).

Any quarter (Staff) by arrangement

341d. Master's Project: Industrial Design (Seminar).

Any quarter (Kahn) by arrangement

342. Advanced Creative Studies—Intensive emphasis in areas of personal specialization, with comparative analysis.

Aut, Win, Spr (Kahn) by arrangement
RELATED COURSES

Rapid Visualization—See Mechanical Engineering 112a.

Introduction to Product Design—See Mechanical Engineering 112b.

Philosophy of Design—See Mechanical Engineering 214a.

Design in the Industrial Environment—See Mechanical Engineering 214b.

COURSES IN ARCHITECTURE

BASIC COURSES

#70. Introduction to Architecture—Theories, design factors and practice.
   3 units, Aut (Williamson) MWF 10

#71a. Architecture Before 1500—Building cultures of the world.
   4 units, Aut (Thompson) MWF 9

#71b. Architecture Since 1500—Building cultures of the world.
   4 units, Win (Williamson) MWF 9

72. Introduction to Residential Design—Lectures on functional, social and aesthetic problems in house design.
   2 units, Win (Faulkner) TTh 11

75. Graphics Laboratory—Drafting procedures.
   2 units, Aut (Staff) MW 1:15-3:05

80. Introduction to Landscape Architecture—Theories, design factors and practice.
   3 units, Spr (Faulkner) TTh 10-12

82. Plant Materials—Identification and use of trees and shrubs.
   2 units, Spr (Stedman) alternate years, given 1967-68

#90. Introduction to Urban Design—Theories, design factors and practice.
   3 units, Win (Thompson) TTh 9

Intermediate Courses

171. Materials and Structures—Aesthetic nature of basic building materials and structural systems.
   3 units, Spr (Thompson) MW 10-12

172. Architecture Design Laboratory—Prerequisites: 70 and 75.
   3 units, Win (Staff) MW 10-12

182. Landscape Design Laboratory—Prerequisites: 75 and 80.
   2 units, Aut (Faulkner) TTh 10-12

192. Community Design Laboratory I.
   5 units, Spr (Williamson) TThF 4:15-6:05

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

270. Individual Work: Architecture—Independent study with permission of instructor.
   Any quarter (Staff) by arrangement

   5 units, Aut (Thompson, Young)
   MWF 3:15-5:05

271b. Architectural Design II—Case study problems.
   5 units, Win (Thompson, Callister)
   MWF 3:15-5:05

   5 units, Aut (Thompson, Young)
   MWF 3:15-5:05

272b. Architectural Design IV—Case study problems.
   5 units, Win (Thompson, Callister)
   MWF 3:15-5:05

273. Working Drawings and Specifications—Design of a single family residence. Prerequisite: preliminary design of a residence prepared during previous summer.
   5 units, Aut (Peterson) TTh 1:15-3:05

   3 units, Aut (Hammond) TTh 8

274b. Steel Construction—Design and technology.
   3 units, Win (Hammond) TTh 8

274c. Reinforced Concrete Construction—Design and technology.
   3 units, Spr (Hammond) MW 8

   2 units, Win (B. Clark) M 10–12 and W 11

274e. Materials: Use and Specification II.
   4 units, Spr (Peterson) TTh 1:15–3:05

275a. Plumbing.
   3 units, Aut (Coddington) T 3:15–5:05
275b. Heating, Air Conditioning, and Acoustics.
   3 units, Win (Coddington) T 3:15-5:05

275c. Electrical Wiring, Illumination, and Elevators.
   3 units, Spr (Coddington) T 3:15-5:05

276. Management of an Architectural Practice.
   3 units, Win (Davis) T 1:15-3:05

   2 units, Aut (Alexander) M 7-9 p.m.

278. Construction Administration—Shop drawings, reports, and inspection.
   2 units, Spr (Peterson) Th 3:15-5:05

279a. Apprentice Training—Office internship in cooperating architectural firms.
   1 unit, Aut (Thompson) by arrangement

279b. Apprentice Training—Office internship in cooperating architectural firms.
   1 unit, Win (Thompson) by arrangement

279c. Apprentice Training—Office internship in cooperating architectural firms.
   1 unit, Spr (Thompson) by arrangement

292. Community Development Laboratory II.
   5 units, Spr (Williamson, Steinberg)
   TThF 4:15-6:05

301a. Master's Project I—Independent work extending over three quarters evidencing the student's ability to solve a significant architecture problem. Prerequisites: a B–grade average in all required courses.
   2 units, Aut (Spencer, Thompson)
   Th 10-12

301b. Master's Project II.
   8 units, Win (Peterson, Stromquist)
   Th 3:15-5:05

301c. Master's Project III.
   8 units, Spr (V. Thompson, I. Thompson)
   T 10-12 and W 7-9 p.m.

382. Seminar: Landscape Architecture.
   2 units, Spr (Rolfs) W 7-9 p.m.
   alternate years, given 1966-67

392. Community Development Laboratory III.
   5 units, Spr (Williamson, Green)
   TThF 4:15-6:05

   Any quarter (Staff) by arrangement

**COURSES IN ART EDUCATION**

213. Foundations of Aesthetic Education—(Enroll in Education 213.)

219. Artistic Development of the Child—(Enroll in Education 219.)

261a,b,c,d. Curriculum and Instruction in Secondary Art—(Enroll in Education 261a, b, c, d.)

280. Art in Elementary Education—(Enroll in Education 280.)

380. Curriculum Theory in Art Education—(Enroll in Education 380.)

480. Research Problems in Art Education—(Enroll in Education 480.)

480I. Individual Study in Curriculum and Instruction in Art. (Enroll in Education 480I.)

**ASIAN LANGUAGES**

Emeritus: Frederic Spiegelberg (Professor)
Executive Head: Patrick D. Hanan

Professors: S. Wing Chan, Patrick D. Hanan

Associate Professor: David S. Nivison

Assistant Professor: William H. McCullough

Instructors: Stella E. Chen, Toshiko Ishida, Kung-yi Kao. Acting: Yin Chuang

**Chinese-Japanese Language and Area Center**

Director: Patrick D. Hanan


Associate Professor: David S. Nivison

Assistant Professors: Harumi Befu, William H. McCullough, Mark Mancall, Lyman P. Van Slyke. Acting: Michael C. Oksenberg


Lecturer: Helen C. McCullough

**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:

2. Concentration in Japanese: 103, 154, 155, 156.

These requirements are in addition to the University’s basic requirements 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, providing 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 appropriate difficulty. 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. Graduate students registered at Stanford may obtain further information about the scope and nature of the A.M. written examination from the Graduate Adviser.

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: 162, 163; 201, 202; 211, 212, 213; 299; 12 units of Chinese course work in the Department numbered between 250 and 270, and 8 units numbered between 270 and 290; 16 units of course work, on the upper division or graduate level, in fields such as descriptive linguistics, Chinese history, Chinese philosophy and Chinese art, as approved by the Graduate Adviser.
3. Pass a written examination covering translation from Classical and Modern Chinese, Chinese literature, and one of the following fields: early Chinese history, later Chinese history, Chinese philosophy.

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; 211, 212, 213; 241, 242, 243; 251,
252; either 246 or 261; 299; 16 units of course work, on the upper division or graduate level, in fields such as descriptive linguistics, Japanese history and Chinese literature, as approved by the Graduate Adviser.


**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 the equivalent courses at another university.

2. He must demonstrate a reading knowledge of French or German by passing a written examination. Students must pass this examination before proceeding to the course work described below.

3. He must complete the following additional course work: 291, 321, 361, plus at least 8 units above the level of 240.

4. He must pass an examination in the supporting East Asian language. If the candidate's field is Chinese, he will be examined on his ability to read Modern Japanese (on the level of 103) and on his knowledge of and ability to use Japanese reference works of importance in Chinese studies. If his field is Japanese, he will be examined on his ability to read Classical Chinese (on the level of 103) and on his knowledge of and ability to use Chinese reference works of importance in Japanese studies.

5. He must pass a written examination in two fields other than the field chosen for the A.M. written examination. The candidate for the degree in Chinese must choose two of the following: early Chinese history, later Chinese history, Chinese philosophy, Chinese Buddhism, Japanese literature. The candidate for the degree in Japanese must choose two of the following: Japanese history, Japanese religion, early Chinese history, Chinese philosophy, Chinese literature. Candidates must also pass an examination demonstrating fluency in the modern spoken language of their field.

**University oral examination—**General regulations governing the oral examination will be found in the section "Degrees" in this Bulletin. The candidate for the degree in Chinese must be prepared in the following fields, selected in consultation with the Graduate Adviser:

1. A field of Chinese literature.
2. A field of Chinese history.
3. Chinese philosophy or art or historical linguistics or some other appropriate subject that concerns China.
4. An outside field. For most candidates this will be a Western literary field and will give attention to modern methods of literary analysis and criticism. Under special circumstances, a candidate may be permitted to substitute a field of Western history, philosophy, comparative religion, or some other appropriate subject.

The candidate for the degree in Japanese must be prepared in the following fields, selected in consultation with the Graduate Adviser:

3. Japanese art or religion or historical linguistics or some other appropriate subject that concerns Japan.
4. An outside field, as described above.

**Dissertation**—The candidate will write a dissertation demonstrating his ability to undertake original research based on primary materials in Chinese or Japanese. He will not receive final approval of the dissertation topic until he has passed the University oral examination.
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 221 or Japanese 221 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, 85, 105, 215, Japanese 5, 25, 105, and 215 as described below.) For detailed information about these and other aspects of the summer program, apply directly to the Department of Asian Languages, preferably before the end of the preceding autumn quarter.

COURSES NOT REQUIRING A KNOWLEDGE OF AN ASIAN LANGUAGE

#151. Ancient Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, Aut (Chan) MWF 10

#152. Medieval Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, Win (Hanan) MWF 10

#153. Modern Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, Spr (Chan) MWF 10

#154. Early Japanese Literature in Translation—From the primitive period to the end of the twelfth century. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, Aut (——) MWF 11

#155. Medieval Japanese Literature in Translation—From the thirteenth to the end of the seventeenth century. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, Win (——) MWF 11

#156. Modern Japanese Literature in Translation—From the eighteenth century to the present. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, Spr (——) MWF 11

3 to 5 units, Spr (McCullough)
by arrangement
See also History 91 and 92, East Asian Civilizations.

I. COURSES IN CHINESE

#1, 2, 3. First-Year Modern Chinese—Conversation, grammar, reading, elementary composition.
1. 5 units, Aut (Kao) MTWThF 9
2. 5 units, Win (Kao) MTWThF 9
3. 5 units, Spr (Kao) MTWThF 9

5. Intensive First-Year Modern Chinese—Equivalent to 1, 2, 3 combined. Prerequisite: consent of instructor.
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 (Chen) MTWThF 1:15
22. 5 units, Win (Chen) MTWThF 1:15
23. 5 units, Spr (Chen) MTWThF 1:15
25. Intensive Second-Year Modern Chinese—Equivalent to 21, 22, 23 combined. Prerequisites: 3 or equivalent and consent of instructor necessary.

15 units, Sum (——) MTWThF 8-12

31, 32, 33. Intermediate Conversation—Prerequisite: 3 or equivalent.
31. 2 units, Aut (Chuang) TTh 11
32. 2 units, Win (Chuang) TTh 11
33. 2 units, Spr (Chuang) TTh 11

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 (Kao, Chuang) MTWThF 9 and 1:15
42. 10 units, Win (Kao, Chuang) MTWThF 9 and 1:15
43. 10 units, Spr (Kao, Hanan, Chuang) MTWThF 9 and 1:15

85. Cantonese—Prerequisite: 23 or equivalent.

15 units, Sum (——) MTWThF 8-12

ADVANCED

101, 102, 103. Introduction to Classical Chinese—Reading, syntax, composition. Prerequisite: 23 or equivalent.

101. 5 units, Aut (Nivison) MTWThF 1:15
102. 5 units, Win (——) MTWThF 1:15
103. 5 units, Spr (——) MTWThF 1:15

105. Intensive Introduction to Classical Chinese—Equivalent to 101, 102, 103 combined. Prerequisite: 23 or equivalent. Consent of instructor necessary.

15 units, Sum (——) MTWThF 8-12

121, 122, 123. Advanced Conversation—Prerequisite: 33 or equivalent.
121. 2 units, Aut (Kao) TTh 11
122. 2 units, Win (Kao) TTh 11
123. 2 units, Spr (Kao) TTh 11

162. History of Chinese Literature: Ancient to Tang Period—Lectures and discussion. Prerequisite: 23 or equivalent.

3 units, Win (——) MWF 10

163. History of Chinese Literature: Sung Period to the Present—Lectures and discussion. Prerequisite: 23 or equivalent.

3 units, Spr (Hanan) MWF 10

GRADUATE

200. Directed Reading in Chinese—Prerequisite: 103 or equivalent.

1 to 3 units, any quarter (Staff) by arrangement


201. 3 units, Aut (Nivison) M 2:15-4:05
202. 3 units, Win (Nivison) M 2:15-4:05

211, 212, 213. Modern Expository Chinese—Scholarly and journalistic writings in Chinese. Prerequisite: 103 or consent of instructor.

211. 4 units, Aut (Chan) MWF 2:15
212. 4 units, Win (Chan) MWF 2:15
213. 4 units, Spr (Chan) MWF 2:15

215. Modern Expository Chinese—Scholarly and journalistic writings in Chinese. Equivalent to 211, 212, 213, combined. Prerequisite: 23 or equivalent.

12 units, Sum (——) MTWThF 9-12

251, 252. Chinese Philosophical Texts.

251. 4 units, Win (Nivison) MWF 2:15-4:05
252. 4 units, Spr (Nivison) by arrangement

254, 255. Chinese Historical Texts.

254. 4 units, Win (——) by arrangement
255. 4 units, Spr (——) by arrangement

257. Fiction and Essays in Classical Chinese.

4 units, Spr (Chen) by arrangement

261, 262. Chinese Poetry—Prerequisite: 251, 254, or equivalent.

261. 4 units, Aut (Chan) MWF 2:15-4:05
262. 4 units, Win (Chan) by arrangement


271. 4 units, Win (Hanan) TTh 2:15-4:05
272. 4 units, Spr (Hanan) by arrangement

274. Chinese Drama—Prerequisite: 271 or equivalent.

4 units, Spr (Hanan) by arrangement
281, 282. Modern Chinese Literature—Prerequisite: 213 or equivalent.

281. 4 units, Aut (Chan) TTh 2:15-4:05
282. 4 units, Win (Chan) TTh 2:15-4:05

291. History of the Chinese Language—Lectures and discussion. Prerequisite: 251 or 254, or equivalent.

4 units, Spr (——) by arrangement

299. Translation.
A total of 5 units, which may be taken in one or more quarters, Aut, Win, Spr (Staff) by arrangement

321. Seminar—May be repeated for credit.
5 units, Win (Hanan) M 2:15-4:05

361. Seminar in Chinese Literary Criticism—May be repeated for credit.
5 units, Win, Spr (——) by arrangement

399. Dissertation.
By arrangement (Staff)

II. COURSES IN JAPANESE

#1, 2, 3. First-Year Modern Japanese—Conversation, grammar, reading, elementary composition.
1. 5 units, Aut (Ishida) MTWThF 9
2. 5 units, Win (Ishida) MTWThF 9
3. 5 units, Spr (Ishida) MTWThF 9

5. Intensive First-Year Modern Japanese—Equivalent to 1, 2, 3 combined. Prerequisite: consent of instructor.
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 (——) MTWThF 1:15
22. 5 units, Win (——) MTWThF 1:15
23. 5 units, Spr (——) MTWThF 1:15

25. Intensive Second-Year Modern Japanese—Equivalent to 21, 22, 23 combined. Prerequisite: 3 or equivalent. Consent of instructor necessary.
15 units, Sum (——) MTWThF 8-12

31, 32, 33. Intermediate Conversation—Prerequisite: 3 or equivalent.
31. 2 units, Aut (Ishida) TTh 11
32. 2 units, Win (Ishida) TTh 11
33. 2 units, Spr (Ishida) TTh 11

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 (Ishida) MTWThF 9 and 1:15
42. 10 units, Win (Ishida) MTWThF 9 and 1:15
43. 10 units, Spr (Ishida) MTWThF 9 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 (McCullough) MTWThF 10
102. 5 units, Win (McCullough) MTWThF 10
103. 5 units, Spr (——) MTWThF 10

105. Intensive Modern Written Japanese—Equivalent to 101, 102, 103 combined. Prerequisite: 23 or equivalent. Consent of instructor necessary.
15 units, Sum (——) MTWThF 8-12

121, 122, 123. Advanced Conversation—Prerequisite: 33 or equivalent.

121. 2 units, Aut (——) T 2:15-4:05
122. 2 units, Win (——) T 2:15-4:05
123. 2 units, Spr (——) T 2:15-4:05

GRADUATE

200. Directed Reading in Japanese—Prerequisite: 103 or equivalent.
1 to 3 units, any quarter (Staff) by arrangement

201, 202, Proseminar—Research methods in Japanese Studies. Prerequisite: 103 or equivalent.

201. 3 units, Aut (McCullough) M 2:15-4:05
202. 3 units, Win (McCullough) M 2:15-4:05

211, 212, 213. Modern Expository Japanese—Scholarly and journalistic writings in Japanese. Prerequisite: 103 or equivalent.

211. 4 units, Aut (McCullough) MWF 9
212. 4 units, Win (——) MWF 9
213. 4 units, Spr (——) MWF 9
215. Modern Expository Japanese—Equivalent to 211, 212, 213 combined. Prerequisite: 103 or equivalent.
   12 units, Sum (---) MTWThF 9-12

   241. 4 units, Aut (---) TTh 2:15-4:05
   242. 4 units, Win (---) TTh 2:15-4:05
   243. 4 units, Spr (McCullough) TTh 2:15-4:05

246. Medieval Japanese Prose—Prerequisite: 243 or equivalent
   4 units (McCullough) given 1967-68

251, 252, 253. Modern Japanese Literature—Poetry, prose, and drama after 1868. Prerequisite: 243 or equivalent.
   251. 4 units, Aut (---) WF 2:15-4:05
   252. 4 units, Win (---) WF 2:15-4:05
   253. 4 units, Spr (---) by arrangement

261, 262. Classical Japanese Poetry—Prerequisite: 243 or equivalent.
   261. 4 units, Aut (---) by arrangement
   262. 4 units, Win (---) by arrangement

291. History of the Japanese Language—Prerequisite: 243 or equivalent.
   4 units (---) by arrangement

299. Translation.
   A total of 5 units, which may be taken in one or more quarters, Aut, Win, Spr (Staff) by arrangement

321. Seminar—May be repeated for credit.
   5 units, Aut, Win (---) by arrangement

361. Seminar in Japanese Literary Criticism—May be repeated for credit.
   5 units, Win, Spr (---) M 2:15-4:05

399. Dissertation.
   (Staff) by arrangement

ADDITIONAL INFORMATION

For information concerning other opportunities for study in the Asian field, see listings under the following departmental headings: Anthropology, Art and Architecture, Economics, Geography, Graduate Division Special Programs, History, Hoover Institution, Humanities (Special Programs), Philosophy, Political Science, Senior Colloquia, Social Sciences (Special Program).

BEHAVIORAL SCIENCES
(HONORS PROGRAM in QUANTITATIVE METHODS)

Committee in Charge: Patrick Suppes (Chairman), Kenneth J. Arrow, Gordon Bower, Bernard P. Cohen, Herbert Solomon

GENERAL STATEMENT OF PURPOSE

The Honors Program in Quantitative Methods is designed to supplement the curricula of able students in the behavioral sciences with an integrated program of quantitatively oriented work. It is intended that students participating in the Program will acquire a firm mastery of certain mathematical tools and also become familiar with substantive theoretical developments in the behavioral sciences which require mathematical methods.

ADMISSION TO THE PROGRAM

A University average of B is required for admission to, and continuation in, the Program. Because many of the courses require specific mathematical background, candidates are urged to apply for admission not later than their sophomore year. Any member of the Committee may be consulted on admission. Information may also be obtained from the Program secretary in Ventura Hall.

REQUIREMENTS OF THE PROGRAM

1. The Honors Program supplements rather than replaces a regular departmental major. Consequently a major in one of the following seven participating departments is required: Communication, Economics, Mathematics, Philosophy, Psychology, Sociology, and Statistics. It is possible to combine this Honors Program with departmental honors programs.

   2. The following required courses totaling approximately 45 units in addition to the elementary calculus sequence are listed ac-
according to the year in which it is recommended they be taken. Students majoring in mathematics or statistics will be required to take a somewhat different list of courses.

First Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 41, 62, 63. Differential and integral calculus</td>
<td>5, 5, 5</td>
<td></td>
</tr>
<tr>
<td>(The sequences 41, 42, 43, or 10, 11, 21, 22, 23 are also acceptable.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philosophy 3. Introduction to Logic</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Second Year

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 64. Partial derivatives, multiple integrals, infinite series</td>
<td>3</td>
</tr>
<tr>
<td>Course in Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 50, Psychology 60, or Economics 7</td>
<td>5</td>
</tr>
</tbody>
</table>

Third Year

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics 116. Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>Statistics 119. Statistical Inference</td>
<td>3</td>
</tr>
</tbody>
</table>

Fourth Year

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 104, or Behavioral Sciences 199. Senior Thesis in Quantitative Methods</td>
<td>5</td>
</tr>
<tr>
<td>Three of the following:</td>
<td></td>
</tr>
<tr>
<td>Economics 272. Econometrics I</td>
<td></td>
</tr>
<tr>
<td>Mathematics 115. Fundamental Concepts of Analysis</td>
<td></td>
</tr>
<tr>
<td>Mathematics 116. Fundamental Concepts of Analysis</td>
<td></td>
</tr>
<tr>
<td>Mathematics 120. Modern Algebra</td>
<td></td>
</tr>
<tr>
<td>Mathematics 130. Ordinary Differential Equations</td>
<td></td>
</tr>
<tr>
<td>Mathematics 131. Partial Differential Equations I</td>
<td></td>
</tr>
<tr>
<td>Mathematics 132. Partial Differential Equations II</td>
<td></td>
</tr>
<tr>
<td>Mathematics 137. Numerical Analysis</td>
<td></td>
</tr>
<tr>
<td>Philosophy 161. Introduction to Set Theory</td>
<td></td>
</tr>
<tr>
<td>Statistics 217a. Introduction to Stochastic Processes</td>
<td></td>
</tr>
<tr>
<td>Statistics 217b. Introduction to Stochastic Processes</td>
<td></td>
</tr>
<tr>
<td>Statistics 221. Analysis of Variance</td>
<td>5</td>
</tr>
</tbody>
</table>

3. The Senior Thesis will be written under supervision of a designated faculty adviser. It may properly be concerned with empirical or experimental problems whose investigation requires use of mathematical techniques. The Thesis may be written as part of a Departmental Honors Program.

4. Each student will be required to take three courses designated by the department in which he is majoring. In general these three courses will exemplify the application of mathematics to the student’s major subject.

3. The Senior Thesis will be written under supervision of a designated faculty adviser. It may properly be concerned with empirical or experimental problems whose investigation requires use of mathematical techniques. The Thesis may be written as part of a Departmental Honors Program.

3. The Senior Thesis will be written under supervision of a designated faculty adviser. It may properly be concerned with empirical or experimental problems whose investigation requires use of mathematical techniques. The Thesis may be written as part of a Departmental Honors Program.
search, and the opportunities for financial aid available to graduate students. Interested students may also wish to consult the departments of Genetics, Medical Microbiology, Anatomy, Physiology, Biochemistry, Pharmacology, the Neurological Sciences program and the Biophysics Laboratory, all of which also conduct graduate programs.

**PROGRAMS OF STUDY**

**BACHELOR OF ARTS**

Candidates for the degree of Bachelor of Arts must complete: (1) a group of specified core courses in biology or their equivalents, and (2) sufficient units of elective courses in the biological sciences or closely related fields to make, when added to the units taken in the core curriculum, a total of 40 units. Elective courses may be selected from the offerings in the Department of Biological Sciences or from a list of courses in other departments (see Note 1 below). Students are expected to decide upon, in consultation with their Departmental adviser, a program of specialization in biology and to select elective courses which fit meaningfully into this program. Courses included under "1" and "2" must be completed with an average grade of not less than C.

**Required Core Courses in Biology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Fundamentals of Biology</td>
<td>5</td>
</tr>
<tr>
<td>11. Plants as Organisms</td>
<td>5</td>
</tr>
<tr>
<td>12. Animals as Organisms</td>
<td>5</td>
</tr>
<tr>
<td>113. Molecular Biology</td>
<td>3 or 6</td>
</tr>
<tr>
<td>114. Cell Physiology</td>
<td>5</td>
</tr>
<tr>
<td>115. Population Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

Students majoring in Biological Sciences will ordinarily take Biology 10 during their sophomore year after having completed Chemistry 1, 2, and 3 during their freshman year.

**Required Courses in Cognate Fields**

- A year (three quarters) of General Chemistry
- A half year (two quarters) of Organic Chemistry
- A year (three 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 1, 2, and 3, or 4 and 5; Chemistry 121 and 123, or 120; Physics 21, 23, and 29; Mathematics 10, 11, 21, 22, and 23, or 41, 42, and 43. It is strongly recommended that students majoring in the Department of Biological Sciences complete one year of a modern European language, preferably German.

**Typical Schedule for a Four-Year Minimum Program**

**First Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 1, 2, 3. General Chemistry</td>
<td>4 4 5</td>
</tr>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>3 3 3</td>
</tr>
<tr>
<td>History 1, 2, 3. Western Civilization</td>
<td>4 4 4</td>
</tr>
<tr>
<td>Math. 10, 11, 21. Analytic Geometry and Calculus</td>
<td>3 3 3</td>
</tr>
<tr>
<td>Group Activities</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 10. Fundamentals of Biology</td>
<td>5 — —</td>
</tr>
<tr>
<td>Biology 11. Plants as Organisms</td>
<td>— 5 —</td>
</tr>
<tr>
<td>Biology 12. Animals as Organisms</td>
<td>— — 5</td>
</tr>
<tr>
<td>Chem. 121, 123. Organic Chemistry</td>
<td>3 3 —</td>
</tr>
<tr>
<td>Math. 22, 23. Analytic Geometry and Calculus</td>
<td>3 3 —</td>
</tr>
<tr>
<td>German 1, 2, 3. Introductory German</td>
<td>4 4 4</td>
</tr>
<tr>
<td>Social Science</td>
<td>— — 5</td>
</tr>
<tr>
<td>Electives (See Note 1)</td>
<td>— — 3</td>
</tr>
<tr>
<td>Group Activities</td>
<td>0 0 0</td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 113. Molecular Biology</td>
<td>— — 6(3)</td>
</tr>
<tr>
<td>Biology 114. Cell Physiology</td>
<td>— 5 —</td>
</tr>
<tr>
<td>Biology 115. Population Biology</td>
<td>3 — —</td>
</tr>
<tr>
<td>Physics 21, 23, 29. Introductory Physics</td>
<td>4 4 4</td>
</tr>
<tr>
<td>Humanities</td>
<td>4 4 5</td>
</tr>
<tr>
<td>Social Science</td>
<td>— — 5</td>
</tr>
<tr>
<td>Electives (See Note 1)</td>
<td>3 3 —</td>
</tr>
</tbody>
</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electives (See Note 1)</td>
<td>15 15 15</td>
</tr>
</tbody>
</table>

**Note 1.** Elective courses may be chosen from those offered by the Department of Biological Sciences or by other departments of the University. Courses offered by other departments which may be of interest to biology majors include: Geology 2, 115; Anatomy 112, 121, 122, 209; Biophysics 200, 220; Obstetrics and Gynecology 401; Pathology 210; Biochemistry 101—102, 102a, 211; Genetics 201, 301, 306; Medical Microbiology 101; Pharmacology 213; Psychology 148.
**Senior Honors Program**

(See Biology 198 under "Courses.") This program is open to students of superior scholarship (overall grade average of B or better) and of outstanding interest and ability in biology. The aim of the program is to aid superior students in gaining greater 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 will lead to graduation "With Departmental Honors."

**Premedical Students**

It is recommended that premedical students who are not biology majors take at least the following courses in biology: 10, 11, 12, and 116. For specific requirements of various medical schools, consult departmental advisers.

**Predental Students**

The Council on Dental Education has fixed as the minimum basis for admission to an approved dental school the successful completion of two full academic years of work in an accredited college of liberal arts and science. The college course must include at least a year's credit in English, in biology, in physics, and in inorganic chemistry, and a half-year's credit in organic chemistry. All courses in science should include both class and laboratory instruction.

The predental requirement in biology may be fulfilled by taking either Biology 4 and 5, or Biology 10, 11, and 12.

**The Teacher's Recommendation**

Programs are provided for candidates seeking either (a) the Standard Teaching Credential (Secondary) with a teaching major or a teaching minor in biology, or (b) the Junior College Credential. Candidates holding the A.B. degree may satisfy the requirements for a General Secondary Credential by completing approved courses of study in biology and education in a minimum of three quarters of graduate study. Candidates who hold the degree of Master of Arts or Doctor of Philosophy may qualify for a Junior College Credential in Biological Sciences with a teaching major or minor in biological sciences, botany, or zoology. In satisfying the requirements for a teaching credential the candidate may offer units transferred from other institutions, but at least one course of advanced character should be taken in this Department. For the details of these programs the prospective candidate should consult the statement on credentials in the section "School of Education" in this *Bulletin*, his adviser in the Department of Biological Sciences, and the Credential Secretary in the School of Education.

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular 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. Detailed requirements for the course are outlined in the School of Education section.

**Advanced Study and Research**

Advanced courses and research are offered to qualified students in the various biological disciplines represented on the campus and at the Hopkins Marine Station by members of the Departmental faculty. Information concerning these research areas, and facilities and financial aid available to graduate students, will be found in the brochure, *Graduate Study in the Biological Sciences at Stanford University* (available upon request to 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, Medical Microbiology, Pharmacology, Anatomy, Biochemistry, Neurological Sciences, Biophysics Laboratory. Students interested in these areas should contact the appropriate department, or should specify that their inquiries or applications to this Department may be routed to others if desirable.

All applications for admission to graduate status in Biological Sciences will be acted upon at one time each year, during March, for admission in September (or June). Applications and supporting materials are due in the Admissions Office not later than March 1.

**Advanced Degrees**

A student who has fulfilled the requirements for the degree of Bachelor of Arts, or
their approximate equivalent as determined by the Department, may apply for admission to the Graduate Division. An applicant must file a report of his scores (aptitude and advanced biology) on the Graduate Record Examination as part of his application. This examination may be taken at most American colleges (see your Registrar for further information).

Before admission to candidacy for an advanced degree a prospective candidate must conform to the regulations of the Department as stated below and of the University as outlined in the section “Degrees” in this Bulletin.

Students who have had their undergraduate training in biology at Stanford are ordinarily encouraged to undertake graduate study elsewhere to insure breadth of experience. If a Stanford undergraduate does wish to seek readmission as a graduate student in Biological Sciences, he should provide the Department with the same completed application forms, recommendations, and transcripts that are required of applicants from outside the University. Printed information regarding choice of a graduate school can be obtained from the Departmental secretary.

Doctor of Philosophy

Preparation for graduate study—It is expected that students seeking entrance to graduate study in biology ordinarily will have the equivalent of an undergraduate major in biology at Stanford (see above). It is recognized, however, that students trained in zoology or botany departments, or who may wish to concentrate on biological problems after undergraduate training in another science, may require special consideration. 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 wherever possible preparation for graduate work include courses in chemistry through organic chemistry, general physics, mathematics through calculus, and foreign languages (preferably German and French, at least 2 years).

The Master’s degree is not required in order to proceed for a doctorate, although it may be recommended in specific cases.

Courses required of all Ph.D. candidates—Beyond the background requirement stipulated above, each student must take in graduate standing at Stanford: (a) A minimum of 15 units of advanced biology courses (belong Biology 115 and exclusive of special problems and research courses) of which 10 units should be in areas other than the field of specialization and fields closely allied to it; (b) Specific course training in the field of specialization, determined in each individual case by the needs of the student, in consultation with his research adviser and sponsor.

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 during the fourth quarter of registration as a graduate student. The qualifying examination is given once a year near the end 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.

Graduate Seminars, devoted to the discussion of current literature and research in particular fields of biology, are an important means of attaining professional perspective and competence.

Language Examinations—Proficiency in reading scientific literature in two foreign languages, normally German and French. The reading examinations must be taken by the end of the second year of residence.

Dissertation—“A contribution to knowledge and the result of independent work, expressed in satisfactory form.” Abstracts of Ph.D. theses are published in Dissertation Abstracts.

The Oral Examination—Normally a three-hour examination, taken when the dissertation is at or near completion, the oral examination is conducted by a committee composed of members of the Department and others appointed by the Chairman of the University Committee on the Graduate Division. A candidate is expected to demonstrate a knowledge of the factual basis and
theoretical implications of his thesis and an adequate mastery of his field of research. He must also show a grasp of the fundamental principles of biology and be able to show how these apply to his field of specialization. More detailed information concerning the oral examination and thesis will be found in the section “Degrees” in this Bulletin. Additional information and a suggested schedule for completion of requirements may be obtained from the secretary of the Department.

Minor for the Degree of Doctor of Philosophy—The minor requirement in Biology is fulfilled by the completion of the Departmental course requirements for the Ph.D. degree with a B average, or the successful passing of the Departmental Qualifying Examination.

MASTER OF ARTS

Students are not normally admitted to the Department for a terminal Master of Arts degree in the Biological Sciences. Students who wish to qualify for this degree will be informed of the requirements on request to the Executive Head of the Department.

COMBINED SCHOLARSHIP AND TEACHING ASSISTANTSHIP PROGRAM

Qualified graduate students who wish to combine graduate study with part-time teaching may apply for a teaching assistantship carrying a stipend of $2,100 annually plus a tax-free grant to cover the cost of tuition and fees for the half-time course load a teaching assistant may carry. Scholarships of approximately $300 to $500 will also be available as awards to a limited number of teaching assistants in addition to the stipend and tuition grant so that the total award normally has a value of $3,500.

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. Before completing his degree, each student may be called upon to assist part-time in laboratory instruction for 2 or 3 academic quarters.

The Department of Biological Sciences makes the majority of the teaching assistantship awards on or before April 1 for the coming year, and for these awards, and for half-tuition scholarships to accompany them, application forms (Application for Fellowship, Scholarship, or Assistantship) should be submitted to the Office of Admissions not later than March 1. However, assistantships occasionally become vacant at other times of the year, and graduate students who desire to be considered for such vacancies may apply at a later date by completing the regular forms and in addition addressing a letter of application to the Executive Head of the Department.

Predoctoral Fellowships — Qualified applicants are urged to take the initiative in applying for predoctoral fellowships from the National Science Foundation and the U.S. Public Health Service (Forms and information: National Science Foundation Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D.C. Deadline: Early January. Research Fellowships Branch, Division of Research Grants, National Institutes of Health, Bethesda, Maryland 20014. No deadline, but 3 to 4 months required between application and decision). These attractive awards provide full tuition and generous stipends. Application may be made by college seniors planning to work for a higher degree after graduation, as well as by students at any level of graduate work. Competition is with other applicants at the same level of advancement.

Application for these fellowships does not preclude application for a teaching assistantship at Stanford; if both are granted one may be declined in favor of the other.

Biology Seminar

The Biology Seminar meets on 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 University calendar. Students are urged to attend.

Courses

The letter “h” following a number indicates that the course is given at the Hopkins Marine Station.

#4, 5. General Biology—Functional mechanisms in microorganisms, plants, and ani-
mals; major biological concepts, including historical development, logical or experimental bases.

Primarily for students who do not intend to major in biology, but may serve as a prerequisite to Biology 11 and subsequent courses leading to fulfillment of degree or premedical requirements. Lectures, laboratory, demonstrations. Enrollment only by signing class lists.

4. 4 units, Aut (Regnery, Baxter) MWF 8; lab. (I) T 9-12, (II) T 2:15-5:05, (III) W 2:15-5:05, (IV) Th 9-12, (V) Th 2:15-5:05

5. 4 units, Win (Regnery, Baxter) MWF 8; lab. (I) T 9-12, (II) T 2:15-5:05, (III) W 2:15-5:05, (IV) Th 9-12, (V) Th 2:15-5:05

10. Fundamentals of Biology — A concentrated introduction to biology for those intending to major in the subject and to take Biology 11-115. Emphasis on fundamental facts, concepts and questions which underlie later, more detailed, consideration in the core curriculum. Readings, lectures, and discussion-demonstrations. Prerequisites: Chemistry 1, 2, and 3.


11. Plants as Organisms — Structure and functions of plants at the organism level. Prerequisite: 10.

5 units, Win (Page) MWF 8; lab. (I) TTh 9-12, (II) TTh 2:15-5:05, (III) WF 2:15-5:05

12. Animals as Organisms — Basic functions of organisms as carried on by animals. Prerequisite: 11.

5 units, Spr (Oliphant, Wessells, Kennedy) MWF 9; lab. (I) TTh 1:15-4:05, (II) WF 1:15-4:05

100h. Marine Algae — Lectures, laboratory, field work on various classes of algae. Open to elementary students.

5 units, Sum (first term) (I. Abbott, ———) TThS

101h. Natural History of Marine Animals — Lectures, laboratory, field work stressing adaptive adjustments of marine animals. Prerequisite: general biology or zoology (or concurrent registration in 111h).

5 units, Sum (second term) (——) MWF

103. Comparative Histology — Microscopic structure of animal tissues; special reference to vertebrates. Prerequisite: 12.

3 units, Aut (Oliphant) TTh 10; lab. Th 1:15-4:05

105. Immunobiology — Principles of immunology as related to certain problems in biology.

2 units, Spr (Regnery) TTh 10, alternate years, given 1966-67

111h. Marine Invertebrates — Structure, classification, biology, phylogeny of lower marine invertebrates, echinoderms, protochordates. Prerequisite: an elementary zoology course.

5 units, Sum (first term) (Abbott) TThS

112h. Marine Invertebrates — Continuation of 111h, covering mollusces, annelids, arthropods, allied minor phyla. While the two courses form a continuous sequence, either half may be taken separately. Prerequisite: elementary zoology, preferably also 111h.

5 units, Sum (second term) (Abbott) TThS

113a. Molecular Biology — The synthesis, function, interactions of the various molecular components of cells with emphasis on molecular genetics. Prerequisites: 114 and Organic Chemistry.

3 units, Spr (Woodward) MWF 11

113b. Molecular Biology Laboratory — By permission.

3 units, Spr (Woodward) by arrangement

114. Cell Physiology — Structure and function of plant and animal cells. Prerequisite: 112.

5 units, Win (Giese) MWF 9; lab. (I) TTh 1:15-4:05, (II) WF 1:15-4:05

115. Population Biology — Introduction to the properties of aggregations of organisms. Prerequisite: 10, 11, and 12.

3 units, Aut (Holm, Ehrlich, Raven) MWF 11

116. Biology of Vertebrates — Structure, function, development, evolution of vertebrates. Prerequisites: 10, 11, and 12.

3 or 5 units, Aut (Wessells) MWF 9; lab. (I) TTh 8-11, (II) TTh 1:15-4:05
124. Comparative Parasitology: Protozoa, Helminths — Principal attention to forms parasitic in man, animals, plants of importance in human economy.

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

128. Classification of Vascular Plants — Lectures, laboratory, field studies. Prerequisite: 11.

4 to 5 units, Spr (Thomas) WF 1:15; lab. WF 2:15-5:05; field trips by arrangement

129. Fungi — Prerequisite: 11.

4 units, Spr (Page) TTh 9; lab. TTh 10-12 and two hours by arrangement

130. The Plant Kingdom: Algae and Fungi — Structure, development, evolutionary relationships of algae, fungi. Lectures, laboratory, field trips. Prerequisite: 11.

4 units, Aut (Page) TTh 1; lab. TTh 2:15-5:05

131. The Plant Kingdom: Mosses and Ferns — Structure, development, evolutionary relationships of liverworts, mosses, the seedless vascular plants. Lectures, laboratory, field trips. Prerequisite: 11.

4 units, Win (Briggs) TTh 11; lab. TTh 2:15-5:05

132. The Plant Kingdom: Seed Plants — Structure, development, evolutionary relationships of seed plants. Lectures, laboratory, field trips. Prerequisite: 11.

5 units, Spr (Holm, Raven) MWF 11; lab. WF 2:15-5:05

136h. General Ichthyology — Fishes, including elements of morphology, taxonomy, embryology, natural history. Prerequisite: 12.

5 units, Sum (first term) (Epel) MWF

145. Laboratory Techniques in Embryology — Application of microsurgical, chemical, tissue culture procedures to developmental problems. Prerequisites: 116 and permission of instructor.

3 units, Win (Wessells) TTh 1:15-5:05

147h. Comparative Embryology — A lecture and laboratory course surveying developmental patterns, and their experimental modifications, in marine plants and animals. Representatives of the algae, lower invertebrates, molluscs, echinoderms, protochordates, and fishes will be studied. Prerequisites: Two courses in biology and one course in biochemistry or organic chemistry.

5 units, Sum (second term) (Epel) MWF

150. Evolution and Human Affairs — A synthesis of evolutionary thought with emphasis on the implications for man. Prerequisite: a course in general biology. No credit will be given for 150 following 115.

3 units, Win (Ehrlich, Holm) MWF

151. Evolutionary Genetics — Application of genetics to study of evolution.

2 units, Spr (Regnery) TTh, alternate years, given 1967-68

153. The Physiological Basis of Behavior — Properties of neurons and synapses and their relation to integrative processes; sense organs as transducers; information processing in sensory systems; organization of reflexes, and the neural analysis of more complex behavior. Prerequisite: 12.

3 units, Win (Kennedy) MWF 8

156. Introductory Plant Physiology — Principal functions of organs of higher plants; growth, mineral nutrition, water relations, movement of materials, respiration, nitrogen relations, photosynthesis. Prerequisite: 114.

5 units, Spr (Briggs) MWF 9; lab. WF 2:15-5:05

160. Advanced Population Biology — Inter-
actions of individuals and populations. Prerequisite: 115.

3 units, Spr (Raven, Ehrlich, Holm) MWF 11

164h. Physiology of Algae.
3 units, Sum (second term) (Blinks) TThS

170. Readings in Paleobotany—Structure, evolutionary relationships of fossil plants. Prerequisites: 11, 131, 132, and permission of instructor.
(Holm) by arrangement

2 units, Spr (Leviton, Myers) alternate years, given 1967–68

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: 11 and 12; and Chemistry 1, 2, and 3; and permission of the instructors.
15 units, Spr (Abbott, Epel, Phillips) TWThFS

4 units, Aut (Ehrlich) by arrangement

198. Senior Honors Program—Readings or research in some phase of biology of especial interest to the individual. Satisfactory completion leads to Departmental recommendation for graduation with honors in biology. Open only to seniors (or students in the last quarter of their junior year) who have maintained an overall average grade of B or better. Not more than six units of honors work may be applied toward the units of electives required for graduation in biology.
(Staff) by arrangement

199. Special Problems.
(Staff) by arrangement

199h. Special Problems.
(Hopkins Marine Station Staff) by arrangement

212. Evolution of the Flowering Plants — Phylogenetic relationships of angiosperms. Prerequisite: 11.
3 units, Win (Raven) MWF 10, alternate years, given 1967–68

215. Biosystematics — Current methods of approach to systematic problems in higher plants. Prerequisites: 11, and permission of the instructor.
4 units, Win (Raven) by arrangement, alternate years, given 1966–67

222h. Biological Oceanography—Intensive lecture, field, and laboratory course dealing with marine organisms and their environment. The work is done on board ship in oceanic regions that vary from quarter to quarter. Open only to graduate students by arrangement with the Chief Scientist through correspondence.
15 units, Aut, Win, Spr, Sum (Bolin, ——) by arrangement

230. Advanced Systematic Ichthyology I—Intensive lecture, laboratory course extending through two quarters. Open only to especially qualified advanced students upon permission of instructor.
4 units, Aut (Myers) by arrangement, alternate years, given 1967–68

231. Advanced Systematic Ichthyology II—Continuation of 230.
4 units, Win (Myers) by arrangement, alternate years, given 1967–68

244. Plant Growth and Development—Morphological, physiological aspects of plant growth. Prerequisite: 156.
2 units, Aut (Briggs) TTh 9

247. Advanced Cell Physiology — Discussion of a selected topic. Prerequisite: 114. By permission. May be repeated for credit.
2 units, Aut (Giese) M 1:15–3:05

248. Genetic Recombination—Emphasis on meiotic recombination and chromosome organization in higher microorganisms. Prerequisite: a knowledge of general genetics.
2 units, Aut (Perkins) M 2:15–4:05

249. Cytogenetics—(Same as Genetics 249.) Principles and modern methods of analysis of major cellular components. The structure and design of chromosomes from bacteriophages to higher organisms. The influence of chromosomal changes in development and evolution. Prerequisites: 4 and 5, or 10.
11 and 12, a knowledge of genetics, and permission of instructor.

3 units, Aut (Ganesan) MWF 10

250. Molecular Biophysics — A survey of physical approaches to biological problems at the molecular level. Lectures include discussion of intra- and inter-molecular forces and their relation to biological structure, physical methods for characterizing macromolecules, the interaction of electromagnetic radiation with biological molecules, isotopic tracer techniques, and classical physics of cellular processes. Assigned readings and problems. Prerequisites: Biology 10, Chemistry 121, and Physics 57, or permission of instructor.

3 units, Aut (Hanawalt) TTh 10 and T 7:15 p.m.


3 units, Spr (Yanofsky) TTh 9

260. Topics in Population Biology—Readings and discussions on research of current or special interest. Prerequisites: 115 and 160 and permission of instructors. May be repeated for credit.

1 unit (Ehrlich, Holm, Raven) by arrangement

261h. Comparative Biochemistry of Marine Organisms—Prerequisites: elementary biology and organic chemistry.

5 units, Sum (first term) (Phillips) MWF

269h. Ecological Physiology—Physiological responses of animals to variation in environmental factors and to organisms. Most work will deal with marine invertebrates. Prerequisites: general zoology and elementary chemistry.

5 units, Sum (first term) (Giese) TThS


3 units, Spr (Ehrlich) by arrangement

300. Research.

(Staff) by arrangement

300h. Research.

(Hopkins Marine Station Staff) by arrangement

350. Graduate Seminars.

(Staff) by arrangement

See also Senior Colloquia.

**DIVISION OF MARINE BIOLOGY AND OCEANOGRAPHY, HOPKINS MARINE STATION**

**Emeriti:** Lawrence R. Blinks, Rolf L. Bolin, Cornelis B. van Neil (Professors)

**Director:** John H. Phillips

**Assistant Director:** Donald P. Abbott

**Professors:** Donald P. Abbott, Arthur C. Giese

**Assistant Professor:** David Epel

**Research Biologist:** 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, with complete control of the coast line of the Point and including a sheltered landing place and storage for small boats. Buildings include the "Marinostat," the Alexander Agassiz Laboratory and the Jacques Loeb Laboratory. The library is especially endowed, and subscribes to about fifty journals. Its collections are particularly good in marine biology, oceanography, and microbiology.

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.

Candidates for admission should make application to the Director, Hopkins Marine Station, Pacific Grove, California 93950. The application should state whether admission to the advanced undergraduate or graduate level as a matriculated student is desired; or whether the student wishes to register on the nonmatriculated basis (available in summer quarter only, except for course 222h). Applications from students wishing to register for summer classes should be sent in not later than March. Later applicants may find some classes filled.

**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.
15 units, Spr (Abbott, Phillips, Epel)
TTHFS

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

222h. Biological Oceanography.
15 units, Aut, Win, Spr, Sum (Bolin, ——, ——) by advance arrangement only

300h. Research—Problems involving original work may be undertaken with members of the staff in the following fields:

Marine Zoology — Problems connected with anatomy, taxonomy, natural history of oceanic invertebrates. Invertebrate ecology.
(Abbott)

Marine Fishes — Morphology, taxonomy, embryology, ecology of marine fishes.
(Bolin)

Physiology — Problems on physiology of invertebrate animals; photobiology, especially effects of ultraviolet light.
(Giese)

Comparative Biochemistry and Immunology—As exemplified in marine animals.
(Phillips)

Comparative Embryology.
(Epel)

SUMMER QUARTER COURSES

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 five-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 ten units in each term, but registration for more than fifteen units in the full quarter is not ordinarily advisable, owing to the intensive schedule.

For detailed descriptions of courses, see listings above under Biological Sciences; also the Hopkins Marine Station Bulletin (issued in March).

First Term

100h. Marine Algae.
5 units (Abbott, ——) TThS

111h. Marine Invertebrates.
5 units (Abbott) TThS

147h. Comparative Embryology.
5 units (Epel) MWF

199h. Special Problems—(See autumn, winter, spring quarters, above.)
(Staff) by arrangement

222h. Biological Oceanography — (See above.)

261h. Comparative Biochemistry of Marine Organisms.
5 units (Phillips) MWF

289h. Ecological Physiology.
5 units (Giese) TThS

300h. Research — (See autumn, winter, spring quarters, above.)
(Staff) by arrangement

Second Term

101h. Natural History of Marine Animals.
5 units (——) MWF

112h. Marine Invertebrates—Continuation of 111h.
5 units (Abbott) TThS

136h. General Ichthyology.
5 units (——) MWF

148h. Comparative Embryology.
5 units (Epel) MWF

164h. Physiology of Algae.
5 units (Blinks) TThS

199h. Special Problems — (See under First Term.)
(Staff) by arrangement

222h. Biological Oceanography — (See above.)

300h. Research—(See under First Term.)
(Staff) by arrangement
DIVISION OF SYSTEMATIC BIOLOGY

Emeriti: Roxana S. Ferris (Curator), Willis H. Rich, Ira L. Wiggins (Professors)
Director: Richard W. Holm
Professors: Richard W. Holm, George S. Myers
Associate Professor: Paul R. Ehrlich
Assistant Professor: Peter H. Raven
Curators: Paul R. Ehrlich (Entomological Collections), George S. Myers (Zoological Collections), John H. Thomas (Dudley Herbarium)
Assistant Curator: Warren C. Freihofer (Zoological Collections)
Research Associates: S. Stillman Berry (Malacology), Walter C. Brown (Herpetology)

The Division of Systematic Biology has for its general purpose the maintenance of provisions (1) for proper housing and care of the systematic collections of animals and plants, and (2) for instruction, investigation, and research in systematics, geographical distribution, and ecology. It is housed in the west wing of the Museum Building, where instruction and research utilizing the collections are conducted. Facilities are available for a limited number of graduate students and qualified investigators.

Advanced courses and research leading to the degree of Doctor of Philosophy, in compliance with University and Department of Biological Sciences requirements, are offered in the following fields: (a) botany (morphology, distribution, and taxonomy of vascular plants); (b) zoology (ichthyology and herpetology, including taxonomy, morphology, ecology, and distribution); and (c) population biology.

DUDLEY HERBARIUM

The Dudley Herbarium, named in honor of Professor William Russel Dudley, is especially rich in material from western North America and offers unusual facilities for critical systematic and distributional studies of the floras of that region. The Harvey Herbarium, comprising about 65,000 sheets, and the herbarium of the late Dr. Herman Knoche, containing over 125,000 sheets, furnish authentic material from Europe and the Mediterranean region. They contain many historical, frequently cited specimens and are of great value to investigators studying plants recently introduced into North America or those closely related to Old World species. The collections of the Dudley Herbarium now number about 700,000 sheets.

ENTOMOLOGICAL COLLECTIONS

The entomological collections are restricted to those being used in particular research projects. No general collections are maintained except for teaching purposes.

ZOOLOGICAL COLLECTIONS

The collection of fishes is one of the largest and most important in the world, its basis being the material collected by Dr. David Starr Jordan, his associates, and his students. The marine and fresh water fishes of both eastern and western North America, the West Indies, Central America, Japan, eastern China, the Philippines, the Malay Peninsula, Hawaii, and Polynesia are well represented. In addition, there are large bathyal collections from the North Pacific and other parts of the world, as well as extensive series of fishes of Peru, Colombia, the Galapagos Islands, Venezuela, British Guiana, the Amazon, Cameroon, South and East Africa, India, the Malay Archipelago, and Australia.

The herpetological collections contain an extensive representation of the amphibians and reptiles of the West and considerable material from southeastern Asia and tropical America.

CHEMISTRY

Emeriti: Philip A. Leighton, J. Murray Luck, John P. Mitchell, Carl R. Noller, George S. Parks (Professors)
Executive Head: William S. Johnson
Associate Executive Head: Douglas A. Skoog
Professors: Claudio Alvarez-Tostado, William A. Bonner, Carl Djerassi, Richard H. Eastman, Paul J. Flory, Eric Hutchinson, William S. Johnson, Frederick O. Koenig, Hubert S. Loring, Harden M. McConnell,

* The curriculum leading to the B.S. degree in Chemical Engineering is described elsewhere in this Bulletin.
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 to the American Chemical Society or to the B.S. degree with Honors.

Students who have taken the College Board Advanced Placement Examination in Chemistry and receive a composite score of 4 will be excused from Chemistry 1 and 2, or from Chemistry 4. Those receiving composite scores of 5 may be excused from Chemistry 3 or 5 on the recommendation of the Committee on Undergraduate Study.

PROGRAMS OF STUDY

MINIMUM REQUIREMENTS FOR THE BACHELOR OF SCIENCE DEGREE

General studies requirement; the equivalent of 18 units of German, or 12 units of German and 12 units of either French or Russian; Mathematics 10, 11, 21, 22, 23, or 41, 42, 43; Physics 51, 52, 53, 54, 55, 56, 57; Chemistry 1, 2, 3, or 4, 5; 112, 113, 116, 121, 122, 123, 124, 125, 171, 173, 175, 176. In addition Chemistry 177 is strongly recommended. Students may petition the Department to substitute Physics 21, 23, 29 for Physics 51–57. All candidates for graduation with chemistry as the major subject are required to have a grade point average of at least 2.00 in their chemistry courses.

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, Chemistry 126, 177, and 180, and at least three units from one of the following: Chemistry 138, 139, 178, 179, 190; 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.

HONORS PROGRAM

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 point average of at least 3.00 in all course work in the University and of 3.30 in courses in chemistry, physics, and mathematics. In addition to the minimum requirements for the B.S. degree, the student must complete Chemistry 177, 178 or 179, and nine units of Chemistry 190 to be taken three units per quarter for three quarters; 3 or 4 units from Chemistry 126, 179 or 178, 180, 221, 223, 225, 233, 235, 246, 247, 272; and nine additional units of courses from the above list or from 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 MINIMUM PROGRAM

<table>
<thead>
<tr>
<th>First Year</th>
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</thead>
<tbody>
<tr>
<td>Course No.</td>
</tr>
<tr>
<td>Chem. 1, 2, 3</td>
</tr>
<tr>
<td>English 1, 2, 3</td>
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<tr>
<td>German 1, 2, 3</td>
</tr>
<tr>
<td>Math. 10, 11, 21</td>
</tr>
<tr>
<td>Group Activities</td>
</tr>
<tr>
<td>Totals</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>Chem. 121, 123, 125. Organic Chemistry</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 122, 124. Organic Preparations</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>German 22, 23. Second-Year Reading</td>
<td>3</td>
<td>3</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Math. 22, 23. Analytic Geometry and Calculus</td>
<td>3</td>
<td>3</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54. Mechanics, Sound, Electricity</td>
<td>—</td>
<td>5</td>
<td>5</td>
<td></td>
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<tr>
<td>Social Science</td>
<td>5</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Electives (See Note 1)</td>
<td>—</td>
<td>4</td>
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<tr>
<td>Group Activities</td>
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Totals .................................. 14 17 15

Third Year

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<thead>
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<th>Subject</th>
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</thead>
<tbody>
<tr>
<td>Chem. 112, 113. Quantitative Analysis</td>
<td>5</td>
<td>—</td>
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<tr>
<td>Chem. 116. Instrumental Analysis</td>
<td>—</td>
<td>4</td>
<td>—</td>
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<tr>
<td>Chem. 171, 173, 175. Physical Chemistry</td>
<td>3</td>
<td>3</td>
<td>3</td>
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</tr>
<tr>
<td>Chem. 176. Physical Chemistry Laboratory</td>
<td>—</td>
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<td>3</td>
<td></td>
</tr>
<tr>
<td>History 1, 2, 3. Western Civilization</td>
<td>4</td>
<td>4</td>
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</tr>
<tr>
<td>Physics 55, 56, 57. Light, Heat, Atomic Physics</td>
<td>5</td>
<td>3</td>
<td>—</td>
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</tr>
<tr>
<td>Social Science</td>
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</tr>
<tr>
<td>Electives (See Note 1)</td>
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Totals .................................. 17 16 15

Fourth Year

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<tr>
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</thead>
<tbody>
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<td>Humanities</td>
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</tr>
<tr>
<td>Electives (See Note 1)</td>
<td>11</td>
<td>11</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

Totals .................................. 15 15 15

Note 1.—Elective courses may be chosen from any offered by the Chemistry Department or by other departments of the University. Courses offered by other departments that may be of particular interest to chemistry majors include: Ch.E. 10, 130a, 130b, 150, 204; Economics 1; English 102; Mathematics 44, 130, 131, 132; Physics 61, 110, 111, 140; Statistics 110; Geology 1, 25; Engr. 50; Min.E. 105; Mat.Sci. 107; Microbiology 101; Biology 11, 12, 116; Biochem. 101, 102.

Teaching Credentials

The requirements for certification to teach chemistry in the secondary schools and junior colleges of California may be ascertained by consulting the section on credentials under “School of Education” in this Bulletin and the Credential Secretary of the School of Education.

ADVANCED DEGREES IN CHEMISTRY

General Requirements

Qualifying examinations are given prior to the first week of the autumn quarter. Each new graduate student must take these examinations on entrance. Satisfactory performance is required for permission to continue work for an advanced degree. Thesis research may not be started until the candidate has passed the qualifying examinations. 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 point average of 3.00 for all chemistry lecture courses as well as for all courses taken during graduate study. All students are expected to give full time to their graduate work once they have begun research. 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

For all students other than those majoring in chemical physics, these examinations will consist of four written examinations 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, except that the examination in physical chemistry will cover only the material described under Chemistry 171, 173, 175, 176. Students who fail to pass these examinations in the autumn will be permitted to repeat them during the first week of the winter quarter. All qualifying examinations will be given during the period September 23–24, 1966, and all must be taken at this time.

Students majoring in chemical physics are required to take two of the four qualifying examinations, namely that in physical chemistry and either that in inorganic or organic chemistry, and in addition thereto, a four-hour written examination in chemical physics. An entering student has only one opportunity to take the chemical physics examina-
tion, which will be given on September 23, 1966. Students who fail to pass the chemical physics examination may qualify for an advanced degree only if they can do so under the program described in the preceding paragraph.

**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, 233, 235, or 272.

**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 teachers with one or more years of experience and/or a regular teaching credential 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 21 units of advanced lecture courses. The foreign language requirement for the Ph.D. in chemistry ordinarily will be met in German and in French 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.

All students majoring in inorganic chemistry are required to take (1) Chemistry 177, 178, 179, and 180 (or be exempted therefrom by passing special examinations administered by the professors in charge of these courses); (2) three units of advanced lecture courses in inorganic chemistry; (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 take (1) Chemistry 126 or pass a laboratory proficiency test in qualitative organic analysis; (2) Chemistry 221, 223 and 225 during the first year, irrespective of background; those who fail to make a grade point average of at least 3.00 in these three courses may not become candidates for the Ph.D. degree in organic chemistry; (3) three units of Chemistry 227; (4) Chemistry 177 and 178 (or be exempted therefrom by passing special examinations administered by the professors in charge of these courses); (5) three units of advanced lecture courses outside of the field of organic chemistry. Beginning with the second year of graduate work at Stanford, organic chemistry majors are required to participate in a series of advanced problem sessions.

All students majoring in physical chemistry are required to take (1) Chemistry 177, 178, and 179 (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 point average of at least 3.00 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, 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 are required to take (1) Chemistry 126 or pass a laboratory proficiency test in qualitative organic analysis; (2) Biochemistry 101 and 102 (eight units) unless an equivalent course in general biochemistry was satisfactorily completed previously; (3) nine units of advanced biochemistry chosen from Chemistry 246, 247, Biochemistry 211, 212, 213, 217, or 218 or allied courses as approved by the Department of Chemistry, and (4) six units of advanced lecture courses in organic, inorganic,
or physical chemistry chosen from Chemistry 180, 221, 223, 225, and 272.

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 177, 178, 179 (or be exempted thereof by passing special examinations given by the professors in charge of these courses); (2) Chemistry 280a, 280b, 280c; (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 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. The University oral examination may not be taken during the summer quarter except after favorable action on a special petition filed not later than the third week of the spring quarter.

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 point average of 3.00 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, 233, 235, or 272.

Fellowships and Scholarships
In addition to the University fellowships and scholarships that are open to properly qualified students, there are at present numerous Departmental fellowships in chemistry. The Allied Chemical Corporation Fellowship, Continental Oil Company Fellowship, Dow Chemical Company Fellowship, Edward Curtis Franklin Fellowship, James W. McBain Memorial Fellowship, Stauffer Chemical Company Fellowship, and Frederick P. Whitaker Fellowship are granted only to graduate students. The William H. Nichols Scholarships, David L. and Lavinia E. Sloan Memorial Scholarship, John Maxon Stillman Scholarship, and Ephraim and Amelia Weiss Scholarships are open to graduates and undergraduates; the Robert M. and Katherine F. Loeser Scholarship and the Frank Card Scholarship are available to undergraduates only.

There also are numerous 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, loss of apparatus, chemicals, etc., are from $10 to $30 per quarter.

Undergraduate Courses

1. General Chemistry — Prerequisite: high school algebra or Mathematics O.
   4 units, Aut (Staff) lec. (I) MWF 8, (II) MWF 9; lab. (I) T 9-12, (II) T 2:15-5:05, (III) W 2:15-5:05, (IV) Th 9-12, (V) Th 2:15-5:05, (VI) F 2:15-5:05

2. General Chemistry—Continuation of 1.
   4 units, Win (Staff) lec. and lab. sections same as under Chemistry 1.

3. General Chemistry—Continuation of 2.
   5 units, Spr (Staff) lec. (I) MWF 8, (II) MWF 9; lab. (I) TTh 9-12, (II) TTh 2:15-5:05, (III) WF 2:15-5:05

4. General Chemistry—Primarily for engineering and science majors with good mathematical background. May not be taken without laboratory. Prerequisite: Mathematics 10 or 41 (may be taken concurrently).
   4 units, Aut (Staff) lec. MWF 8; lab. sections same as under Chemistry 1.
5. General Chemistry—Continuation of 4.  
4 units, Win (Staff) lec. MW F 8; lab. sections same as under Chemistry 1.

110. Quantitative Analysis — Primarily for premedical students. Not for Chemistry or Chemical Engineering majors. Concurrent registration in 111 required. Prerequisite: 3 or 5. It is recommended that 121 and 123 be completed previous to registration for 110.
2 units, Spr (Loring) TTh 11

111. Quantitative Analysis Laboratory — Concurrent registration in 110 required.
3 units, Spr (Loring) MW F 1:15–4:05 or TTh 1:15–4:05 and S 9–12

112. Quantitative Analysis—For Chemistry or Chemical Engineering majors. Concurrent registration in 113 required. Prerequisite: 3 or 5.
3 units, Aut (Skoog) MW F 10

113. Quantitative Analysis Laboratory — Concurrent registration in 112 required.
2 units, Aut (Skoog) MW F 1:15–4:05 or TTh 1:15–4:05

116. Instrumental Analysis — Theory and techniques of electrometric titrations, polarography, electrodeposition, spectrophotometry, refractometry, polarimetry, and chromatography. Prerequisites: 112, 113, 171, and previous or concurrent enrollment in both 173 and Physics 29 or 57.
4 units, Win (Simpson) lec. TTh 10; lab. TTh 1:15–4:05 or WF 1:15–4:05

120. Organic Chemistry — Aliphatic, aromatic compounds. For students other than Chemistry, or Chemical Engineering majors. Prerequisite: 3 or 5.
5 units, Sum (Staff) MT WTh FS 9

121. Organic Chemistry — Carbon compounds. Prerequisite: 3 or 5.
3 units, Aut (Bonner, Mosher) lec. (I) MW F 11, (II) TTh S 10

122. Organic Preparations — Laboratory course. Prerequisite: 120, or previous or concurrent enrollment in 123.
3 units, Win (Altman) MT 1:15–5:05 or WTh 1:15–5:05

123. Organic Chemistry — Continuation of 121.
3 units, Win (Bonner, Mosher) MW F 11

124. Organic Preparations — Continuation of 122.
3 units, Spr (Altman) MW F 1:15–4:05

125. Organic Chemistry — Continuation of 123.
3 units, Spr (Mosher) MW F 11

126. Qualitative Organic Analysis Laboratory—Prerequisites: 124 and 125.
4 units, Aut (Bonner) MW F 1:15–5:05

138. Nuclear Chemistry—Properties of nuclei and radioisotopes; nuclear reactions; fission, fusion, reactors, and accelerators; radiation detection and measurement; radiation safety; radiation chemistry, radiotracers, radioactivation analysis, and their applications. Prerequisites: 3 or 5, Mathematics 23, and Physics 57, or equivalent.
3 units, Win (Kruger) TTh 11

139. Radiochemistry Laboratory—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisite: 138 or consent of instructor.
3 units, Spr (Kruger) Th 1:15 and one lab. by arrangement

171. Physical Chemistry—Chemical thermodynamics: fundamental principles, Gibbian equations, equilibrium conditions, phase rule, systematic deduction of equations, gases, solutions. Prerequisites: 3 or 5, Mathematics 10, 11, 21 (or equivalent) and Physics 51, 52, 53, 54 and previous or concurrent registration in Physics 55 (or Physics 21, 23, 29 on petition).
3 units, Aut (Hutchinson) MW F 8

173. Physical Chemistry — Chemical thermodynamics (continued): electrochemical thermodynamics, especially the galvanic cell, conductance phenomena, colloid and surface chemistry. Prerequisite: 171.
3 units, Win (Hutchinson) MW F 8

175. Physical Chemistry — Chemical kinetics of homogeneous and heterogeneous reactions. Prerequisite: 173.
3 units, Spr (Boudart) MW F 8

176. Physical Chemistry Laboratory—Vacuum, temperature control, electronic, and optical techniques used in the measurement of enthalpy changes, viscosity, surface ten-
sion, vapor pressure, electronic and vibration-rotation molecular spectra, optical rotation, solution conductance, reaction rates, and X-ray crystal scattering. Prerequisites: 116 and previous or concurrent enrollment in Chemistry 175.

3 units, Spr (Pecora) lec. T 10;
lab. TTh 1:15-4:05 or WF 1:15-4:05

177. Physical Chemistry — Introduction to quantum mechanics. Prerequisites: 175 and Physics 29 or 57.

3 units, Aut (Harris) MWF 11

178. Physical Chemistry — Introduction to statistical mechanics. Prerequisite: 177.

3 units, Win (Pecora) MWF 11

179. Physical Chemistry — Introduction to molecular structure. Prerequisite: 177.

3 units, Spr (Simpson) MWF 11

180. Inorganic Chemistry — A systematic discussion of the chemistry of some of the nonmetallic elements, emphasizing the application of equilibrium, rate, and structural principles. Prerequisite: 171.

3 units, Win (Taube) MWF 10

GRADUATE COURSES

Undergraduates may register for chemistry courses numbered 200 and above only if admitted to the Honors Program or if special permission has been granted by the instructor in the course.

221. Advanced Organic Chemistry — Lectures. Prerequisites: 125 and 175.

3 units, Aut (Altman) M 10 and WF 9

223. Advanced Organic Chemistry — Continuation of 221. Prerequisite: 221, or permission of instructor.

3 units, Win (Johnson) MWF 9

225. Advanced Organic Chemistry — Continuation of 223. Prerequisite: 223, or permission of instructor.

3 units, Spr (van Tamelen) MWF 9

227. Selected Topics in Organic Chemistry — May be repeated for credit. Prerequisite: 225, or permission of the instructor.

3 units, Aut (Djerassi) M 8–10 and W 8, given 1967–68

230a. Thermodynamics of Irreversible Processes — (Enroll in Chemical Engineering 230a.) A course dealing with the main developments in the thermodynamic treatment of irreversible chemical and electrochemical processes, transport processes, coupling phenomena, etc., with special emphasis on topics and methods of interest to students of chemical engineering, physical chemistry, and related fields. Prerequisite: physical chemistry with elementary thermodynamics.

3 units, Aut (Van Rysselberghe) by arrangement, alternate years, given 1967–68

230b. Thermodynamics of Irreversible Processes — Complements 230a; separately open to qualified students.

2 units, Win (Van Rysselberghe) by arrangement, alternate years, given 1967–68


2 to 3 units, Spr (—) TTh 10

235. Advanced Inorganic Chemistry — Selected topics. Prerequisite: 175.

2 units, Aut (—) TTh 10

240. Organic Chemistry Seminar — Attendance is required of all graduate students majoring in organic chemistry.

No credit, Aut, Win, Spr (Staff) F 4


2 units, Aut (Loring) TTh 9, alternate years, given 1966–67


2 units, Aut (Loring) TTh 9, alternate years, given 1967–68

272. 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: 179 or permission of instructor.

3 units, Aut, Win, Spr (Staff) MWF 10

274. Elementary Chemistry from a Systematic Point of View — Chemical composition, chemical species, component, chemical reaction, equilibrium, rate of reaction, reaction
mechanism. Precise definitions and some of their implications. Problems. Prerequisites: 2 or 4, and either 171 or permission of the instructor.

3 units, Spr (Koenig) TThS 9

276. Electrochemical Concepts and Conventions—A survey of the fundamentals of electrochemistry. Prerequisite: 175.
1 unit, Win (Van Rysselberghe) by arrangement, alternate years, given 1967-68

277a. Electrochemical Thermodynamics and Kinetics — Thermodynamic treatment of reversible cells, electrodes; irreversible phenomena in electrochemical systems, kinetics of electrode processes, polarization and overvoltage, Tafel law, electrochemical procedures in physical, analytical chemistry. Prerequisite: 175.
2 units, Win (Van Rysselberghe) TTh 9, alternate years, given 1966-67

277b. Electrochemical Thermodynamics and Kinetics — Continuation of Chemistry 277a. Prerequisite: 276 or 277a.
2 units, Spr (Van Rysselberghe) TTh 9, alternate years, given 1966-67

278. Selected Topics on Macromolecules—Lectures. May be repeated for credit.
2 units, Aut (Flory) by arrangement

280a. Chemical Physics—Lectures. Prerequisite: 175 or permission of instructor.
3 units, Aut (McConnell) MWF 9, alternate years, given 1967-68

280b. Chemical Physics — Continuation of 280a. Prerequisite: 280a or permission of instructor.
3 units, Win (McConnell) MWF 9, alternate years, given 1967-68

280c. Chemical Physics — Continuation of 280b. Prerequisite: 280b or permission of instructor.
3 units, Spr (McConnell) MWF 9, alternate years, given 1967-68

297. Physical and Inorganic Chemistry Seminar — Attendance is required of all graduate students majoring in physical or inorganic chemistry.
No credit, Aut, Win, Spr (Staff) T 4

300. Department Seminar — Attendance is required of all graduate students, and all undergraduates registered for Chemistry 190.

No credit, Aut, Win, Spr (Staff) M 4

RESEARCH AND SPECIAL ADVANCED WORK

190. Introduction to Methods of Investigation—For general character and scope, see Chemistry 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 Chemistry 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 Course 200 (or Course 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 Chemistry 126. 
(Staff) by arrangement

See also Senior Colloquia.

CLASSICS

Emeriti: Hermann F. Fränkel, Raymond D. Harriman (Professors)
Executive Head: Brooks Otis
Professors: Brooks Otis, Lionel Pearson, Antony E. Raubitschek
Associate Professors: Edwin J. Doyle, Edwin M. Good (Religion and Hebrew)
Assistant Professors: Andrew Devine, Michael Wigodsky. Acting: Ronald Mellor, John Moore

The Department of Classics offers work in the Greek, Latin, and Hebrew languages and literatures, in Greek and Roman History and in Classical Archaeology. It aims to develop in the student 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 as a major subject equips students for teaching Latin and Greek in high school and college and is also an essential part of a liberal education.

The General Studies Foreign Language requirements can be fulfilled by courses in Greek, Latin, or Hebrew, the Basic requirement (for all students) by completing the work of the second year, as described below in Sections I, II, and III, the Additional requirement (for the A.B. degree) by courses at the 100 level. Humanities 61 and courses marked ≠ satisfy Area requirements in Humanities (Fine Arts or Literature).

**Admission to the Department**

Students should enroll as majors in the Department as early as possible, since they must complete the second-year courses in Latin and Greek (Latin 23 or 28, Greek 23) or have reached an equivalent standard through work done elsewhere before they can be admitted to courses on the 100 level. Students interested in Greek should start at latest in the winter quarter of their sophomore year and if possible in their freshman year.

**Programs of Study**

**Bachelor of Arts**

The Degree of Bachelor of Arts in Classics may be taken either in 1: Classics (Latin and Greek), 2: Latin or Greek, or 3: Latin or Greek with a related minor.

A student’s program of study should be prepared in advance after consultation with his Departmental adviser. Major students must register each quarter for at least one course in the major subject. A student interested in obtaining certification for teaching Latin in the State of California should consult the Head of the Department or his adviser.

1. Latin and Greek. 28 units in Latin courses and 28 units in Greek, all in courses at the 100 level or higher. At least 4 units at the 100 level in Latin composition and 4 units in Greek composition must be included, and, if recommended by the student’s adviser, one or both of the 170 series (Latin 171-173; Greek 171-173). (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: 28 units in Latin courses, all at the 100 level or higher, including at least 4 units at the 100 level in Latin composition and, if recommended by the student’s adviser, the 170 series (171-173); two courses in Roman history (101-103); Humanities 61 or some work in Greek history or ancient art or some study of Greek.

   b) Greek: 28 units in Greek courses, all at the 100 level or higher, including at least 4 units at the 100 level in Greek composition and, if recommended by the student’s adviser, the 170 series (171-173); two courses in Greek history (101-103); Humanities 61 or some work in Roman history or ancient art or some study of Latin.

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 (a) Greek or (b) Latin or French, German, Italian, English, Philosophy or History.

**Combined Majors**

Students may with the consent of the Heads 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 Modern European Languages. Students interested in such a major should consult the Heads of each of the departments concerned.

**Minors**

The Department recommends for an undergraduate minor in Classics (Latin or Greek) the following: 18 to 19 units of Latin or Greek of which at least 12 shall be on the 100 level or above, and 4 units in related courses (Greek or Roman history, ancient art).
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

There will be an opportunity for some Classics majors to attend the Intercollegiate Classical-Center at Rome. This is an intercollegiate program for classical undergraduates conducted by Stanford University. All students interested in this program should consult the Head of the Department.

Advanced Degrees

Master of Arts

Students may 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 other 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.

6. Passing of an oral examination testing his general knowledge of the Classical field. A reading knowledge of French or German is required.

Second-year graduate students, and in some cases first-year 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 the thesis requirement 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 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.

2. Candidates will be required to pass examinations as follows:

   a) Reading examinations in French and German.

   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 Department secretary).

   c) A final written examination 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 examination 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.

3. The examinations in translation from Greek and Latin authors will normally
be taken in the autumn term of the second or third year of graduate work, the final written examination in the spring term of the same year, the dissertation colloquium and special topics examination in the spring following. The period between the translation and final written examinations will be devoted largely to an intensive preparation for the latter examination, during the course of which candidates will be expected to make full use of relevant secondary material in modern languages. They should therefore plan to satisfy the requirements in composition and French and German as soon as possible, preferably before the time of the translation examination. Except in very special circumstances they will not be allowed to take the final written examination until the other three sets of examinations have been successfully completed.

4. Each candidate (not later than the end of the quarter in which he takes his final written examination) must submit to the Executive Head 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 Executive Head 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. Greek or Latin 171-173 are strongly recommended.

Graduate Program in Humanities

The Department of Classics participates in the Graduate Program in Humanities leading to the degree of Doctor of Philosophy. For a description of that program see the section “Humanities (Special Programs)” in this Bulletin.


#101. Tragedy—Euripides or Sophocles.
3 to 4 units, Aut (Staff) MWF 1:15

#102. Tragedy—Continuation of 101.
3 to 4 units, Win (Staff) MWF 1:15

#103. Attic Prose: The Orators.
3 to 4 units, Spr (Staff) MWF 1:15

105. Greek Composition, Elementary.
2 units, Aut (——) by arrangement

115. Greek Composition, Intermediate.
2 units, Win (——) by arrangement

151. Herodotus.
3 to 4 units, Aut (Raubitschek, Staff)
by arrangement, given 1967-68

152. Thucydides.
3 to 4 units, Win (Pearson, Staff)
by arrangement, given 1967-68

153. Aristophanes.
3 to 4 units, Spr (Raubitschek, Staff)
by arrangement, given 1967-68

155. Greek Composition, Advanced.
2 units, Spr (——) by arrangement

160. Individual work.
By arrangement

161. Hesiod and Aeschylus.
3 to 4 units, Aut (Staff) MWF 10

#162. Plato and Aristotle.
3 to 4 units, Win (Otis, Staff) MWF 10

163. Plato and Aristotle — Continuation of 162.
3 to 4 units, Spr (Moore, Staff) MWF 10

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

171. History of Greek Literature: Epic and Lyric.
4 units, Aut (——, Staff) MWF 1:15

172. History of Greek Literature: Comedy, Tragedy.
4 units, Win (——, Staff) MWF 1:15

4 units, Spr (——, Staff) MWF 1:15

See also Classical Courses (Latin and Greek) listed under VII.

GRADUATE COURSES

4 units, Spr (Otis) by arrangement

204. The Constitution of Athens.
4 units (Raubitschek) by arrangement

205. Composition for Graduates.
2 units, Aut, Win, Spr (Pearson) by arrangement

206. Homer.
4 units, Win (——) by arrangement

207. Herodotus.
4 units, Spr (Pearson) by arrangement

208. Greek Epigraphy.
4 units (Doyle) by arrangement

209. Thucydides.
4 units (Raubitschek) by arrangement

212. Aristophanes.
4 units (Doyle) by arrangement

213. Euripides.
4 units (——) by arrangement

214. Topography of Athens.
4 units, Aut (Raubitschek) by arrangement

4 units (Pearson) by arrangement

218, 219. Greek Seminar.
218. 4 units, Aut (——) by arrangement
219. 4 units, Spr (——) by arrangement

260. Directed reading.
By arrangement

See also Classics 201, 207, and 208.

II. COURSES IN LATIN

FIRST- AND SECOND-YEAR COURSES

A placement test will be set for freshmen in the autumn (and for other students by arrangement) to determine at what stage they should begin; they will be ranked as follows on the basis of the test:

1. General Studies Basic requirement completed—eligible for third-year course.
2. 6 units needed to complete requirement—22 and 23 or 27 and 28.
3. 9 units needed—21, 22, 23.
4. More elementary work needed.

The following table shows the sequence of courses offered each year:
#1. First-Year Latin.
4 units, Aut (——, Staff) MTWF 8

#2. First-Year Latin—Continuation of 1.
4 units, Win (——, Staff) MTWF 8

#3. First-Year Latin—Continuation of 2.
4 units, Spr (——, Staff) MTWF 8

#5. Accelerated Course in Elementary Latin — Intended especially for graduate students in other departments.
5 units, Aut (——) MTWThF

#6. Accelerated Course in Elementary Latin—Continuation of 5.
5 units, Win (——) MTWThF

#21. Grammatical Review and Reading in Latin Prose.
3 units, Aut (——) MWF 9

3 units, Win (——, Staff) MWF 9

#23. Second-Year Latin—Catullus and Ovid.
3 units, Spr (——, Staff) MWF 9

27. Latin Prose: Cicero.
3 units, Aut (——) TTh 1:15 and one hour by arrangement

3 units, Win (——) TTh 1:15 and one hour by arrangement

109. Christian or Medieval Latin Authors—
Prerequisite: 6, 28, or equivalent.
3 units, Spr (——) by arrangement

THIRD- AND FOURTH-YEAR COURSES

The series 101–103 and 111–113, and 151–153 and 161–163 will be offered in alternate years and may be taken in successive years.

#101, 102, 103. The Ciceronian Age—Cicero, Catullus, Sallust.
101. 3 to 4 units, Aut (Mellor, Staff) MWF 9
102. 3 to 4 units, Win (Mellor, Staff) MWF 9
103. 3 to 4 units, Spr (Doyle, Staff) MWF 9

105. Latin Composition, Elementary.
2 units, Aut (——) by arrangement

111. 3 to 4 units, Aut (——, Staff) MWF 9, given 1967–68
112. 3 to 4 units, Win (——, Staff) MWF 9
113. 3 to 4 units, Spr (——, Staff) MWF 9

2 units, Win (——) by arrangement

#151. Plautus and Terence.
3 to 4 units, Aut (Wigodsky) by arrangement, given 1967–68

#152. Roman Satire—Horace.
3 to 4 units, Win (Wigodsky) by arrangement, given 1967–68

3 to 4 units, Win (Wigodsky, Staff) by arrangement, given 1967–68

155. Latin Composition, Advanced.
2 units, Spr (——) by arrangement

160. Individual Work.
By arrangement

#161. Lucretius.
3 to 4 units, Aut (Staff) by arrangement

3 to 4 units, Win (Staff) by arrangement

#163. Tacitus.
3 to 4 units, Spr (Staff) by arrangement

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

170. Teachers’ Course.
3 units, by arrangement

4 units, Aut (Otis, Staff) MWF 9

4 units, Win (Otis, Staff) MWF 9

4 units, Spr (Otis, Staff) MWF 9

GRADUATE COURSES

4 units (Wigodsky) by arrangement
III. COURSES IN HEBREW

#1. First-Year Hebrew — Introduction to classical Hebrew language, emphasizing reading ability in various styles as found in the Hebrew Bible.
4 units, Aut (Good) TWFThF 11

#2. First-Year Hebrew—Continuation of 1.
3 units, Win (Good) MWF 11

#3. First-Year Hebrew—Continuation of 2.
3 units, Spr (Good) MWF 11

#22. Second-Year Hebrew — Advanced reading in the Hebrew Bible, with particular attention to poetry and poetic structure, critical analysis, and methods of interpretation.
4 units, Aut (Staff) by arrangement

4 units, Win (Staff) by arrangement

4 units, Spr (Good) by arrangement

IV. COURSES IN GREEK AND ROMAN AUTHORS IN TRANSLATION

#161. The Classical Epic: Homer, Apollonius, Virgil—A study of the epic in respect to structure, character, theme, and imagery.
3 units, Aut (——, Staff) MWF 1:15

#162. Tragedy: Aeschylus, Sophocles, Euripides, Seneca—A study of the origin, function, and purpose of tragedy.
3 units, Win (——, Staff) MWF 1:15

3 units, Spr (——, Staff) MWF 1:15
207, 208. Comparative Grammar of Greek and Latin.

207. 4 units (Devine) by arrangement
208. 4 units (Devine) by arrangement

COMMUNICATION

Emeritus: Chilton R. Bush (Professor)
Executive Head: Clifford F. Weigle
Director, Institute for Communication Research: Wilbur Schramm
Professors: Herbert Brucker, Nathan Mac-coby, Wilbur Schramm, Clifford F. Weigle
Associate Professors: Edwin B. Parker, William L. Rivers. Acting: George C. Stoney
Assistant Professors: David G. Clark. Acting: Godwin C. Chu, William J. Paisley
Instructors: Henry S. Breitrose, Janet K. Voelker
Lecturers: William B. Blankenburg, Daniel E. Garvey, Jr., Lyle M. Nelson, Templeton Peck

The Department of Communication engages in research in communication and offers a curriculum which prepares its students for careers in journalism, broadcasting, documentary film, and communication research.

The main objectives of the professional curriculum are to provide a broad program in the social and humanistic studies; to present courses in the processes and effects of communication, and to equip the student with an adequate set of professional values.

A secondary objective is to provide that amount of training in skills and techniques that will sustain the student's interest in his chosen profession and will assist him in beginning his career.

The technical courses provide not only practice but a content that is an application of some of the principles of the behavioral sciences and humanities. The technical curriculum in this sense is like the curricula of the Schools of Medicine and Engineering which apply the principles of the biological and physical sciences.

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.

Students who wish an undergraduate minor in the Department may arrange for a suitable sequence of preprofessional courses.

Prospective undergraduate students should write the Office of Admissions.

Prospective graduate students should write to: Executive Head, Department of Communication, Stanford University, Stanford, California 94305.

The Department requires that applications 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 if exceptional circumstances prevent the applicant from taking the tests.

PROGRAMS OF STUDY

BACHELOR OF ARTS

Two Bachelor of Arts degree programs are offered, one in the Journalism Division and one in the Broadcasting and Film Division. Requirements are as follows:

1. Two courses in general or English literature; Psychology 1; Sociology 1 or Anthropology 1. In addition, Journalism Division students are required to take Economics 1 and Political Science 1 and 10 or 20. (The student who wishes to take both Political Science 10 and 20 may substitute 15a and b.)

2. A unified program totaling not less than 20 units of courses numbered 100 or higher shall be arranged, with the approval of the adviser, from one or two other departments such as Anthropology, Art, Economics, English, History, Music, Philosophy, Political Science, Psychology, Sociology, or Speech and Drama.

3a. Broadcasting and Film Division: Communication 1, 100a and b, 105a, or b or c; 123; 141 or 142, and 180.

3b. Journalism Division: Twenty-five to thirty units in communication of which the following courses are required: 1, 50, 51, 107, 108 and 140. In addition, the student preparing for newspaper or press association editorial work will take Communication
the student preparing for advertising work will take Communication 115 and 116; the student interested primarily in writing for consumer magazines and industrial publication will take Communication 150 and 169.

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 requirement "2" above.

Majors in Communication may elect one of the following interdisciplinary honors programs:

- Behavioral Sciences (Honors Programs in Quantitative Methods)
- Humanities Undergraduate Honors Program
- Social Sciences (Honors Program in Social Thought and Institutions)

Communication Honors Program

In addition to the regular undergraduate programs in communication, a Communication Honors Program is designed for those exceptionally able students who wish, in their major, to pursue an intensive and somewhat independent study of communication. This program is directed toward the integration of a substantial body of theoretical and factual information and the development of both communication skills and creative scholarly skills by independent study, tutorial guidance, small seminars, and research experience. Particular emphasis is placed on the planning of an individual program for the student that will combine his specialized interests with a body of basic knowledge about communication processes. The plan will be aimed at helping the student prepare for a comprehensive examination to be taken in the final quarter of his senior year, over his entire area of communication study. The plan will include arrangements for continuous supervised work in communication skills or in communication research. A report of the work done under this plan will be submitted as an undergraduate thesis at the end of the next to final quarter of the student's senior year. It is possible for a student to elect both the Communication Honors Program and one of the three interdisciplinary honors programs listed above.

Master of Arts

The Master of Arts degree is awarded by the Department in the fields of Journalism, Broadcasting and Film, or Communication Research. Requirements are as follows:

1. The candidate must earn 45 units in graduate residence at Stanford; he must earn an average grade of B on his entire program of study. An independent project 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. A candidate may petition the Department by the end of the second week of the second quarter for permission to submit the report as a thesis.

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; it includes training in one or more communication media; and, it includes the equivalent of a minor in a related field—or a cohesive group of courses in several fields.

3. Students in Broadcasting and Film, upon completion of academic work, including the independent project, must pass a comprehensive written examination, after which they spend a three-month internship with a professional film or broadcasting organization. (No tuition is charged for the internship period.) Academic work will include 100a and b, appropriate 105 and 110 courses, 215, 220, 310, 311, and 312. No particular specialization in undergraduate work is expected of a candidate. Special programs of study may be arranged for individual candidates, which will take account of the nature of their previous preparation.

Doctor of Philosophy

The Department offers the Doctor of Philosophy degree in Communication, with programs in Mass Communication Research, in Developmental Communication, and in Public Affairs Communication.

In addition to fulfilling the course and residence requirements for the degree, 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 comprehensive written examination in the subjects required of all candidates and in the area of advanced specialty of the particular candidate.

3. Demonstrate reading knowledge of a foreign language. Except by special permission, this language will be Russian, French, or German.

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 at least one year of research experience in the Institute for Communication Research, or in comparable research activities.

6. Have some familiarity with at least one medium of mass communication. Such familiarity may be obtained prior to graduate study by working for a communication medium. Students without such practical experience will be expected to take some media-oriented courses, such as the Summer Radio-Television-Film Institute or journalism courses, as part of their graduate program.

7. Complete a dissertation satisfactory to an advisory committee of three or more members and to the University Committee on the Graduate Division.

The following is an example of a typical Ph.D. program in Mass Communication Research. The curriculum for Developmental Communication is virtually identical, but includes a sequence in developmental psychology and a dissertation in the area of how people, as they mature, learn to use and in turn are influenced by the mass media.

1. **Communication Theory**
   - Comm. 211. Theory of Communication I
   - Comm. 212. Theory of Communication II
   - Comm. 213. Theory of Communication III

2. **Methodology**
   - Comm. 217. Research Methods I
   - Comm. 218. Research Methods II
   - Comm. 219. Research Methods III
   - C.S. 126. Computing for Nonscientists

3. **Statistics**
   - Psych. 60. Statistical Methods
   - Psych. 152. Analysis of Data
   - Stat. 161. Statistical Methodology

4. **Experimental Psychology** (at least two of the following)
   - Psych. 103a. Experimental Psychology: Higher Mental Processes
   - Psych. 103b. Experimental Psychology: Perception
   - Psych. 103c. Experimental Psychology: Animal Learning
   - Psych. 103d. Experimental Psychology: Social Processes

5. **Social Psychology and Personality**
   - Psych. 212. Advanced Social Psychology
   - Psych. 261. Seminar in Social Psychology
   - Psych. 220. Human Motivation
   - Psych. 213. Advanced Personality

6. **Sociology**
   - Sociol. 137. Advanced Organizational Behavior
   - Sociol. 161. Advanced Interpersonal Behavior
   - Sociol. 165. Advanced Social Stratification

Preparation for examinations and for the dissertation should include selected courses from among the following:

- Comm. 220. Mass Communications in Society
- Comm. 255. International Communication
- Comm. 256. Communication in Economic and Social Development
- Psych. 209. Advanced Perception
- Psych. 210. Advanced Learning
- Psych. 211. Advanced Developmental Psychology
- Psych. 221. Organizational Processes and Task Performance
- Psych. 251. Psychopathology
- Psych. 254. Principles of Behavioral Modification I
- Psych. 267. Seminar in Interpersonal Processes
Phil. 157a,b. Logic
Phil. 164. Philosophy of Science
Anthr. 167. Language and Culture
Anthr. 158. Culture and Personality
Pol.Sci. 382a, 382b. Research Seminar in Political Behavior
Pol.Sci. 312. Research Seminar in Comparative Politics—Problems in Politics of Development

Other courses and special advanced reading courses may be selected in conference with the adviser.

The following is an example of a typical Ph.D. program in Public Affairs Communication:

1. Communication Theory
   Comm. 211, 212. Sequence in Communication Theory

2. Structure and Function of the Mass Media
   Comm. 220. Mass Communications in Society
   Comm. 230. Mass Media and Government
   Comm. 240. Economics of the Mass Media
   Comm. 255. International Communication

3. Methodology
   Comm. 217, 218. Sequence in Research Methods
   Comm. 227. Analysis of Documentary Evidence

4. Statistics
   Psych. 60. Statistical Methods, or
   Stat. 50. Elementary Statistics
   One other statistics course

5. Law
   Law 104. Law in Society

6. Political Science, History, Economics — a unified program of five courses in one of these fields, and three courses in one or both of the others. Suggested:
   Pol.Sci. 108. Seminar in Administrative Responsibility
   Pol.Sci. 152. Modern Political Thought
   Pol.Sci. 158. Theoretical Foundations of Political Sociology
   Pol.Sci. 170. The Supreme Court and the Constitution
   Pol.Sci. 211. Seminar in the Theory of Comparative Politics
   Pol.Sci. 312. Research Seminar on Comparative Politics
   Pol.Sci. 321. Advanced Seminar on British Political Systems
   Hist. 32. Twentieth Century Europe
   Hist. 93. East Asian Civilizations—The recent period.
   Hist. 122a. Russian Foreign Policy 1700–1917
   Hist. 122b. Russian Foreign Policy Since 1917
   Hist. 164. A Political History of the American People since 1914
   Hist. 166. American Intellectual History: Nineteenth Century
   Hist. 167. American Intellectual History: Twentieth Century
   Econ. 117. Economic History of the United States
   Econ. 118. Underdeveloped Economies
   Econ. 120. Comparative Economic Systems
   Econ. 158. Organization and Social Control of Industry
   Econ. 165. International Economics
   Econ. 200. Topics in the History of Economic Thought
   Econ. 215. Economic Development I
   Econ. 216. Economic Development II

7. Selected courses from these and other departments chosen in consultation with an adviser, in preparation for the degree examinations and the dissertation.

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.

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 15 units of graduate courses in the Communication Department, including one research methods course and either Communication 211 or Communication 212. The Communication 217 requirement may be waived when comparable research methodology courses have been taken in some other department. The remainder of the course program will be adapted to the particular needs of each candidate.

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 or experience with the mass media. For further information about the Institute write to the Director.

COURSES OPEN TO UNDERGRADUATES AND GRADUATES

I. GENERAL


5 units, Win (Parker) 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)

190. Comparative Communication Systems — Foreign press, broadcasting, and film: their control and support; their relations to economic and social development, political systems, and cultural patterns; and their roles in public opinion and national policy.

4 units, Spr (Schramm) 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

II. JOURNALISM

50. Editorial Techniques I — Theory and techniques of news communication for newspapers and radio-TV; analysis of journalist's audience; representative media; journalistic vocations. To be taken concurrently with Communication 51. Open to non-majors.

3 units, Aut (Rivers) MWF 10
Spr (Clark) MWF 9

51. Editorial Techniques I Laboratory — Practice in news writing. Weekly conferences, laboratory, outside assignments. To be taken concurrently with Communication 50. Open to non-majors. Prerequisite: typing skill of 35 words per minute.

1 unit, Aut (Rivers) by arrangement
Spr (Clark) by arrangement

107. Editorial Techniques II — Copy editing, headline writing, news display, illustration, typography, printing processes. To be taken concurrently with Communication 108. Prerequisites: 50 and 51.

3 units, Win (Weigle) MWF 9


2 units, Win (Clark) by arrangement

115. Advertising I — Fundamentals of marketing, consumer research, media, copy, layout. Open to non-majors.

3 units, Aut (Blankenburg) MWF 11


3 units, Win (Blankenburg) MWF 11
140. History of Anglo-American Journalism
—Open to non-majors.
   3 units, Aut (Weigle) TTh 9
   4 units, Sum (——) by arrangement

150. Forms of Journalistic Writing — Practice in writing magazine articles, with emphasis on marketing manuscripts. Conferences. Prerequisites: 50 and 51 or consent of instructor.
   3 units, Win (Rivers) TTh 11
   4 units, Sum (——) TTh 10

152. Magazine Editorial Techniques—Planning, writing, production studied with local magazine editors, correspondents; industrial editing. Prerequisite: 150, consent of instructor.
   3 units, Spr (Rivers) Th 4:15-6:05

169. Legal Aspects of Journalism — Libel, contempt, constitutional guaranties, privacy, copyright, inspection of public records. Open to non-majors.
   3 units, Spr (Clark) MW 11

175. Reporting of Public Affairs — Local, state, federal courts; municipal, state, federal administration in the local community. Open only to major students with senior standing.
   4 units, Win (Clark) MWF 10

Practice Courses

121. Advanced Practice — Practice work in executive positions on editorial or business staff of The Stanford Daily, Quad, and Chaparral; weekly conferences. Open to undergraduate students who qualify by election or appointment; not open to graduate students. Students limited to total of 7 units credit. Credit may not be offered in fulfillment of Communication unit requirements for degrees in communication.
   1 to 2 units, each quarter (Staff) by arrangement

183. San Francisco Newspaper Practice — Majors who have made a high record in their entire program, and especially in 175, are permitted to work in San Francisco in the senior year, by arrangement with San Francisco newspapers. Work is under supervision of specially appointed San Francisco newspapermen and faculty of the Department.
   5 units, Spr (Weigle) by arrangement

III. BROADCASTING AND FILM

100a. Elements of Audio Communication — The use of sound for broadcasting and film. To be taken concurrently with 100b.
   3 units, Aut (——) MW 10-12

100b. Elements of Visual Communication — Production for film and television. To be taken concurrently with 100a.
   3 units, Aut (——) MW 1:15-3:05

105a. Radio Production — Elementary course in which students study local radio programs and produce their own shows. Prerequisites: 100a and consent of instructor.
   4 units, Win (——) TTh 1:15-3:05

105b. Television Production — Elementary course in which students study local television shows and work out their own productions in a San Francisco studio. Prerequisites: 100a and 100b and consent of instructor.
   4 units, Win (——) MW 1:15-3:05

105c. Film Production — A beginning course in which students produce their own short films. Prerequisites: 100a and 100b and consent of instructor.
   4 units, Win (——) TTh 1:15-4:05

110a. Advanced Radio — Primarily for graduate students working on radio projects for their degree or producing for broadcasting. Admission by recommendation of instructor only. Prerequisites: 100a and 105a.
   3 units, Spr (——) T 1:15-4:05

110b. Advanced Television — Primarily for graduate students producing television projects for a degree. Admission by recommendation of instructor only. Prerequisites: 100a and 100b and 105b.
   3 units, Spr (——) W 1:15-4:05

110c. Advanced Film — Primarily for graduate students producing film projects for a degree. Admission by recommendation of instructor only. Prerequisites: 100a and 100b and 105c.
   3 units, Spr (——) Th 1:15-4:05

123. Basic Writing for Broadcasting and Film.
   3 units, Aut (——) TTh 10-12

124. Writing for Film and Broadcast Production.
   3 units, Win (——) MW 10-12
125. Advanced Writing for Film and Broadcasting.
   3 units, Spr (——) M 1:15–3:05

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, Spr (Breitrose) MWF 9; lab. by arrangement

   3 units, Spr (——) TTh 9

180. Broadcasting and Film Criticism — The techniques and role of criticism based upon the objectives and potential of these media. For advanced students. Prerequisite: consent of instructor.
   3 units, Spr (——) MWF 11

Summer Radio-Television-Film Institute

201S. Noncommercial Station Operation — (Same as Education 341s; see Summer Session Bulletin.) A course taught in the studios of KQED for advanced students who wish to learn the philosophy, administration, origination, planning, and coordination of noncommercial television programs.
   3 units, Sum (KQED Staff) by arrangement

203S. Teaching by Television — (Same as Education 342s; see Summer Session Bulletin.) The growing impact of television as an instrument of education; the challenge and specific requirements of teaching by television; the utilization of educational program material telecast by commercial and noncommercial stations. Laboratory work in campus classroom studio with video tape playback and evaluation.
   3 units, Sum (Staff) by arrangement

204S. Modern Broadcasting — The key questions of broadcasting from the viewpoint of station management, programming and sales in relations with government, personnel, ratings, and sponsors. Emphasis on FM, multiplexing, modern production methods, and international broadcasting. Laboratory work through one unit of 204Sa taken concurrently.
   3 units, Sum (KNBR Staff) by arrangement

204Sa. Radio Laboratory — Direct application of the radio course work will be made through the student management and operation of the University station, KZSU. Two weeks' on-the-air experience in all forms of broadcasting including management, program planning, engineering, production and performance. All students registered for 204S must take at least one unit of this course. It may be taken separately from 204S for 1–2 units. Recommended for all students.
   1 unit, Sum (Staff) by arrangement

205S. Film Production — Basic theory and techniques of film making. Individual student productions from script to release print. Cameras, lighting, sound, editing. Limited to 15 students. Students with prior work in film production may register for Communication 299, Advanced Individual Work, 1–4 units, with the consent of the instructor.
   4 units, Sum (Staff) by arrangement

207S. Radio and Television Writing — Theory and practice in writing for radio and television. Special emphasis on the documentary and other nondramatic forms.
   3 units, Sum (Staff) by arrangement

209S. Radio and Television News—Practical course to train students for work in the radio and television newsroom; gathering, selection, rewriting, editing and reporting of news for broadcast and TV newsmagazine; production and direction of feature material and special events broadcasts. Students handle news department of KZSU.
   3 units, Sum (KNBR Staff) by arrangement

   3 units, Sum (KPIX Staff) by arrangement

214S. Television Production — Practice in television planning, direction, and performance through student production of a variety of program types, both educational and commercial. Programs are video taped for analysis and criticism.
   3 units, Sum (KPIX Staff) by arrangement
Mass Communications in Society — See Communication 220. Required of all students.

**Courses for Graduates**

201. Process and Effects of Communication — Lectures on the theory of communication, and on the experimental, survey, and analytical literature of the field. To be taken with one of the related seminar courses: 202, 203, 211, or 215.

2 units, Aut (Schramm) M 2:15-4:05


3 units, Aut (Parker) W 2:15-4:05

203. Process and Effects of Communication — Theory of communication process for A.M. candidates in communication research. To be taken concurrently with Communication 201.

3 units, Aut (Paisley) W 2:15-4:05

207. Survey of Communication Research Methods — Research designs, sampling, data collection, and data analysis. For A.M. students.

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

211. Theory of Communication I — Seminar and tutorial meetings, extensive readings and papers. For doctoral candidates planning to continue with the sequence on theory. To be taken concurrently with Communication 201.

3 units, Aut (Schramm) W 2:15-4:05

212. Theory of Communication II — Theory of the communication process. Analysis of the experimental literature in attitude change. Prerequisite: consent of instructor.

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


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

215. Process and Effects of Broadcasting and Film Media of Communication — Theory of communication process for A.M. students in broadcasting and film. To be taken concurrently with Communication 201.

3 units, Aut (Breitrose) Th 7-10 p.m.

217. Communication Research Methods I — Methods of research in mass, group, and interpersonal communication. Application of scientific method to communication research. Design of communication studies for laboratory and field experiments and sample surveys. Conceptualization of variables, sampling, data collection, interview techniques, data processing and data analysis. Report preparation. Prerequisite: previous or concurrent registration in elementary statistics.

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

218. Communication Research Methods II — Continuation of 217.

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


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

220. Mass Communications in Society — The nature and social responsibilities of the media, the structure of the industry, problems of regulation, management, educational and commercial interests. For first-year graduate students.

3 units, Spr (Rivers) T 4:15-6:05

Sum (Staff) by arrangement


4 units (Staff) by arrangement


5 units (Staff) by arrangement

240. Seminar in Mass Media History.

4 units (Staff) by arrangement

245. Economics of the Mass Media.

4 units (Staff) by arrangement

255. International Communication — Chief patterns of mass communications throughout the world; philosophies behind them; economic, social, political reasons why a given kind of pattern develops where it does; channels by which nations, cultures communicate with each other; kinds of barrier which intervene in those channels; manipulative communication between nations which is characteristic of the "cold war."

4 units, Spr (Chu) M 2:15-4:05

256. Communication in Economic and Social Development — Seminar on the com-
munication 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, Spr (Schramm) T 4:15–6:05

270. Advanced Communication Theory and Method Seminar — May be repeated for credit. Prerequisites: 219 and 213.

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


4 units, Aut (Paisley) TTh 2:15–4:05

299. Advanced Individual Work—Graduate majors may supplement certain courses with individual projects of distinctly advanced order.

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

300. Thesis.

6 to 10 units (Staff) by arrangement

309. Directed Graduate Project—Research in connection with a staff project, in lieu of Master’s thesis.

3 to 6 units (Staff) by arrangement

310. Seminar in Broadcasting and Film.

2 units, Aut (——) by arrangement

311. Seminar in Broadcasting and Film.

2 units, Win (——) by arrangement

312. Seminar in Broadcasting and Film.

2 units, Spr (——) by arrangement

COMPUTER SCIENCE

Acting Executive Head: John G. Herriot


Visiting: Friedrich L. Bauer (winter quarter), James H. Wilkinson (winter quarter)

Associate Professors: Edward A. Feigenbaum, Gene H. Golub

Assistant Professors: Joyce B. Friedman, Richard W. Watson, Niklaus E. Wirth


Research Associates: Kenneth M. Colby, Lester D. Earnest, Aram J. Grayson

Affiliated Faculty:

Professors: Kenneth J. Arrow (Economics and Statistics), Robert V. Oakford (Industrial Engineering)

Associate Professor: Arthur F. Veinott, Jr. (Industrial Engineering)

OFFERINGS AND FACILITIES

The Department aims to acquaint a variety of 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.

Of the numerous areas of computer science, the Department has competence in numerical analysis, operations research, artificial intelligence, computational linguistics, programming systems and languages, logical design of computer systems, and computer control of external devices.

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 Program.

Since computer science is inherently interdisciplinary, graduate students of computer science are expected 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 and include Computer Science 136, 137, 138, and 139 in their course of study.

In connection with its courses and research, the Department makes considerable use of the Computation Center. See the sec-
tion “Computation Center” in this Bulletin.

The Department conducts a weekly colloquium, presented by the staff and visiting scientists, which covers a spectrum of current research 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 following are Departmental requirements:

A candidate is expected to complete an approved course program of 45 units; at least 36 units will be in this Department, or in the Mathematics Department, or selected from the list of suggested courses in other departments which appears at the end of the course offerings in Computer Science. These 36 units must include 6 units of Computer Science 239 and 15 additional units of courses numbered 200 or above.

A student whose primary interest is in the numerical aspects of computing should include in his program Mathematics 106, 113, 114, 115, 130, 131, and Computer Science 136, 137, 138, 237a, b, 238, unless as an undergraduate he has taken these courses or equivalent ones elsewhere.

A student whose primary interest is in the non-numeric aspects of computing should include in his program Mathematics 113, 130, Philosophy 160a, b, and Computer Science 136, 137, 139, 231, 236a, b, 238, unless as an undergraduate he has taken these courses or equivalent ones elsewhere.

The candidate must have a 2.50 average in his course work and a 3.00 average in his courses taken in the Computer Science Department.

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:

Candidates for the degree of Doctor of Philosophy 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 computer science, mathematics, mathematical logic, and possibly such other subjects as statistics, electrical engineering or psychology, the proportions depending on the student's previous education and his planned research. Since computer science is becoming increasingly formal and abstract, we place considerable emphasis on the student's mathematical education and ability.

In any case there are the following requirements for the standard program:

1) Complete, as a graduate student, an approved coherent program at least 60 units leading to the qualifying examination. To this end, the following computer science courses are recommended: Computer Science 224, 225, 231, 236a, b, 237a, b, 238, 239 (6 units), 245, 382 (2 units of presenting papers). An especially well-written paper for course 239 is required.

2) Possess a substantial reading knowledge of one of the languages: French, German, or Russian.

3) Pass a qualifying examination before admission to candidacy.

The qualifying examination covers three areas: numerical analysis and computational mathematics; advanced non-numeric applications including artificial intelligence; computer and programming systems and languages. Students are expected to excel in the latter area, and in at least one of the first two areas. Upon petition, the Department faculty may approve modifications to the makeup of the qualifying examination in particular cases.

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, computer control of external devices, and in certain applications of computers, such as in Operations Research, Computational Linguistics, and Logic.

TEACHING AND RESEARCH ASSISTANTSHIPS

There are graduate assistantships available in both the Computer Science Department and the Computation Center. Assistants will receive a tuition scholarship for up to nine units of study per quarter during the academic year, and in addition will receive stipends for the nine-month academic year.
ranging approximately from $2300 to $2600. They will have desks in Polya Hall at the Computation Center. Some may work full time in the summer for between $500 and $600 per month.

Duties in the academic year involve less than twenty hours of work per week. Part of this is in assisting Stanford people with their programs and methods for solving problems with computers, often in connection with formal or informal programming courses. Part of the time is spent in developing programs and systems for solving problems of general interest on computers, or in assisting 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.

Applicants for assistantships are expected to have a background in computing at least as deep as that achieved in course 136, together with some knowledge of a machine language. A deeper background is preferable. An applicant’s major field may be computer science, mathematics, statistics, physics, psychology, electrical engineering, or other discipline in which there is significant research involving the use of automatic digital computers. Because of the great need for improved computing and programming systems as tools for research, preference will generally be given to students of computer science.

Further information may be obtained from the Executive Head 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 Executive Head of the Computer Science Department of his desires to have an assistantship in computing and stating his desired major department.

**Courses for Undergraduate Students**

5. Introduction to Programming — This course is an introduction to ALGOL, a problem-oriented language for describing computational processes. There will be practice in solving elementary problems on Stanford’s automatic digital computers. The course is limited to freshman and sophomore students. Prerequisite: Mathematics O or equivalent.

2 units, Aut (———) WF 11
Win (Oakford) TTh 1:15
Spr (———) WF 11

6. Introduction to Programming—Continuation of 5. Courses 5 and 6 together include approximately the same material as course 136, with emphasis on scientific applications. This course is limited to undergraduate students.

2 units, Win (———) TTh 1:15

**Courses for Undergraduate and Graduate Students**

126. Computing in the Social Sciences and Humanities—It is recommended that students with the prerequisites for course 136 take that course. The syllabus is roughly that of course 136, but the problems are selected more from non-numeric applications. Prerequisite: Mathematics O or equivalent.

3 units, Aut (Friedman) MWF 2:15
Win (Golub) MWF 2:15

136. Introduction to Algorithmic Processes—Concept and properties of an algorithm; language and notation for describing algorithms; analysis of computational problems and development of algorithms for their solution; use of a specific procedure-oriented language to solve simple numerical and non-numerical problems using an automatic digital computer. Prerequisite: Mathematics 23 or 43.

3 units, Aut (———) MWF 10; (Herriot)
MWF 11; (———) MWF 1:15;
(———) TTh 11:00-12:15
Win (———) MWF 10;
(———) MWF 1:15
Spr (———) MWF 10; (———)
MWF 11; (———) MWF 1:15
Sum (———) MTWTh 11

137. Numerical Analysis—This course and 138 are designed to acquaint seniors and graduate students of science and engineering with methods of solving mathematical problems on automatic digital computers. Problems discussed include numerical differentiation and integration, solution of linear and nonlinear equations, solution of differential equations, and approximation of
functions. Introduction to the analysis of convergence and errors. Pitfalls in automatic computation and their remedies. Prerequisites: 136 and Mathematics 130, or equivalents.

3 units, Win (Herriot) MWF 11;
(  ) MWF 2:15

138. Numerical Analysis — Continuation of 137. Also the numerical analysis of functions of several variables, including problems of linear algebra. Prerequisites: 137 and Mathematics 113, or equivalents.

3 units, Spr (Golub) MWF 2:15

139. Computer Organization and Information Structures—Logical structure of computer systems: flow of control, instruction codes, input-output, subroutines, interpretive and assembly systems, pushdown stacks, recent advances in computer organization, etc. Study of information representations and their relation to processing techniques. Several computer projects will be included.

3 units, Aut (Wirth) TTh 2:15–3:30;
(  ) MWF 1:15
Win (  ) MWF 1:15

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS

224. Computer Simulation of Cognitive Processes—Introduction to computer simulation techniques and information-processing models of thought processes. Survey of various computer simulation models. This research area lies at an interface between psychology and computer science, and the course is expressly designed for graduate students in both fields. Some knowledge of experimental and theoretical psychology is advisable but not mandatory. Prerequisite: 238, or concurrent registration in 238.

3 units, Aut (Feigenbaum) by arrangement

225. Artificial Intelligence—Introduction to problem solving and heuristic programming. Survey of chess- and checker-playing programs; theorem-proving programs; General Problem Solver; mathematical, linguistic, and industrial applications. Question-answering programs, and natural-language communication with machines. Advice-taker and Inquiring System concepts. Other topics as time allows. The course is designed to dovetail with 224 with minimum overlap, but 224 is not a prerequisite. Prerequisite 238.

3 units, Win (Watson) TTh 1:15–2:30

231. Structure of Digital Computers—Boolean algebra; analysis and synthesis of combinatorial and sequential networks; electronic components used in logical gates. The design of a simple digital processor, arithmetic unit, program control, memories. Use of this processor and its simulation on another computer. Various existing forms of machine organization. Prerequisite: 139 or equivalent.

3 units, Aut (Watson) MWF 8
Win (McCarthy) MWF 10

233. Topics in Numerical Analysis—Selected topics in numerical analysis. Prerequisite: 138 or equivalent.

3 units, Win (Bauer) by arrangement

236a, b. Systems Programming and the Theory of Formal Languages—The technique of constructing systems programs: supervisory programs (monitors), input-output systems, interpreters and compilers for procedure-oriented languages, in particular ALGOL. Selected topics from the theory of formal languages: syntactic analysis and semantic interpretation. Prerequisite: 139 or equivalent.

236a. 3 units, Win (Wirth) TTh 2:15–3:30
236b. 3 units, Spr (  ) TTh 2:15–5:30


237a. 3 units, Aut (Golub) MWF 3:15
237b. 3 units, Win (Wilkinson)
MWF 3:15
237c. 3 units, Spr (Herriot) MWF 3:15

238. Computing with Symbolic Expressions—The LISP programming language with applications to symbolic differentiation, integration, simplification of algebraic expressions, and compiling. Design of list-processing systems. Prerequisite: 136 or substantial programming experience.

3 units, Aut (Raphael) TTh 11:00–12:15
239. Computer Laboratory — A substantial computational program is undertaken and well documented. Prerequisite: 138 or 139, or equivalent.
Any quarter (Staff) by arrangement

243. Mathematical Theory of Computation—Semantics and syntax of programming languages; formal systems for proving equivalence of programs; computability and unsolvability; computer proof procedures; related topics in mathematical logic. Prerequisite: 238 and Philosophy 160a, b, or equivalents.
3 units, Win (Friedman) TTh 11:00-12:15

245. Advanced Topics in Artificial Intelligence—Analysis and discussion of selected frontier research problems in the field. Research paper will be required. Prerequisites: 224 and 225.
3 units, Spr (Feigenbaum) TTh 11:00-12:15

246. Data Reduction and Control Programming—Organization and programming of automatic data reduction systems: data collection, storage, and retrieval; machine-to-machine data transmission; control programs; interrupt processing; list-processing applications; decision processes. Prerequisites: 137, 231, 236a, 238.
Alternate years, given 1967-68

248. Computational Linguistics—Applications of computers to language problems; formal models of language. Parsing algorithms; recognition programs for transformational grammars; mechanical translation. Prerequisite: 136 or consent of the instructor.
3 units, Spr (Friedman) TTh 11:00-12:15

250. Graphic Data Processing—Filtering, image transformation, classifications, learning, picture-processing machines. Prerequisites: 137, 231, 238.
3 units, Spr (Miller) MWF 9

270. Large Scale Systems in Mathematical Programming—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-production and distribution models, and those that arise as a solution procedure for nonlinear, integer, and stochastic programming problems. The decomposition principle, partitioning proposals, and 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: Operations Research 465b, or equivalent.
1 to 2 units, any quarter (Staff) by arrangement

360. Advanced Reading and Research.
Any quarter (Staff) by arrangement

3 units, Spr (Dantzig) by arrangement

376. Seminar in Inventory—Advanced topics. Prerequisite: Operations Research 256.
3 units, Win (Veinott) by arrangement

382. Computer Science Seminar—A variety of special-interest seminars are offered each quarter on such topics as (a) numerical analysis, (b) programming, (c) artificial intelligence, (d) pattern recognition. These seminars cover topics of current research in their respective areas.
1 to 2 units, any quarter (Staff) by arrangement

The following courses offered in other departments may be of especial interest to students of computer science:

Analog Computation—See Electrical Engineering 268.

Data Processing—See Industrial Engineering 141, 141a, 161, 162, 257.

Data Processing in Business Problems—See Business 366, 367, and 368.

Information and Communication Theory—See Electrical Engineering 250a, b, 251a, b, 252, 253a, b, 254.

Mathematical Logic—See Philosophy 160a, b, 161, and 292a, b, c.

Mathematical Models in Behavioral Sciences—See Behavioral Sciences courses.

Mathematical System Theory—See Engineering Mechanics 239a, b, c, d.

Mathematics—See Mathematics courses.

Organizational Processes and Task Performance—See Psychology 221.

Recursion Theory — See Philosophy 293a, b, c.


Statistical Methods of Econometrics — See Economics 272.


Theory of Automata—See Philosophy 162 and Electrical Engineering 264.


Theory of Switching and Digital Computer Circuitry — See Electrical Engineering 261, 262, and 266.

ECONOMICS


Executive Head: Edward S. Shaw

Directors: Lorie Tarshis (Undergraduate Study), Emile Despres (Graduate Study)


Associate Professors: Paul A. David, Ronald I. McKinnon, Koji Taira


Affiliated Faculty:
Professors: George L. Bach (Graduate School of Business), Alan S. Manne (Graduate School of Business, on leave 1966-67), Helen C. Farnsworth, Roger W. Gray, Richard J. Hammond, Bruce F. Johnston, William O. Jones (Food Research Institute)

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 for 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 Serra House 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.

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. Courses offered by the Institute count toward completion of requirements for degrees in economics.

PROGRAMS OF STUDY

Bachelor of Arts
The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor’s degree:

Enrollment in the Department—Students who have not yet taken any economics courses at Stanford may be enrolled in the Department upon request. All other students will be enrolled only if they have had a C average or better in their previous work in economics at Stanford; however, deficiencies in this average may be made up by repeating courses although no University credit will be given for such repetitions.

Graduation—The student is urged to select his program of study carefully, with a view to his own special needs and interests.
His Departmental adviser will be prepared to advise him on his program at any time.

To be recommended by the Department for the degree of Bachelor of Arts in economics, the student must have satisfied the following requirements:

1. Completion of 45 units in courses in economics, and with the permission of the student's adviser, in the curricula of the Food Research Institute and of Engineering-Economic Systems.
   a) Economics 1, 5, 105, 10, 110, and 111 or their equivalent shall be included in the 45 units. Economics 5 and 10 shall be completed by the end of the junior year.
   b) Economics courses taken at other universities may be included in the 45 units. The Director of Undergraduate Study for the Department will establish the amount of credit to be granted toward completion of the Departmental requirements. However, if the elementary course is repeated at Stanford, credit will not also be given for the elementary course taken at another institution toward the required 45 units, and in any case no more than 5 units credit will be given for such a course.
   c) A minimum of 30 units of courses numbered 100 or above, of which 20 must be taken at Stanford, shall be included in the 45 units, except that for this requirement Economics 190 and 191 will be counted as first- or second-year courses.

2. An average grade of C or better shall have been received for all course units completed at Stanford in economics and the curricula of the Food Research Institute and Engineering-Economic Systems, and an average grade of C or better shall have been received for Economics 1, 5, and 10.

3. Completion of a program, approved by the student's adviser, of at least 25 units of courses numbered 100 and above (in history, courses numbered 20 or above) in not more than two of the following subjects: cultural anthropology, history, industrial engineering, mathematics including computer science and statistics (including courses in differential and integral calculus numbered below 100 for which partial credit is given), philosophy, political science, psychology, and sociology.

The Undergraduate Honors Program—All economics majors who qualify are urged to complete the requirements for a degree with honors. The purpose of this program is to encourage the study of economics beyond the ordinary requirements for the degree of Bachelor of Arts. The Bachelor of Arts degree with honors in economics will be granted upon application to all of those who have met the following requirements in addition to those listed above:

1. The student must have received a grade point average of at least 3.00 in all economics courses at Stanford.
2. The student must present a minimum of 55 units in economics and the curricula of the Food Research Institute and of Engineering-Economic Systems, including 10 units of Honors Seminars.

A candidate for admission to the Honors Program should apply to the Director of Undergraduate Study in the third quarter of his junior year if possible.

ADVANCED DEGREES

MASTER OF ARTS

The University's basic requirements for the Master's degree (residence, thesis, etc.) are set forth in the section "Degrees" in this Bulletin. The following are Departmental requirements:

Admission to Candidacy—Completion of the Stanford requirements for a Bachelor of Arts degree in economics, or an approximately equivalent training, is required of students who undertake a program of study for the degree of Master of Arts in economics. 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. Admission to candidacy for the degree will be restricted to students whose record bears promise of successful graduate work.

Recommendation for the Degree—To be recommended to the University Committee on the Graduate Division for the degree of Master of Arts in economics, the student
must have satisfied the following requirements:

1. Completion of a program of study at Stanford amounting to not less than 45 units of credit. No courses numbered below 100 and no courses completed with a grade less than C may be counted toward the 45 units required. Ordinarily the program will include at least 30 units of economics, of which at least 15 units (or 10 units in addition to the thesis) must be in courses at the 200 level. 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 9 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 all additional units approved by the Department.

**Doctor of Philosophy**

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are set forth in the section "Degrees" in this Bulletin. The following are Departmental requirements:

**Admission to Candidacy** — The Director of Graduate Study in Economics will recommend the student to the University Committee on the Graduate Division for admission to candidacy for the degree of Doctor of Philosophy in economics when the following conditions have been satisfied:

1. The student must have passed satisfactorily the two comprehensive field examinations in "Price and Allocation Theory" and "Theory of Income and Economic Fluctuations." These examinations will normally be given at the end of the spring quarter and will cover the subject matter of Economics 202, 203, 204, and 210, 211, 212.

2. Candidates for the Ph.D. degree will be required to demonstrate a reading knowledge of economics in one foreign language, except that additional training may be required of students whose dissertations are concerned with foreign economic systems or require more than ordinary acquaintance with literature in a foreign language. The language selection must be approved by the Director of Graduate Study.

The requirement may be satisfied in either of two ways: (a) by completion with passing grade of a second-year reading course equivalent, for the language concerned, to French 23; (b) by passing a special reading examination, to be given preferably by a qualified member of the Department of Economics or, in place of this, the relevant language department. This examination will be scheduled once annually.

3. The minimum mathematics requirement of the Department is satisfied by successful completion of Statistics 63 (also Mathematics 63) or Mathematics 43 with a grade of C or better, or its equivalent (as judged by an examination administered by the Department). This requirement should be satisfied as soon as possible after first graduate registration in the Department. Those with little or no previous mathematical background are strongly advised to register their first autumn quarter for Mathematics 41 (a prerequisite of Statistics 62, which is not ordinarily offered until winter quarter).

While the minimum requirements of the Department will be satisfied by Statistics 63, continuation in mathematics is recommended. The Director of Graduate Study will advise on suitable additional mathematics and statistics courses of use to economists.

Students admitted to the Department to pursue work toward the Ph.D. are normally expected to satisfy the requirements for admission to candidacy by the end of their first year in residence. Hence, previous preparation in mathematics, a foreign language, or both is desirable.

**Recommendation for the Degree** — Before being recommended for the degree of Doctor of Philosophy in Economics, the student must have completed the following requirements:

1. Qualification in background subjects.
   a) For those who do not elect Econometrics as a field (see below), an acquaintance with the statistical tools used in economics equivalent to Economics 170.
   b) Economics 200. History of Economic
Thought. Students will be expected to satisfy this requirement by the end of their second year in residence.

Qualification in six fields of study (if no minor subject is offered) or in three fields of study and a minor subject. All candidates without exception will be expected to qualify in “Price and Allocation Theory” and “Theory of Income and Economic Fluctuations.” The remaining fields may be chosen according to the following options:

a) Option A—Without a Minor Subject. The preparation required will be determined by the professor or professors in charge of each field and will normally consist of a two-quarter sequence at the 200 level or approximately equivalent preparation. An approved program of 15 units in other than economics may, at the discretion of the Director of Graduate Study, be substituted for one field. Students electing Option A are expected to complete the requirements in at least five fields by the end of their second year in residence.

1) Economic Development or Economic History

2) Three other fields, one of which may be the field not chosen under 1), chosen from the following list:
- Monetary Theory
- Public Finance
- Labor Economics
- Structure of Industry
- International Economics
- Econometrics
- Mathematical Economics
- Economic Development
- Economic History

b) Option B—With a Minor Subject. Students who elect Option B will be expected, if possible, to complete their minor requirement and the third comprehensive by the end of their second year in residence.

1) Economic History or Economic Development.

2) A minor subject, the choice of which must be approved by the Director of Graduate Study and the requirements for which are determined by the department concerned. Students interested in specializing in Mathematical Economics or Econometrics are encouraged to minor in statistics.

Comprehensive field examinations will be scheduled once 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. However, students will not typically be recommended for the Ph.D degree with a record of only B's in the six comprehensive examinations (Option A). Successful candidates are expected to pass with distinction in some fields of economics.

3. Training in independent research. Participation in two year-long seminars in two fields and preparation of satisfactory reports or papers in each. Under normal circumstances one of the two seminars will be in the field in which the candidate’s dissertation lies and his continued participation in that seminar is encouraged. Seminars will in part be designed to assist the student in locating a suitable dissertation topic. Satisfaction of this requirement is expected no later than the end of the third year of graduate residence.

4. Teaching experience. 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. Under exceptional circumstances and upon recommendation of the Departmental Graduate Study Committee, the Director of Graduate Study may excuse a student from this requirement. It is not permitted to satisfy this requirement during the first year of graduate study; it will normally be satisfied by the end of the third year of residence.

5. Satisfactory performance in the University oral examination. Except in special cases, the first four stages of preparation must be completed before the student is admitted to the University oral examination. This examination is held for each student after his Departmental dissertation committee has certified to the Director of Graduate Study in Economics that the dissertation is complete in at least rough-draft form. The examination is based on the dissertation and on the field or fields of economics within which it lies.

Minor for the Degree of Doctor of Philosophy—To be recommended for the degree of Doctor of Philosophy with economics as a minor subject, the student is required to qualify in three fields of economics, one of which must be either Price and Allocation Theory or Theory of Income and Economic Fluctuations. Qualification in these fields is tested in the Departmental comprehensive written examinations that are given once annually. The standard of achievement in these examinations is the same for minor as for major candidates.

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 in economics. These grants range up to $4,000 (inclusive of tuition) with special allowance for dependents under certain circumstances. Furthermore, students who make a good record during their first year may be assured of favorable consideration for further support for a period of up to three more years. This is true regardless of whether the student has come on a Departmental or an outside (NSF, Woodrow Wilson, etc.) fellowship initially.

Completed application forms for graduate fellowships should be filed before January 15 at the Office of Financial Aids and at the same time as completed application forms for admission are filed with the Admissions Office.

Opportunities for employment as research assistants are also available. The salary scale for half-time employment depends upon the student's experience and ability.

Qualified graduate students who wish to combine their studies with part-time teaching may apply for teaching assistantships which carry a stipend of $2,100 for three quarters of half-time teaching and a tuition scholarship covering up to half-time tuition and fees. Graduate students may apply for a teaching assistantship without a tuition scholarship if they are not subject to tuition charges or if they do not require scholarship aid.

Entering students are not normally considered for research or teaching assistantships.

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 1966–67.

#1. Elementary Economics—The functioning of a modern market economy: the determination of national income and its distribution; the composition of output; the growth of economy.

5 units, Aut, Win, Spr (Staff) MTWThF 9
4 units, Sum (Staff) MTWThF 9

5. Economics of Prices and Markets I—The role of prices in the allocation of economic resources; behavior of consumers and firms; market structure. (May be taken as 105a by graduate students.) Prerequisite: 1 or equivalent.

5 units, Aut, Win, Spr (Staff) MTWThF 9
4 units, Sum (Staff) MTWThF 9

6. Price Theory and Policy—Content same as Economics 5 but use will be made of mathematical tools in presentation. (May be taken as 106 by graduate students.) Prerequisites: 1 or equivalent and Mathematics 23 or Mathematics 43 or Mathematics 63.

5 units, Aut, Spr (Staff) MTWThF

7. Introduction to Statistics—(Same as Statistics 7.) Especially designed for students of economics, sociology and other social sciences.

5 units, Aut (Staff) MTWThF

10. Money, Income, and Employment I—An analysis of major sectors and markets in the economic system and of national economic accounts. (May be taken as 110a by graduate students.) Prerequisite: 1 or equivalent.

5 units, Aut, Spr (Staff) MTWThF 10
4 units, Sum (Staff) MTWThF 10

105. Economics of Prices and Markets II—Distribution of income; problems in marginal cost pricing; monopoly power, its sources and impact. Prerequisite: 5.

5 units, Win, Spr (Staff) MTWThF 9


5 units, Win, Spr (Staff) MTWThF
110. Money, Income, and Employment II—An analysis of equilibrium, instability, and growth in the economic system as a whole. Prerequisite: 10.
5 units, Aut, Spr (Staff) MTWThF 10

111. Money, Income, and Employment III—An analysis of policies and techniques of regulation for stability, growth, and other objectives in the economic system as a whole. Prerequisites: 5 and 110.
5 units, Aut, Spr (Staff) MTWThF 11

116. Economic History of the United States—Historical trends in the American economy from the colonial period to the great Depression; special references to problems of national and regional economic development, including social and political influences thereon. Prerequisites: majors 5 and 10; non-majors 1.
5 units, Spr (David) MTWThF

117. The Postwar U.S. Economy in Historical Perspective—Analysis of selected aspects of U.S. economic experience since World War II, focusing on forces determining growth, stability and income distribution. References to postwar developments in other industrialized nations; primary emphasis on elements of historical continuity and recent departures in the functioning of the economy. Prerequisites: majors 5 and 10; non-majors 1.
5 units, Win (Abramovitz) MTWThF

118. Underdeveloped Economies—Characteristics of backward economies. Elements and mechanism of development. Emphasis on theory, but attention will be given to policy problems and case studies. Prerequisites: majors 5 and 10; non-majors 1.
5 units, Aut, Spr (Taira) MTWThF

5 units, Win, Spr (Staff) MTWThF

121. Economic Development: Japanese Experience—Problems of modernization and industrialization in non-Western setting. Social change and economic growth in modern Japan since Meiji Restoration. Prerequisite: 1 or equivalent.
5 units, Aut (Taira) MTWThF

141. Public Finance and Fiscal Policy—Effects of government expenditure, borrowing, and taxation upon resource allocation, national income and employment, prices, and income distribution. Prerequisites: 5 and 10.
5 units, Aut, Win (Staff) MTWThF

5 units, Aut (Landes) MTWThF

158. Organization and Social Control of Industry—Methods of evaluating economic efficiency; anti-trust laws and the attempts to preserve competition; economic regulation of public utilities, communications, and transportation. Emphasis on independent study. Prerequisites: 5 and 105, or consent of instructor.
5 units, Spr (Rosse) MTWThF

165. International Economics—Comparative advantage in production and trade among nations; international monetary mechanism; domestic monetary, fiscal and tariff policies and their relationship to foreign trade. Prerequisites: majors 5 and 10; non-majors 1.
5 units, Spr (Tarshis) MTWThF

170. Econometrics—Introduction to econometrics; selected topics in the literature of econometrics; statistical methods of special application to economic problems and special statistical problems encountered in testing economic hypotheses with non-experimental data; emphasis on conceptual understanding rather than technique. Prerequisites: 5, 10, 7 (or Statistics 50), Mathematics 41 or equivalent, or consent of the instructor.
5 units, Aut, Spr (Staff) MTWThF

190. 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. For majors in Economics, this is considered a lower division course.
5 units (Staff) MTWThF
191. 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 other than 190 may not enroll. For majors in Economics, this is considered a lower division course. Prerequisite: 190 or equivalent.
5 units (Staff) MTWThF

199. Senior Seminar in Economics — Advanced specialized topics to be arranged with instructor. Required of all Honors students. To be offered in five sections. Each section will meet throughout the year under the guidance of one instructor. Maximum number of students in each section is ten. Prerequisite: Admission to Honors Program or seniors majoring in economics with a minimum grade point average in economics of 3.00, or consent of instructor.
10 units (Staff)

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.

Six seminars will be offered in any one year.

A. CORE THEORY CURRICULUM
(Professors Abramovitz, Arrow, Maddala, McKinnon, Reder, Shaw, and Tarshis)

200. Topics in the History of Economic Thought—Landmarks in the development of classical, neoclassical and institutionalist economies; their relation to economic conditions in their time and to modern economics.
5 units, Win (Staff)

*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 the instructor. May be omitted by graduate students with adequate background in the subject. Prerequisite: consent of instructor.
5 units, Aut (Staff)

*203. Price and Allocation Theory II—Different forms of competitive and monopolistic behavior; their effect on efficiency of economic organization. Prerequisite: 202.
5 units, Win (Staff)

5 units, Spr (Staff)

*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, 211 are prerequisites for 212.

210. 5 units, Aut (Staff)
211. 5 units, Win (Staff)
212. 5 units, Spr (Staff)

301a,b,c. Seminar in Microeconomics.
10 units (Staff) by arrangement

310a,b,c. Seminar in Macroeconomics.
10 units (Staff) by arrangement

B. ECONOMIC DEVELOPMENT
(Professors David, Despres, Hohenberg, Manne, and Taira)

5 units, Win (Staff)

5 units, Spr (Staff)

225. Historical Experience of Economic Growth—(See under Economic History.)
315a,b,c. Seminar in Economic Development.
10 units (Staff) by arrangement

321. Seminar in Economic Growth — Prerequisite: consent of instructor.
5 units (Taira) by arrangement
C. ECONOMIC HISTORY
(Professors Abramovitz, David, and Hoberg)

*225. Historical Experience of Economic Growth—Topics in European and Japanese economic history with emphasis on problems and issues relevant to growth. Change in pre-industrial and industrializing economies in historical perspective.
   5 units, Aut (Staff)

   5 units, Win (Staff)

325a,b,c. Seminar in Economic History.
   10 units (Staff) by arrangement

D. MONETARY THEORY AND INSTITUTIONS
(Professors Gurley, Maddala, and Shaw)

*230. Monetary Theory—Advanced topics in monetary theory with special reference to policy criteria and control techniques. Prerequisite: 211.
   5 units (Staff)

330a,b,c. Seminar in Monetary Theory and Institutions.
   10 units (Staff) by arrangement

E. PUBLIC FINANCE
(Professors Arrow, Coen, Gurley, James, and Margolis)

*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.
   241. 5 units (Staff)
   242. 5 units (Staff)

341a,b,c. Seminar in Public Finance—Prerequisite: 241 or consent of instructor.
   10 units (Staff) by arrangement

F. ECONOMICS OF LABOR
(Professors Landes, Reder, and Taira)

   5 units (Staff)

*248. Wages and Income Distribution—Wage levels, structure; income distribution, effects of education on earnings, special references to empirical data.
   5 units (Staff)

345a,b,c. Seminar in Labor Economics.
   10 units (Staff) by arrangement

G. ECONOMICS OF INDUSTRY
(Professors Margolis and Rosse)

*254. Dynamic Processes in the Firm—Mathematical analysis of the dynamic effects of investment in facilities, inventories, research, and advertising in the firm. Applications to specific problems concerning the optimal operation of the firm. Prerequisites: 105 and a knowledge of differential equations.
   5 units (Staff)

*256. Industrial Structure and Market Performance—Economies of scale; the size of establishments and firms; integration; the structure of industries; characteristics and performance of markets; problems of public policy.
   5 units (Staff)

355a,b,c. Seminar in Structure of Industry.
   10 units (Staff) by arrangement

H. INTERNATIONAL ECONOMICS
(Professors Despres, McKinnon, and Tarshis)

   5 units (Staff)

   5 units (Staff)

365a,b,c. Seminar in International Economics.
   10 units (Staff) by arrangement

I. MATHEMATICAL ECONOMICS
(Professor Arrow)

280. Linear Programming—(Enroll in Busi-
ness 465a.) This course will survey linear programming, emphasizing standard model formulation, fundamental theorems, variations of the simplex method and parametric programs. Students will solve linear programs on computer. Prerequisites: Mathematics 113 and Mathematics 115.

4 units, Aut (Dantzig) TTh 1:15

281. Mathematical Programming — Generalized programming, integer programming, decomposition methods, linearization of nonlinear problems, and discussion of current field developments and important applications. Prerequisite: Business 465b.

4 units, Win (Dantzig) TTh 1:15


3 units, Win (Staff)


3 units (Staff)

284. Advanced Dynamic Programming: Optimal Economic Growth — (Enroll in Computer Science 375.) Current techniques for optimal policies of consumption and capital accumulation. Prerequisites: Operations Research 351 or consent of instructor.

3 units (Staff)

285. Special Topics in Mathematical Economics—The topics for 1966–67 will be announced. May be repeated for credit. Prerequisites: consent of instructor and working knowledge of differential calculus are required.

5 units (Staff)

385a,b,c. Seminar in Mathematical Economics.

10 units (Staff) by arrangement

J. ECONOMETRICS

(Professors Arrow, Maddala, and Statistics Department)

270. Theory of Probability—(Same as Statistics 116.) Elementary probability theory, sampling, distributions. Prerequisite: working knowledge of the calculus.

4 units, Aut, Win, Spr, Sum (Staff)

271. Elementary Statistical Inference—(Enroll in Statistics 219.) Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. Prerequisite: 270.

3 units, Win (Solomon) MWF 9

*272. Econometrics I — First quarter of two dealing with the statistical methods of econometrics. Emphasis on multiple regression analysis, tests of linear restrictions, and other single equation methods and problems. Selected applications in economics. Multivariate normal distribution. Introduction to maximum-likelihood methods. Prerequisites: 271 and Statistics 63, or consent of instructor. Mathematics 114b desirable.

5 units, Win (Staff)

*273. Econometrics II — Continuation of 272 emphasizing simultaneous equations, methods and problems. Selected applications in economics. Special topics may be introduced in some years. Prerequisites: 272 and consent of instructor.

5 units, Spr (Staff)

370a,b,c. Seminar in Econometrics.

10 units (Staff) by arrangement

ENGLISH

Emeriti: Hardin Craig, A. Yvor Winters, (Professors); Margaret D. Hudson (Instructor)

Executive Head: Thomas C. Moser

Associate Executive Head: Charles N. Fifer

Professors: Robert W. Ackerman, John W. Dodds, Newell F. Ford, Alfred H. Grommon, Albert J. Guerard, Paul H. Kocher, David Levin, John Loftis, Herbert D. Meritt, Thomas C. Moser, Lawrence V. Ryan, Richard P. Scowcroft, George F. Sensabaugh, Claude M. Simpson, Jr., Wal-
lace E. Stegner, Wilfred H. Stone, Ian P. Watt, Virgil K. Whitaker

Associate Professors: Charles N. Fifer, H. Bruce Franklin, Lucio P. Ruotolo, W. Wesley Trimpi, Jr. Visiting: Murray Roston


Lecturers: Blair Fuller, Edward P. McClanahan, Clive Miller, Nancy H. Packer

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

The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor’s degree. Only students who have achieved a C average in courses counting toward the Departmental major will be recommended for graduation.

1. Prospective English majors may profitably elect one or more of the following courses:
   - English 25 and 76; Humanities 61.

2. All students majoring in English are required to take the following Departmental courses:
   - 102. Introduction to the English Language.
   - 141. Chaucer.
   - 143. Shakespeare.
   - 183. English Literature: Neoclassicism and Romanticism.

   The last three courses should be taken as early as possible, preferably in sequence.

   In addition to the courses listed above, the student must complete one of the following programs:

   a) English Literature.
      1) One course from each of the following groups:
         - (a) English 100, 142, 144, 145, 146, 147, 148, 149, 150, 151, 152, 154, 155, 171, 172, 173.
         - (b) English and American literature courses numbered 200 and above.
      2) English 192. Senior Seminar in English Literature.

   b) American Literature. The undergraduate major in American Literature should plan to take English 177 and 178 in sequence during the junior year, and should not register for any American literature course numbered in the 200’s until he has studied the corresponding period in English 177 or 178.
      1) English 177. American Literature to 1855.
      2) English 178. American Literature, 1855 to the present.
      3) One additional course from the following list: English 155, 172, 255, 264, 265, 266, 267, 268, 269, 270, 271, 278; Speech and Drama 206.
      4) English 196. Senior Seminar in American Literature.

   c) Creative Writing. All students wishing to major in Creative Writing must have maintained at least a B record in preliminary writing courses.
      1) One course from each of the following groups:
         - (a) 142, 144, 145, 146, 147, 148, 149, 150, 151, 152, 154, 155.
         - (b) 171, 172, 173, 265, 266, 269, 270, 271; Speech and Drama 206.
      2) Completion of at least 12 units of work in one of the programs listed below:
         - (a) Fiction. English 255, The Development of the Short Story; plus 8 units of English 133, Directed Writing, or a more advanced course, with grades of B or better.
         - (b) Poetry. English 251, The English Lyric, and English 201, The Writing of Poetry, which may be repeated for a total of 8 units of credit.

3. In addition to the English major require-
ments, courses totaling not less than 16 units of college work must be taken in one of the following minor fields:
One foreign language and literature.
Philosophy and/or History.
Philosophy and Religion (junior and senior courses listed under Special Programs in Humanities: Religion).
Speech and Drama.
Music or Art (advanced courses).
Unified program to be arranged with the approval of the adviser and the Department.
Humanities Honors Program. (The entire Honors Program must be taken to fulfill the minor requirement.)

Honors Program in English
Students with at least a B average in their university work and special interest in literary studies may apply for admission to the Honors Program in English literature, preferably by the start of the sophomore year and not later than the junior year. Admission is selective.

The program offers more intensive and more independent work in the field. Course requirements are as follows: English 102, 141, 143, 182, 183, 184, and four elective advanced courses in English or American literature. There will be special seminar sections for honors candidates in the basic surveys (182, 183, 184); or, with the approval of the adviser, three advanced courses in the appropriate period may be substituted for any one of the basic surveys. (Not more than two such substitutions will be permitted.) The requirements in a minor field are the same as for all English majors.

Honors candidates will take an oral qualifying examination in the spring of their junior year. The examination will deal with material from the candidate's previous courses in English; it will also deal with two or three texts chosen by the candidate from an assigned list. Students preparing for the examination will register for English 190, 4 units. Those who pass the examination with at least a B will write an essay, in the senior year, of 10,000–15,000 words (13 units).

Since the major in creative writing is limited to students with special aptitudes, it is also regarded as an honors program.

Combined Major in Classics and English
Students may with the consent of the Heads 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 Heads of each of the departments concerned.

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.

Teachers' Credentials
Students wishing to obtain the Standard Teaching Credential (Secondary) entitling them to teach in grades 7–14 in the public schools of California, or a Junior 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 Departmental courses or their equivalents:

<table>
<thead>
<tr>
<th>Teaching Major</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>9</td>
</tr>
<tr>
<td>One course in the English language, English 102 or 209</td>
<td>4</td>
</tr>
<tr>
<td>English 208. Introduction to Modern Linguistics</td>
<td>4</td>
</tr>
<tr>
<td>English 204. Advanced Exposition</td>
<td>3</td>
</tr>
<tr>
<td>English 143. Shakespeare</td>
<td>4</td>
</tr>
<tr>
<td>English 182. English Literature: The Renaissance</td>
<td>5</td>
</tr>
<tr>
<td>English 183. English Literature: Neoclassicism and Romanticism</td>
<td>5</td>
</tr>
<tr>
<td>English 184. English Literature: Victorian and Modern</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American literature (preferably in the chief American poets and American novelists)</td>
<td>8</td>
</tr>
<tr>
<td>Education 184. Literature for Adolescents</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 20 or 30 recommended</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 164a. Principles of Directing or Communication 50 and 51. Editorial Techniques and Lab.</td>
<td>4</td>
</tr>
<tr>
<td>Electives (courses in literary criticism and oral interpretation of literature are strongly recommended)</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
</tr>
</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 182, 183, or 184.

Teaching Minor

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>9</td>
</tr>
<tr>
<td>English 204. Advanced Exposition</td>
<td>3</td>
</tr>
<tr>
<td>English 102. Introduction to the English</td>
<td></td>
</tr>
<tr>
<td>Language or English 209</td>
<td>4</td>
</tr>
<tr>
<td>English 143. Shakespeare</td>
<td>4</td>
</tr>
<tr>
<td>English 184. English Literature: Victorian and Modern</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American literature</td>
<td>8</td>
</tr>
<tr>
<td>Electives, preferably in the English novel or English 208, Introduction to Modern Linguistics</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
</tr>
</tbody>
</table>

A candidate for the Stanford Junior 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 college instructors — in other words, those fully qualified to study for the Ph.D. degree, whether or not they plan to do so. Other graduate students interested in obtaining a teaching credential are advised to work for the Stanford General Secondary Credential.

2. Stanford Junior College Credential. Candidates for the Stanford Junior College Credential must meet the following requirements:
   a) Completion of the Master’s degree in English.
   b) Completion of 30 quarter units in a teaching minor, 12 units of which are in advanced undergraduate or graduate courses.
   c) Completion of the following professional courses in education:
      1) Education 262a or b. Curriculum and Instruction in Secondary School English (3 units), offered only during summer and autumn quarters, or English 399, Seminar in the Teaching of Composition, offered only during spring quarter.
      2) Education 289. Curriculum and In-

struction in the Junior College (3 units), offered only in the winter quarter.

3) Education 248. Student Teaching in Junior College (6 units), to include (1) student teaching in a public junior college, unless the candidate has been officially appointed to the teaching staff of the Department of English; and (2) observation of and, if possible, participation in classes in a public junior college, if the candidate has been officially appointed to the teaching staff of the Department of English. To be supervised by representatives of the School of Education and the Department of English.

d) Strongly recommended. Education 347. The Junior College (3 units), offered in summer and winter quarters. The recommended sequence of courses is as follows: Education 262a or b, or English 399; Education 289; Education 248; Education 347.

e) Fulfillment of the Constitution Requirement.

f) Confer with Professor Lewis Mayhew, School of Education, and with Professor Alfred Grommon, School of Education and Department of English.

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 teachers with one or more years of experience and/or a regular 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. 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., or for the Master's degree in an approved Credential Program or for the Master's degree in Creative Writing in English, will be accepted as graduate students.

Candidates in an approved Credential Program may earn the Master's degree by passing satisfactorily 36 units of specified work, one foreign language examination, and the qualifying examination for the Ph.D. in English. No thesis is required.

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 36 units of specified work (including English 310 and the qualifying advanced writing course) and one foreign language examination, and by submitting a piece of imaginative writing of substantial length and merit. This must be submitted at least four weeks before the close of the quarter in which the degree is to be granted.

Candidates for the Master's degree in Creative Writing who, after a quarter's work, are not accepted as degree candidates in the writing program may earn the Master's degree in English by completing satisfactorily 36 units of specified work, by passing one foreign language examination, 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 72 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.

A candidate for the Ph.D. degree may concentrate in English literature or in English philology, or may take the Ph.D. in English and American literature, in English and comparative literature, or in English and humanities. Applicants interested in a Ph.D. in English philology should determine the requirements of the program through correspondence with Professors Meritt or Ackerman.

Requirements of the Ph.D. program in English literature are as follows:

1. Old English and Middle English language and literature (English 310 and 312 or equivalent work elsewhere).
2. A minimum of four seminars, insuring coverage in genres and periods.
3. A minimum of 32 additional units of graduate courses and seminars (200–300), distributed according to the adviser's judgment and the candidate's needs.
4. One of the following minor programs, amounting to at least 16 units of graduate credit at Stanford or elsewhere:
   a) A minor in a related department, the choice of minor to be approved by the Department of English, but the program itself to be prescribed by the department in which it is taken;
   b) A supplementary program in American literature or English philology;
   c) A special interdepartmental program of studies related to the student's projected research.

A student who wishes to begin the study of English on the graduate level, and who has had a strong undergraduate major in a subject normally accepted for the Ph.D. minor, may petition the Department to waive the minor requirement so that he may devote equivalent time to strengthening his foundation in English.

5. A written qualifying examination to be taken at the end of the summer after the first year of graduate work. This examination will be based largely upon a reading list supplied the student at the time of his acceptance at Stanford.
6. A university oral examination to be taken no later than the winter quarter of the student's third year of graduate work. This examination will cover the period of the dissertation, the minor, and plans for the dissertation itself based upon a prospectus approved by the adviser.

Requirements of the Ph.D. program in English and American literature are as follows:

1. English 310 and either 311 or 312, except that the candidate may omit 312 instead of 311 only if he has had a course in Chaucer or other Middle English writers.

2. A minimum of 28 units of graduate courses (200-300) in American literature and 28 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; at least three must be taken at Stanford.

3. At least 8 units of electives to be distributed between English and American literature according to the adviser's judgment of the candidate's background.

4. A written qualifying examination to be taken at the end of the summer after the first year of graduate work. This examination will be based largely upon a reading list supplied the student at the time of his acceptance at Stanford.

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 the period of the dissertation, together with plans for the dissertation itself based upon a prospectus approved by the adviser.

Requirements of the Ph.D. program in English and comparative literature are as follows:

1. A knowledge of English literature since 1350 comparable to that demanded of candidates for the Ph.D. in English literature. Candidates will take the appropriate parts of the qualifying examination at the end of the summer after the first year of graduate work.

2. A knowledge of the basic structure of the English language (including the structure of Old English) and of Chaucer. This requirement may be met by examination, or by taking eight units of courses chosen from among those offered in linguistics, English philology, and early and middle English literature including Chaucer.

3. A knowledge of two foreign languages comparable to that demanded under the basic program and an advanced knowledge of a third language; or, an advanced knowledge of two foreign languages.

4. A minimum of 36 units in the history, thought, and literature of one period, in two or more languages, one of which must be English and one European. As much as 24 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. No more than two of the four required may be in 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, should be taken no later than the winter quarter of the third year of graduate study.

Language Requirements—All candidates for the Ph.D. degree (except those in English and comparative literature) must demonstrate a reading knowledge of Latin, German, and French by passing the examinations in these languages. These examinations are normally given on Friday of the eighth week in the autumn, winter, and spring quarters, unless that Friday falls on a holiday; and on Friday of the sixth week in the summer quarter. Another modern foreign language may be substituted for German or French if it is required for the student's projected research.

The student should pass one foreign language examination before his qualifying examination; a second foreign language before his university oral examination; a third foreign language before he submits his dissertation.

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 Executive Head to appoint a committee to super-
vise 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.

**GRADUATE PROGRAM IN HUMANITIES**

The Department of English participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in English and Humanities. Candidates for this degree may omit English 311 or 312 from their requirements, but must offer a reading knowledge in the three foreign languages (Latin, French, German) required by the Department of English. For a description of the Humanities program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."

**FRESHMAN AND SOPHOMORE COURSES**

The Department does not offer a prescribed course in remedial English. Students with special problems are offered tutorial help by instructors in regular Freshman English classes, or by special instructors, according to individual needs.

#1, 2, 3. *Freshman English*—Writing, chiefly expository, emphasizing the control of meaning through critical and creative thinking, and through mastery of style. Introduction to the criticism of literature. (Appel and Guerard, Directors, with Charyn, Felstiner, Fifer, Friedlander, Grommon, Harris, Kostelanetz, Middlebrook, Miller, Moser, Rebholz, Rigg, Roston, Ruotolo, Stone, and Staff).

1. A course in writing, reading, and thinking designed to help the student write lucid and persuasive prose. Study of the serious essay as an instrument of social criticism and of humane discourse on man and his environment.

3 units, Aut

2. Continuation of 1. Emphasis on tone and style, and on the imaginative enrichment of prose; introduction to the novel and the short story.

3 units, Win

3. Continuation of 2. Exercises in precise and evocative writing of various kinds; study of poetry, drama, and literary criticism.

3 units, Spr

#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

2F. Continuation of 1F.

3 units, Spr

#1S, 2S, 3S. *Freshman English (Special)*—Sections of 1, 2, and 3 for students of exceptionally high aptitude and achievement, paralleling the regular sections, but offering more advanced training. Open by invitation. (Kolve, Director, with Carnochan, Evans Felstiner, Friedlander, Harris, Polhemus, Trimpi.)

1S. A course in advanced composition with study of expository prose.

3 units, Aut

2S. Continuation of 1S, with emphasis on prose fiction.

3 units, Win

3S. Continuation of 2S, with emphasis on poetry, drama, and literary criticism.

3 units, Spr

#4. *Freshman English (Seminars)*—Open by invitation to a limited number of students of creative ability who have already shown (in English 1, 2, 1S, or 2S) the capacity to write lucid expository prose. There will be small groups devoted to various kinds of
writing, including fiction and poetry. The seminar may replace, for those invited, one quarter of regular or special Freshman English. Where 4 is substituted for 3 or 3S, an introduction to poetry will be included.

3 units, Win, Spr (Appel, Guerard, Directors, Staff)

5. Narration—Basic problems of narrative and imaginative writing. Prerequisite: 3.

3 units, Aut (Packer) (I) MWF 1:15; (McClanahan) (II) MWF 1:15; (Fuller) (III) MWF 1:15

Win (Fuller) (I) MWF 1:15; (McClanahan) (II) MWF 1:15; (III) MWF 1:15

Spr (Fuller) (I) MWF 1:15; (II) MWF 1:15

#7. Masterpieces of English Literature—Intensive study of a few masterpieces of English literature from various centuries, including poetry, drama, the essay, the novel.

4 units, Aut (Roston) MTWF 10

#9. Masterpieces of American Literature—Intensive study of a few masterpieces of American literature, including poetry, drama, the essay, the novel.

4 units, Spr (——) MWThF 10

#25. Shakespeare—Rapid reading of about half the plays and poems in chronological sequence.

4 units, Aut (Ford) MTWF 11

Win (Ryan) MTWTh 10

#75, 76, 77. Introduction to the Chief Types of Literature—Open to all undergraduates. Large courses may be divided into sections.

75. Introduction to the Novel—Various species of novels in English and in translation; analysis of technique of fiction.

4 units, Spr (——) MWF 9

76. Introduction to Poetry—Prosody, poetic forms and types, critical theories regarding poetry. Masterpieces of English poetry will be studied in the light of these theories.

4 units, Win (Middlebrook) MTWF 10

77. Introduction to the Drama—Principal dramatic forms; development of dramatic art; masterpieces of the theater from various periods, countries.

4 units, Spr (Friedlander) TWThF 11


JUNIOR AND SENIOR COURSES

The following courses (100–184) are open to juniors and seniors of all departments. Well-prepared sophomores may be admitted, but only by special permission of the instructor. Freshmen and sophomores who do not have such permission may be refused admission to the courses. Students in other departments may be especially interested in the following introductory courses: 100, The English Bible as Literature; 102, Introduction to the English Language; 177–178, an introductory survey of American literature; and 182–184, an introductory survey of English literature.

100. 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 use made of Biblical themes in English literature.

4 units, given 1967–68

102. Introduction to the English Language—Designed to give the student a knowledge of fundamental matters about the English language; to familiarize him with terminology, classification of language; to enable him to form standards of judgment about good English.

4 units, Win (Meritt) TWThF 11

Spr (Rigg) TWThF 11

129. Scientific Writing—Advanced course in exposition especially for science engineering majors. Prerequisite: 3, or equivalent. Open to juniors and seniors only.

3 units, Aut (——) MWF 9, 10, or 11

Win (——) MWF 9, 10, or 11

Spr (——) MWF 9, 10, or 11

Sum (——) MTWF 9

133. Directed Writing: Fiction—Intermediate course in which the student is to practice various forms of fiction on his own initiative. Open to sophomores so far as space permits. May be repeated for credit. Prerequisite: 5.

3 to 5 units,

Aut (Packer) (I) MW 2:15–4:05;

(Fuller) (II) TTh 2:15–4:05
Win (Scowcroft) (I) TTh 2:15-4:05; (Guerard) (II) MW 2:15-4:05; Spr (McClanahan) (I) TTh 2:15-4:05; (Fuller) (II) MW 2:15-4:05; Sum (McClanahan) MW 2:15-4:05

134. Directed Writing: Poetry—Intermediate course in writing various types of verse. May be repeated for credit.
4 units, Win (Trimpi) MW 2:15-4:05

141. Chaucer — Enrollment in any given term limited to 70. Each student must sign up in the Department office during May pre-registration for a place in one of the sections taught the following year.
4 units, Aut (Kolve) MTWF 9

142. Spenser.
4 units, given 1967-68

143. Shakespeare—Intensive study of four or five plays, including sources, stage history, important critical material. Prerequisite: 25 or extensive reading of the plays.
4 units, Win (Friedlander) MTWF 1:15

144. Milton.
4 units, Aut (Sensabaugh) TThF 9

145. Donne and Jonson.
4 units, given 1967-68

146. Swift and Pope.
4 units, Aut (Carnochan) TThF 10

147. Johnson and His Circle.
4 units, given 1967-68

4 units, given 1967-68

149. Byron, Shelley, and Keats.
4 units, Aut (Ford) MTWF 9

150. Dickens and Trollope.
4 units, given 1967-68

151. Matthew Arnold.
4 units, given 1967-68

152. Browning and Tennyson.
4 units, given 1967-68

154. Modern British Comic Writers — The nature and uses of comic modes — Wilde, Shaw, Waugh and others.
4 units, Win (Felstiner) MTWF 10

4 units, Win (Guerard) MTWF 10

#171. Contemporary Drama — Ibsen, subsequent dramatists — English, Continental, American. Lectures, discussions; critical papers.
4 units, Win (Dodds) MTWTh 9

#172. Forms of the Modern Novel—Studies in major English, American, and Continental novelists from 1850 to the present.
4 units, Aut (Guerard) TThF 11

173. Twentieth Century English Fiction.
4 units, Aut (Ruotolo) TThF 11

177. American Literature to 1855.
4 units, Win (Levin) TThF 9

178. American Literature, 1855 to the Present.
4 units, Spr (Simpson) TThF 9

182, 183, 184. English Literature—A basic survey required of all English majors. Students will attend two or three general lectures weekly and participate in a two-hour seminar.

182. English Literature: the Renaissance.
5 units, Aut (Evans, Ryan) MWF 10; seminars by arrangement

183. English Literature: Neoclassicism and Romanticism—Prerequisite: 182.
5 units, Win (Fifer) MWF 10; seminars by arrangement

184. English Literature: Victorian and Modern—Prerequisite: 183.
5 units, Spr (Ruotolo) MWF 10; seminars by arrangement

189. Special Work—Under exceptional circumstances advanced undergraduate students may enroll for special work under supervision of some member of the Department for credit not to exceed four units a quarter.
Any quarter, by arrangement

190. Tutorial Work, Department Honors Program.
Any quarter, by arrangement

English 192 and 196 are open only to senior English majors and to juniors in the English Honors Program. Enrollment is strictly limited. Each student must sign up for a senior seminar during the previous May pre-registration period. The class lists will contain specific topics and prerequisites. Topics
will vary from instructor to instructor and quarter to quarter.

192. Senior Seminar in English Literature.
4 units,

Aut (Felstiner) (I) MW 2:15-4:05;
(Polhemus) (II) MW 4:15-6:05
(Carnochan) (III)
TTh 4:15-6:05;
(-——) (IV) TTh 2:15-4:05;
(Ackerman) (V) MW 2:15-4:05
Win (Kolve) (I) MW 4:15-6:05;
(Harris) (II) MW 4:15-6:05;
(Sensabaugh) (III) TTh 2:15-4:05
Spr (Kolve) (I) MW 2:15-4:05;
(Kostelanetz) (II) MW 4:15-6:05;
(Ford) (III) TTh 4:15-6:05

196. Senior Seminar in American Literature.
4 units,

Aut (Middlebrook) TTh 2:15-4:05
Win (Roston) (I) MW 2:15-4:05;
(Grommon) (II) TTh 2:15-4:05
Spr (Moser) (I) MW 2:15-4:05;
(Levin) (II) TTh 4:15-6:05

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

[N.B.] Though these courses are designed primarily for English majors, graduate students in other departments who wish to broaden their programs will find many of them useful on the same basis as the Graduate Division Special Courses.

201. The Writing of Poetry—Primarily for students seriously interested in the composition of poetry. First- and second-year students may be admitted to this course and to 251 upon application. 251 must be taken simultaneously with 201 or before it. Permission of the instructor required. May be repeated for credit.

2 units, given 1967–68

203. Advanced Fiction Writing — A workshop group open by permission to graduates and exceptionally advanced seniors. All applicants should leave samples of writing with the Creative Writing secretary at least ten days before the beginning of each quarter.

2 to 5 units, Aut, Win (——) TTh 2:15–4:05
Spr (Scowcroft) TTh 2:15–4:05

204. Advanced Exposition — Advanced course dealing with problems of writing for professional purposes. Prerequisite: 3 or equivalent.

3 units, Win (——) MWF 1:15

205. The History of Criticism.
4 units, Aut (Trimpi) MWF 1:15

208. Introduction to Modern Linguistics—A survey of current developments in the study of Modern English with some attention to their applications in the teaching of English.

4 units, given 1967–68


4 units, Aut (Ackerman) MTWF 9h
Sum (Meritt) MTWThF 11h

230a. Literary Forms of the Humanistic Movement.
4 units, Win (Trimpi) MWF 1:15

230b. Continuation of 230a.
4 units, Spr (Trimpi) MWF 1:15

231. Medieval Literature—An introduction to the literature of medieval England, exclusive of Chaucer. The Anglo-Saxon poems are read in translation, the major poems of the fourteenth and fifteenth centuries in the original language. Prerequisite: 141 or equivalent.

4 units, Spr (Kolve) MTWF 10h

237. The English Drama to 1642.
4 units, Spr (Sensabaugh) TWFThF 10

238. Drama of the Restoration and Eighteenth Century.
4 units, Aut (Roston) MTWF 1

241. The English Novel through the Eighteenth Century—Study of the most significant novels, with emphasis on development of the form.

4 units, Win (Scowcroft) MTWThF 1:15

242. The English Novel in the Nineteenth
Century — Study of the most significant novels, with emphasis on development of the form.

- **4 units, Spr (Polhemus) MTWF 9**

244. The Impressionist and Experimental Novel—Prerequisite: 172 or graduate standing.

- **4 units, given 1967–68**

251. The English Lyric — Historical examination of lyric poetry considered in respect to distinctions and historical relationships of schools and movements.

- **4 units, given 1967–68**

252. English Poetry of the Nineteenth Century.

- **4 units, given 1967–68**

255. The Development of the Short Story.

- **4 units, Win ( ) TWThF 11**


- **4 units, Spr (Simpson) TWThF 11**

265. Hawthorne and Melville.

- **4 units, Win (Levin) TWThF 11**

266. Chief American Poets, from 1630 to the Present.

- **4 units, given 1967–68**

267. Emerson and Thoreau.

- **4 units, given 1967–68**

268. Narrative Prose in America—A study of most significant nonfictional narrative works, with emphasis on history and biography, including autobiography.

- **4 units, given 1967–68**

269. Twain, Howells, and James.

- **4 units, Aut (Simpson) TWThF 9**

270. Contemporary American Fiction — Study of representative novels and stories from Wharton to Nabokov.

- **4 units, Spr (Appel) MTWF 1:15**

271. Joyce and Nabokov.

- **4 units, Sum (Appel) MTWThF 10**

#278. Popular Ballad and Folksong.

- **4 units, Aut (Simpson) TWThF 11**

299. Advanced Work in Writing and Criticism.

- **Any quarter, by arrangement**

Curriculum and Instruction in Secondary School English I—See Education 262.

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**Graduate Courses**

[N.B.] All graduate seminars are limited in enrollment. Students must obtain the approval of the instructor and sign his seminar list before registering.

300. Thesis.

- **Any quarter, by arrangement**

302. Introduction to Renaissance Bibliography—An introduction to tools and methods for graduate study in the Renaissance, especially historical and textual research. Recommended for students who expect to do advanced work in the Renaissance.

- **1 unit, Win (Evans) W 1:15**

303. Seminar in Tragedy—Theory, practice of tragedy in various literatures from Aeschylius to O'Neill. Lectures, reports. Prerequisite: some introductory reading of drama.

- **4 units, Aut (Dodds) MW 2:15–4:05**

304. Seminar in Modern Literary Criticism—The use of literary criticism in graduate study and in teaching.

- **4 units, given 1967–68**

305. Seminar in the History of Literary Theory.

305a. The Classical and Medieval Backgrounds — (305a may be taken independently of 305b.)

- **4 units, given 1967–68**

305b. The Renaissance — Prerequisite: 305a.

- **4 units, given 1967–68**


- **4 units, given 1967–68**

307. Seminar in the Novel — Prerequisite: The equivalent of 241, 242, 265, or 270.


- **4 units, Spr (Scowcroft) MW 2:15–4:05**

307c. Conrad.

- **4 units, Aut (Guerard) MW 2:15–4:05**


- **4 units, Win (Carnochan) TTh 4:15–6:05**

309. Literature and Visual Arts.

- **4 units, Spr (Roston) TTh 4:15–6:05**
310. Old English—Elements of Old English grammar; reading exercises.
   4 units, Aut (Meritt) (I) TWThF 9;
   (Rigg) (II) TWThF 10
   Sum (Merritt) MTWThF 9
311. Beowulf—Prerequisite: 310 or equivalent.
   4 units, Win (Meritt) TWThF 9
312. Middle English—History, dialects of Middle English; readings of representative selections from the literature. Prerequisite: 310 or equivalent.
   4 units, Win (Ackerman) MTWTh 10
   4 units, given 1967–68
316. Seminar in Elizabethan Language—Vocabulary, pronunciation, grammar, orthography of the period. Prerequisite: 312 or equivalent.
   4 units, given 1967–68
318. Seminar in Middle English Literature—Prerequisite: 312 or equivalent.
   4 units, Spr (Ackerman) TTh 2:15–4:05
320. Seminar in Chaucer—Troilus and Criseyde in some years, selected short poems in others; structure, history of the works, their literary significance. Prerequisite: 141 or equivalent.
   4 units, Aut (Meritt) TWThF 11
321. English Literature of the Fifteenth Century.
   4 units, Win (Rigg) MW 2:15–4:05
322. Seminar in Medieval Drama.
   4 units, given 1967–68
325. Shakespeare Seminar—Prerequisites: The equivalent of 25 or 143, 182 or 330, and 237.
   4 units, Win (Whitaker) MW 4:15–6:05
   4 units, Win (Ryan) MW 4:15–6:05
331. Seminar in Literary Problems of the English Renaissance—Prerequisite: 182 or 330, or equivalent.
   331a. Jacobean Drama—Additional prerequisite: 237 or equivalent.
   4 units, given 1967–68
331b. Marlowe and His Contemporaries.
   4 units, Aut (Kocher) MW 2:15–4:05
331c. Natural and Moral Philosophy: Bacon.
   4 units, given 1967–68
331e. English Drama before Shakespeare.
   4 units, given 1967–68
331f. English Poetry from 1590 to 1620.
   4 units, Spr (Rebholz) MW 2:15–4:05
334. The Age of Milton.
   4 units, Aut (Sensabaugh) TWThF 10
334b. Seminar: Problems in Seventeenth Century Literature—Prerequisite: 330 or 334a, or equivalent.
   4 units, Win (Sensabaugh) MW 4:15–6:05
   4 units, Spr (Evans) MW 4:15–6:05
335. Victorian Prose: Carlyle, Ruskin, and Arnold.
   4 units, Aut (Harris) MW 4:15–6:05
335a. Jacobean Drama—Additional prerequisite: 237 or equivalent.
   4 units, given 1967–68
335b. Romanticism.
   4 units, Spr (Ford) MW 4:15–6:05
335c. Nineteenth Century Poetry.
   4 units, given 1967–68
338. Seminar: Literary Problems of the
Nineteenth Century—Prerequisite: 184 or 350, or equivalent.

358a. Nineteenth Century Comic Fiction.
4 units, Win (Polhemus) MW 2:15–4:05

358d. The Bloomsbury Group.
4 units, given 1967–68

361. Seminar in American Critics.
4 units, given 1967–68

4 units, Aut (Moser) TTh 4:15–6:05

371. Seminar in American Historians as Men of Letters—Prerequisite: 268 or equivalent.
4 units, given 1967–68

4 units, given 1967–68

377. Seminar in American Literature of the Colonial Period—Prerequisite: 177 or equivalent.
4 units, given 1967–68

4 units, given 1967–68

381b. Studies in Realism and Naturalism.
4 units, Win (Simpson) MW 2:15–4:05

381d. Faulkner.
4 units, given 1967–68

381e. The Romance: Hawthorne and Cooper.
4 units, Spr (Levin) MW 4:15–6:05

382. Utopian Fiction.
4 units, given 1967–68

395. 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. Seminar in the Teaching of Composition—Open only by permission of the Director of Freshman English.
2 units, Spr (Appel) W 7–9 p.m.

The English Review Club meets two times quarterly to discuss recent publications and creative work of interest to graduate students in English.

See also Senior Colloquia.

FRENCH and ITALIAN

Emeriti: Georges E. Lemaitre, Roberto B. Sangiorgi, Stanley A. Smith (Professors); Earl K. Carter, Jessie E. Smith (Assistant Professors)

Executive Head: John C. Lapp

Professors: Giovanni Cecchetti, Robert G. Cohn (on leave autumn quarter), Raymond Giraud, Alphonse G. Juillard, John C. Lapp (on leave winter and spring quarters), Robert L. Politzer, Leo Weinstein. Visiting: Raymond Picard

Associate Professors: William C. Calin, Pauline Newman-Gordon (on leave 1966–67)

Assistant Professors: Marc Bertrand, Michael T. Cartwright, Ralph M. Hester, Vincenzo P. Traversa. Visiting: Yvette Scalzitti


Lecturers: John G. Barson, Marguerite Bauer, Clio P. Dorr, Jacqueline Ollivier

The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts (see below under "Advanced Degrees"), and Doctor of Philosophy in French 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 IN FRENCH

Candidates must have completed the first- and second-year courses in reading, composition, and conversation (or their equivalent) offered in French.

Candidates are expected to complete a minimum of 36 units, selected with the approval of their adviser, from courses numbered 100 and higher. These 36 units must include:
For French majors: 111, 112, 121, and 130, 131, and 132, plus 24 additional units in literature, to include two of 150, 151, 152.

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 teachers with one or more years of experience and/or a regular 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. Detailed requirements for the course are outlined in the School of Education section.

Stanford Program in Nantes — (For French majors only.)

Each year French majors, in their junior year, may apply for the Departmental program at the University of Nantes during the 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 of the preceding year. 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

Candidates should read carefully the general regulations governing advanced degrees in the section "Degrees" in this Bulletin. Applicants for admission to graduate studies must have an undergraduate major in French with an average grade of B (or the equivalent). They should have reached a high level of speaking proficiency, to be demonstrated either through a personal interview or by a tape recording forwarded to the Department. They must also have a minimum of two years of high school Latin or the equivalent and pass examinations testing their ability to read Latin, German, and one additional Romance language, normally Italian or Spanish, before taking the written and oral examinations for the Ph.D. Another language may be substituted for German if it is required for the student's projected research.

In general, only applicants who seem fully qualified to attempt the Ph.D. will be admitted to graduate standing in the Department (except for candidates for the Master of Arts in Teaching). The course requirements for the A.M. are prerequisite for the Ph.D., but the degree of Master of Arts is not a prerequisite, and the program for the A.M. 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.

Master of Arts: French

1. Language requirements. Reading knowledge of the second Romance language should be demonstrated by passing an examination not later than the second quarter of residence.

2. Course requirements:

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Units</th>
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<tbody>
<tr>
<td>a) Cours de style avancé French 210</td>
<td>3</td>
</tr>
<tr>
<td>b) Three courses in philology French 310, 311, 312</td>
<td>9</td>
</tr>
<tr>
<td>c) Five graduate courses in literature at the 300 level</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>
</tbody>
</table>

Total: 36

Note—Students already holding the A.M. must satisfy the Department that they have met the equivalent of these requirements before admission.
DOCTOR OF PHILOSOPHY: FRENCH

General Requirements — Candidates are expected to complete the course requirements for the Masters of Arts degree in French. All candidates, regardless of their field of specialization, are expected to fulfill the following general requirements:

1. Language requirements. A reading knowledge of Latin and German, to be tested by examination. Another foreign language may be substituted for German, if it is required for the student’s projected research.

2. Course requirements. French 310, 311 and 312, if these have not already been completed in the first year; at least three additional courses in literature at the 300 level; four additional seminars in literature, at least two of which are to be outside the candidate’s special field of interest. The total of literature courses and seminars must include at least six units of work in each century.

3. Oral and written examinations. The student must pass, normally in the autumn quarter of the third year of graduate study, oral and written examinations in four fields of French literature, plus philology and the history of the French language, a field being defined as a century. For examination purposes, centuries are grouped as follows: I, Middle Ages, sixteenth and seventeenth century; II, eighteenth, nineteenth and twentieth century. Students will be examined in two centuries from each group.

4. Submit a doctoral dissertation worthy of publication as a contribution to study in the field.

Specialization in Linguistics — Requirements of specialization in linguistics are as follows:

a) A working knowledge of a third Romance language.

b) The amount of literary study required of the candidate for the Master’s Degree (i.e., 18 units), including at least one course in medieval literature.

COURSES OPEN TO ALL STUDENTS

The courses in this section do not require a knowledge of any language other than English.

GENERAL COURSE

101. Science of Language—Introduction to the fundamentals of language, its nature and function; phonological, grammatical, and lexical structure of natural languages and their development; outline of the descriptive, comparative, and historical study of language.

3 units (Juilland) given 1967-68

FRENCH

#160. Molière — Representative comedies of Molière in English translation.

3 units, Spr (Weinstein)


3 units, Spr (Giraud) TTh 10

#171. Contemporary French Novelists — Significant authors of contemporary France: Proust, Gide, Malraux, Sartre, Camus, etc. Lectures, readings in English.

3 units, Win (Cohn) TTh 11

ITALIAN

#175. Dante in English — Reading, interpretation of Vita Nuova and The Divine Comedy in translation.

3 units, Aut (Cecchetti) MWF 2:15

180. The High Renaissance—Given only at Stanford in Italy.

2 units, Aut (Frulla)

#140. The Contemporary Italian Novel in Translation—Reading, discussion of significant novels of such authors as Silone, Berto, Moravia, Verga, Pratolini.

3 units, Spr (Traversa) given 1967-68

FRENCH COURSES

FIRST- AND SECOND-YEAR

(Under the direction of Ralph M. Hester)

Note — Students registering for the first time in a first- or second-year course must take a
placement test, if they have had any training in French before entering Stanford. Tests will be given September 22, 26, 28 and October 3 (for autumn quarter); November 21 and January 4 (for winter quarter); March 1 and April 3 (for spring quarter).

#1. First-Year French.
4 units, Aut, Win, Spr (Staff) MTWThF

#2. First-Year French—Continuation of 1.
4 units, Aut, Win, Spr (Staff) MTWThF

#3. First-Year French—Continuation of 2.
4 units, Aut, Win, Spr (Staff) MTWThF

#5. Intensive French for Beginners —
( Equivalent to 1 and 2.) Offers preparation in speaking, writing, and reading the language.
8 units, Sum (Staff) MTWThF

10. Elementary French—A reading course in French for students seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to seniors and graduate students only.
3 units, Win, Spr (Staff) MWF 8

#22. Second-Year French—Prerequisite : 3.
3 units, Aut, Win, Spr (Staff) MTWTh

#23. Second-Year French — Continuation of 22.
3 units, Aut, Win, Spr (Staff) MTWTh

30. Conversation française premier degré—
Prerequisite : 3 or equivalent.
1 unit, Aut, Win, Spr, Sum (Staff) TTh 9 and TTh 1:15

31. Conversation française deuxième degré—
Prerequisite : 23 or equivalent.
1 unit, Aut, Win, Spr (Staff) TTh 9 and TTh 1:15

#54. Cours pratique de littérature—Composition littéraire, lecture et explication de textes littéraires divers. Satisfies General Studies requirements under “C.” Prerequisite : 23 or equivalent.
4 units, Aut, Win, Spr (Staff) MTWThF

#82–86. Intensive French — Given only at Stanford in France.
6 units for each of two quarters, Aut-Win, Spr-Sum (Staff) MTWTh, two hours daily

THIRD- AND FOURTH-YEAR

Language Courses
(Under the direction of Ralph M. Hester)

110. Cours de Phonétique—Prerequisite : 23 or equivalent.
3 units (Hester) given 1967–68

111. Composition, grammaire et étude de textes I—Prerequisite : 23 or equivalent.
3 units, Aut (Cartwright) MWF 11;
(Bauer) MWF 1:15

112. Composition, grammaire et étude de textes II—Continuation of 111.
3 units, Win (Cartwright) MWF 11;
(Bauer) MWF 1:15

121. Cours avancé de français—Prerequisites : 111 and 112 or equivalent.
4 units, Win (Hester) MWF 8

Literature Courses

#130. Introduction à la littérature française—Moyen-Age et 16ème siècle : choix de textes, explication de textes, composition littéraire. Prerequisite : 54 or equivalent.
3 to 4 units, Aut (Hester) (I) MWF 8;
(Calin) (II) MWF 10
Spr (Hester) MWF 8

#131. Introduction à la littérature française—17ème et 18ème siècles. Prerequisite : 54 or equivalent.
3 to 4 units, Aut (Scalzitti) MWF 11
Win (Bertrand) (I) MWF 9;
(Calin) (II) MWF 11

#132. Introduction à la littérature française—19ème et 20ème siècles. Prerequisite : 54 or equivalent.
3 to 4 units, Win (Scalzitti) (II) MWF 1:15
Spr (Bertrand) (I) MWF 11;
(Scalzitti) (II) MWF 1:15

Note—Prerequisites for the following courses are French 130, 131, and 132 or 85, and 86 or equivalent.

4 units, Win (Cadin) given 1967–68
#140. Littérature de la Renaissance I — Rabelais, les poètes lyonnais, les poètes de la Pléiade.
4 units, Win (Hester) given 1967–68

#141. Littérature de la Renaissance II — Montaigne, les poètes baroques; le théâtre.
4 units, Spr (Hester) given 1967–68

#150. Le XVIIème siècle I — Poésie et roman; les poètes baroques, Théophile de Viau, Saint-Amant, Tristan l'Hermite; les Fables de La Fontaine; Mme de La Fayette: La Princesse de Clèves.
4 units, Aut, given 1967–68

#151. La XVIIème siècle II — La tragédie; Racine: Andromaque, Athalie, Britannicus, Iphigénie; Corneille: Horace, Cinna, Polyeucte, Nicomède.
4 units, Aut (Picard) TTh 11 and Th 2:15

#152. Le XVIIème siècle III — Moralistes et prédicateurs: Pascal, Pensées; La Rochefoucauld, Maximes; Le théâtre de Molière.
4 units, Spr (——) MWF 1:15

4 units, Spr (——) MWF 1:15

#161. Le XVIIIème siècle II — Roman et théâtre. Roman: Prévost, Manon Lescaut; Diderot, La Religieuse; Rousseau, La Nouvelle Héloïse. Théâtre: Lesage, Turcaret; Marivaux, Le Jeu de l'Amour et du Hasard; Beaumarchais, Le Barbier de Séville.
4 units, Win (Cartwright) MTTh 1:15

4 units, Aut (Weinstein) MWF 10

4 units, Win (Weinstein) MWF 10

4 units, Spr (Weinstein) MWF 10

#180. Le XXème siècle I — La Poésie française de Valéry au Surréalisme.
4 units, Aut (Scalzitti) MWF 9

#181. Le XXème siècle II — Le Théâtre français de Giraudoux à Ionesco.
4 units, Spr (Bertrand) MWF 1:15

#182. Le XXème siècle III — Le Roman en France depuis 1898.
4 units, Spr (Scalzitti) MWF 9

#190. La Poésie française de Villon à nos jours.
4 units, Spr (——) MWF 11

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, each quarter (Staff) by arrangement

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

204. Études de style.
3 units (Juilland) given 1967–68

205. Modern French — Phonology, morphology, and syntax.
3 units, Aut (Juilland) MT 4:15

210. Cours de style avancé — Perfectionnement de la langue écrite; traduction de prose et de vers; composition.
3 units, Aut (Juilland) MT 4:15

3 units, Aut (Calin) M 2:15–4:05

3 units, Win (Bertrand) MWF 1:15

GRADUATE COURSES

310. Introduction à la linguistique romane, problèmes de linguistique structurale et historique.
3 units, Aut (Juilland) Th 2:15–4:05

311. Old French Texts — Reading and philological interpretation of selected old French texts. Prerequisite: 225.
3 units, Win (Calin) TTh 2:15

312. Histoire de la langue française depuis le Moyen Age jusqu'à présent — Prerequisite: French 311.
3 units, Spr (Juilland) T 4:15–6:05
Cours de méthode—Méthode critique et bibliographique, préparation de thèses.
3 units (Lapp) given 1967–68

La Renaissance en France I—Les Prosateurs; Rabelais et Montaigne.
3 units, Win (Hester) MW 2:15

La Renaissance en France II—Les poètes de la Pléiade et les poètes baroques de la fin du XVIème siècle.
3 units, Spr (Hester) TTh 1:15

Graduate Seminars.
The Chansons de Geste.
3 units, Spr (Calin) T 2:15–4:05
Montaigne.
3 units, Aut (Lapp) T 2:15–4:05
Racine.
3 units, Aut (Picard) W 2:15–4:05
Diderot.
3 units, Spr (Cartwright) Th 2:15–4:05
Flaubert.
3 units, Spr (Giraud) W 2:15–4:05
Mallarmé.
3 units (Cohn) given 1967–68

Stendhal.
3 units, Aut (Weinstein) W 4:15–6:05
Proust.
3 units, Win (Cohn) W 2:15–4:05

La Poésie moderne—L’expression du réel chez Eluard, Char, Reverdy.
3 units, Win (Scalzitti) T 2:15–4:05

Le Théâtre classique français—Corneille, Molière, Racine.
3 units (Weinstein) given 1967–68

Rousseau—Lectures in French.
3 units, Cartwright given 1967–68

Diderot—Lectures in French.
3 units (Giraud) given 1967–68

Le Roman au XVIIIème siècle.
3 units (Cartwright) given 1967–68

3 units (Weinstein) given 1967–68

Baudelaire.
3 units, Spr (Cohn) W 4:15–6:05

The Symbolist Poets.
3 units (Cohn) given 1967–68

La Critique littéraire au XIXème siècle—Sainte-Beuve, Taine, Brunetière, and others.
3 units (Weinstein) given 1967–68

La “grande génération”—Proust, Gide, Péguy, Claudel, Romain Rolland, Valéry.
3 units (Newman-Gordon) given 1967–68

Proust—Lectures in French.
3 units (Newman-Gordon) given 1967–68

Gide—Lectures in French.
3 units (Giraud) given 1967–68

Le Théâtre contemporain.
3 units (Giraud) given 1967–68

Les Poètes fantaisistes—Verlaine; Corbière, Laforgue, Apollinaire, Toulet.
3 units (Newman-Gordon) given 1967–68

Individual Work—Exclusively for graduate students in French working on thesis or engaged in special work.
1 to 12 units, each quarter (Staff) by arrangement

ITALIAN COURSES

First-Year Italian.
4 units, Aut, Win, Spr (Staff) MTWThF

First-Year Italian.
4 units, Aut, Win, Spr (Staff) MTWThF

First-Year Italian.
4 units, Aut, Win, Spr (Staff) MTWThF

Intensive Italian for Beginners—Equivalent to 1 and 2. Offers preparation in speaking, writing, and reading the language.
8 units, Sum (Staff) MTWThF

Basic Italian—A reading course in Italian for students seeking to fulfill University requirements of reading knowledge for the Ph.D. degree. Open to senior and graduate students only.
2 units, Aut, Spr (Staff) MTTh 10

Second-Year Italian—Prerequisite: 3 or equivalent.
3 units, Aut, Win, Spr (Staff)
#23. Second-Year Italian—Continuation of 22.
3 units, Aut, Win, Spr (Staff)

#82-86. Intensive Italian — Given only at Stanford in Italy.
6 units for each two quarters, Aut-Win or Spr-Sum (Staff) MTWTh two hours daily

111. Italian Grammar and Composition.
3 units, Aut (——) given 1967-68

112. Italian Grammar and Composition — Continuation of 111.
3 units, Win (——) given 1967-68

113. Italian Grammar and Composition — Continuation of 112.
3 units, Spr (——) given 1967-68

#130. Introduzione allo studio della letteratura italiana I—Dalle origini alla fine del Quattrocento. Prerequisite: 23 or equivalent.
3 units, Aut (Cechetti) MWF 1:15

#131. Introduzione allo studio della letteratura italiana II—Dal Cinquecento al tardo Settecento. Prerequisite: 23 or equivalent.
3 units, Win (Traversa) MWF 1:15

#132. Introduzione allo studio della letteratura italiana III—Dal tardo Settecento al Novecento. Prerequisite: 23 or equivalent.
3 units, Spr (Traversa) MWF 1:15

#150. Dante, La Divina Commedia—Studio e interpretazione.
3 units, Aut, given 1967-68

#151. Dante, La Divina Commedia—Studio e interpretazione.
3 units, Win (——) given 1967-68

#152. Dante, La Divina Commedia—Studio e interpretazione.
3 units, Spr (——) given 1967-68

#160. Letteratura Italiana del Medioevo—Il corso non include lo studio de La Divina Commedia.
3 units, Aut (——) given 1967-68

#161. Umanesimo e Rinascimento—La letteratura e la cultura italiana dal Petrarca a Lorenzo de’ Medici.
3 units, Aut (Cechetti) TTh 2:15

#162. Il Pieno Rinascimento—La letteratura e la cultura italiana dall’Ariosto e il Machiavelli al Tasso.
3 units, Spr (——) given 1967-68

#163. L’Ottocento — Foscolo, Leopardi e Manzoni. Aspetti del romanticismo italiano.
3 units, Aut (Cechetti) given 1967-68

#164. L’Ottocento — Da Nievo a Verga, Carducci e D’Annunzio. De Sanctis e la critica.
3 units, Win (Cechetti) given 1967-68

3 units, Spr (Cechetti) TTh 2:15

#166. Il Novecento — Poeti e romanzi da dal 1920 a oggi, specialmente Ungaretti, Montale, Quasimodo, Bontempelli, Bacelli, Palazzeschi, Moravia, Vittorini, Pavese. La critica stilistica.
3 units, Spr (Traversa) given 1967-68

LINGUISTICS AND PHILOLOGY COURSES

203. Vulgar Latin — Phonology, morphology, syntax of Vulgar Latin, as compared to Classical Latin and as established from subsequent Romance developments. Reading of selected texts. Prerequisite: working knowledge of Classical Latin.
3 units (——) given 1967-68

204. Introduction to Romance Linguistics—Development of Romance languages from Vulgar Latin; phonology, morphology, syntax. Prerequisite: working knowledge of Latin.
3 units, Win (Juilland) T 4:15-6:05

205. Old Provençal — Reading of selected poems of the troubadors, with study of Old Provençal morphology, phonology.
3 units, Win (Juilland)

207. Old Italian — Phonology, morphology of Old Italian; preliterary linguistic monuments. Introduction to Italian dialectology.
3 units (Politzer) given 1967-68

250. Seminar in Romance Linguistics—Prerequisite: 204 or equivalent.
3 units, Spr (Juilland) F 2:15-4:05

270. Topics in Structural Linguistics.
3 units, Aut, Win (Juilland) given 1967-68
Teacher Training Courses

288. Methods of Teaching French—(Same as Education 288.)
3 units, Win (Politzer) M 4:15–6:05 and by arrangement
See also Senior Colloquia.

Geography

Undergraduate courses in Geography will be offered by the Food Research Institute.

History

Executive Head: David M. Potter
Lecturer: George S. Rentz
Instructors: The Staff of the History of Western Civilization

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.

The course in the History of Western Civilization, which surveys the development of the Western world from earliest times to the present, is required by the University of all students as a necessary part of a liberal education, and supplies a foundation for the other work in the Department.

Programs of Study

Bachelor of Arts

The Department offers a variety of courses and programs for fulfilling the requirements of an undergraduate major in history. A student majoring in history must seek breadth of view by a choice of courses in three or more of the fields offered in the Department. In addition to Western Civilization, the major program must include at least one course in European or English history prior to 1600. For the degree of Bachelor of Arts, the Department requires completion of 48 units of work in history (introductory, intermediate, and advanced courses, seminars, individual reading), with an average grade of not less than C. Included in these 48 units, a basic seminar for 5 units is required. It will normally be taken in the junior or senior year.

Each undergraduate major in history shall select a minor program of at least 30 units. These units are to be distributed over no more than two fields of study; at least 20 units must be taken in courses numbered 100 or higher; and in the fields marked with an asterisk (*) courses numbered under 20 cannot be counted toward the minor. Fields accepted for the minor are defined as follows: anthropology; history of art and architecture; Asian languages*; classics*; history and theory of communication; dramatic literature and history of drama; economics; English (excluding courses numbered 5 and under); French*; geography; German*; Humanities Honors Program; Italian*; music (except composition or performance courses); philosophy; political science (including Law in Society 104); psychology (excluding courses primarily of a laboratory nature); religious studies; Russian and other Slavic languages*; Social Thought Honors Program; sociology; Spanish and Portuguese*.

(Note: General Studies senior colloquia will not count toward a minor in history.)

The Cory and Riottes scholarships are available for women students in the Department.

In order to provide for students with spe-
cial interests, the course work, seminars, and directed reading taken in the Department, together with the minor and other work taken outside, may be devoted to the development of an integrated program to cover, for example: (1) an area, such as Central Europe, the Far East, Near East, or Latin America; (2) a period, such as Europe in the Middle Ages or in the nineteenth century; (3) a country, such as France, England, Russia, the United States, or Japan; (4) a civilization, such as American civilization or Chinese civilization.

HONORS IN HISTORY

For a limited number of undergraduate majors the Department offers a special program of senior research leading to Honors in history. Students accepted for this program, in addition to fulfilling the Departmental requirements for a major, will complete 60, instead of the normal 48, units of history, including a 15-unit senior essay, the work for which will normally begin in spring quarter of the junior year and be completed by end of winter quarter of the senior year. It is expected that much of the work of the first quarter would resemble directed reading under the guidance of the essay adviser to provide an opportunity for background reading and formulation of the essay topic. To undertake this program, the student must be accepted by a member of the Department who will agree to advise him on the essay. In accepting a student for a senior project, the adviser and the Department will take into account the student's general preparation in the field of his project, and his grade standing in history and in the University (at least a B average in each). The James Birdsall Weter scholarships in history are available to a limited number of honors students; and Weter prizes may be awarded each year to authors of 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.

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, 20 Nassau Street, Princeton, New Jersey.

GRADUATE STUDY

Graduate students who have worked out a purposeful program and who are candidates for advanced degrees will be given personal guidance in their program. Work toward the Ph.D. degree is offered in a number of fields in which staff and library resources are unusually strong:

1. European History — (a) Middle Ages and the Renaissance and Reformation, especially the history of religion and technology; (b) Modern European History, especially the French Revolution and the Napoleonic period, for which Stanford has the Jarbo Collection; (c) History of Germany and France in the twentieth century; (d) History of Russia since 1914; (e) History of the Near East since 1914; (f) European History, 1914 to the present, with special reference to the origins, conduct, and results of World War I and World War II.

The rich, and in some respects unique, collections of the Hoover Institution on the causes, conduct, and results of World War I are being augmented for World War II and the period between these two wars. 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 rev-
olutions 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.

2. British History — (a) English History since 1200, for which the Library contains important documentary sets; (b) The British Empire and Commonwealth.

3. United States History — (a) British North America to 1783, for which the Library has an unusually complete collection of printed sources; (b) diplomatic history, for which Stanford has recently acquired virtually complete microfilmed records of the Department of State to 1906; (c) The National Period, for which the Library has extensive documents, newspapers, and manuscript collections; (d) History of the Far West, particularly California since 1848, for which use may be made of the Borel Collection.

4. Latin American History — particularly Brazil, for which the Library contains the important Branner Collection.

5. The Far East — (a) Diplomatic History of the Far East; (b) History of Japan; (c) History of China. The Stanford Library and Hoover Institution have important materials for Far Eastern History, including large holdings of works in Western languages, such as runs of important serials and newspapers and extensive documentary collections of World War II in Asia, and also basic source and reference materials in the Chinese and Japanese languages, especially for the nineteenth and twentieth centuries.

6. African History — (a) Sub-Saharan Africa to 1880; (b) Sub-Saharan Africa since 1880; (c) Northern Africa; (d) Southern Africa; (e) Comparative Tropical History. The Hoover Institution has an outstanding collection for the study of Africa from 1860 on, especially for French-speaking Africa, the former British colonies, and South Africa.

**Master of Arts**

The Department requires for the Master's degree the completion of 45 units of graduate study, at least 36 of which must be in the Department. The candidate's program must include two graduate seminars involving the preparation of research papers. A reading knowledge of one modern foreign language is required. The Department will not recognize for the degree requirements 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.

**Doctor of Philosophy**

General requirements relative to time, examination, and dissertation are stated in the section “Degrees” in this Bulletin. The Department requires a reading knowledge of two foreign languages, selected as having the greatest relevance to the student's dissertation and research program. In special cases, a coherent program of graduate courses outside the major and minor departments may be substituted for one foreign language.

The candidate is expected to plan his work and write his dissertation under the direction of the member of the Department designated as his adviser and sponsor. The Department requires preparation in one major field and two secondary fields. The major field is to be selected from the following: (1) Europe, 300–1400; (2) Europe, 1400–1789; (3) Europe Since 1700; (4) Russia and East Central Europe; (5) The Near and Middle East; (6) East Asia; (7) Britain and the British Empire Since 1485; (8) Latin America; (9) The United States (including Colonial America). The secondary fields are somewhat more limited in scope, and normally cover about half of one of the major fields listed above. Ancient Greece or Rome may also be chosen as a secondary field.

A minor in another department or a supporting program of not fewer than twenty-five units of advanced and graduate courses, taken as a graduate student, at least fifteen
units of which shall be in one discipline (e.g., American literature, economics, political science) may be substituted for one of the two secondary fields.

The candidate will include in his program a graduate course (History 300) in historiography, a graduate course (History 301) in American historiography if the thesis field is American history, and a graduate course (History 302) in methods of teaching at the college level.

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, and of fellowships offered in connection with it, see the section "Humanities (Special Programs)" in this Bulletin.

The Department has about fifteen student assistantships and several research assistantships and teaching assistantships which are customarily held by candidates for advanced degrees.

I. INTRODUCTORY COURSES

Required of all students. Opportunities for individual study are open to a small group of carefully selected students.

#1. History of Western Civilization—Western Civilization to circa A.D. 1000; prehistoric man; ancient Orient; Greece, Rome, early Middle Ages.
4 units, Aut (Staff)

#2. History of Western Civilization—Major developments in Western Civilization in later Middle Ages, Renaissance, seventeenth and eighteenth centuries.
4 units, Win (Staff)

#3. History of Western Civilization—Nineteenth, twentieth centuries.
4 units, Spr (Staff)

II. INTERMEDIATE COURSES

Courses numbered 10-99 are designed primarily for sophomores and juniors.

20. Medieval Europe, 300-1400—Emphasis on transition from ancient Mediterranean to European civilization, development of medieval social, cultural institutions and ideas.
5 units, Aut (Bark) MTWTh 9

30. Europe in the Seventeenth and Eighteenth Centuries—Economic, political, cultural survey of seventeenth, eighteenth centuries.
5 units, Aut (Dawson) MTWThF 10

5 units, Win (——) MTWThF 10

32. Twentieth Century Europe—Political, social, economic, cultural developments to present. Not open to students who have had an advanced course in twentieth century European history.
5 units, Spr (Wright) MTWThF 10

60. Interpretive Survey of United States History.
4 to 5 units, Spr (Bailey) MTWTh 9

62. Nineteenth Century America—The period from 1800 to 1900 viewed as a whole in a series of topics selected because of their continuing relevance in the twentieth century.
4 to 5 units, Aut (Fehrenbacher) MTWTh 1:15

78. Tradition and Reform in Latin America—Survey of political and social change from Cortes to Castro.
5 units, Aut (Wirth) MTWTh F 1:15

91. East Asian Civilizations—Origin and development of the civilizations of China and Japan.
5 units, Aut (Mancall) MTWThF 9

5 units, Win (Mancall) MTWThF 9

93. East Asian Civilizations—The recent period.
5 units, Spr (Buss) MTWThF 9

III. ADVANCED COURSES

Courses numbered 100 and 101 (basic seminars and colloquia) are open only to juniors and seniors majoring in history. Requests for admission to basic seminars and colloquia are submitted to the Department office and involve permission of the instructor. Lecture courses numbered 105-199 are open to juniors, seniors and graduate stu
dents; sophomores may be admitted by permission of the instructor.

Courses in directed reading for undergraduates are designed not as a substitute for but as a supplement to lecture courses. Prerequisites: at least an average grade of B in the University; at least an introductory course in the field; third- or fourth-year standing; and permission of the instructor. In a few cases one or more of these prerequisites may be waived by special action of the Department.

Courses in senior research are intended primarily (though not exclusively) for Honors candidates engaged in writing senior theses.

A. UNDERGRADUATE SEMINARS AND COLLOQUIA

100. Basic Seminar—An introduction to the method and problems of historical research and writing. Required of undergraduate majors in history.

5 units, Aut, Win, Spr, Sum (Staff)


5 units, Aut (Seaver)


5 units, Spr (Miller)

101c. Undergraduate Colloquium: European Socialisms in the Nineteenth and Twentieth Centuries.

5 units, Win (Wright)

101d. Undergraduate Colloquium: Rationalism and Irrationalism in European Thought.

5 units, Spr (Craig)

101e. Undergraduate Colloquium: Problems in Nineteenth Century American History.

5 units, Win (Fehrenbacher)

101f. Undergraduate Colloquium: Interpretations of the American Character.

5 units, Spr (Potter)

101h. Undergraduate Colloquium: Problems of United States Asian Policy.

5 units, Win (Buss)

101i. Undergraduate Colloquium: Comparative Revolutions.

5 units, Aut (Mancall)

101s. Undergraduate Colloquium: The Island of Taiwan.

5 units, Win (Van Slyke)

101w. Undergraduate Colloquium: Twentieth Century America.

5 units, Aut (Bernstein)


5 units, Aut (Knoles)

102b. Undergraduate Colloquium: Problems in Modern Russian History.

5 units, Win (Emmons)

102c. Undergraduate Colloquium: Nationalism in Latin America.

5 units, Spr (I. Johnson) given 1967–68

102d. Undergraduate Colloquium: Origins of the Cold War.

5 units, Spr (Lederer) given 1967–68

102e. Undergraduate Colloquium: Social Classes in Modern History.

5 units, Spr (Smith)

102f. Undergraduate Colloquium: Tropical History.

5 units, Spr (Mancall)

102h. Undergraduate Colloquium: Cultural and Intellectual Currents in Modern Africa.

5 units, Spr (W. Johnson)

B. THE ANCIENT WORLD

See Classics, Section V, Courses 100, 101, 102, 103, 111, 112, 113, 201, 202, all of which are accepted for credit toward a major in history.

C. MEDIEVAL AND RENAISSANCE EUROPE

105. The Emergence of Medieval Europe—Genesis of European civilization from end of Roman political unity through Carolingian period.

3 units, Win (Bark) TTh 9

107. The High Middle Ages—Such aspects of European civilization in twelfth, thirteenth centuries as papacy and Holy Roman Empire, French and English monarchical states, Crusades, medieval towns, rise of universities, scholasticism, Gothic art.

3 units, Spr (Bark) TTh 9
108. Medieval Antisemitism — An inquiry into the causes of antisemitism in the period in which intense anti-Jewish feeling first developed and many of the characteristic beliefs of modern antisemitism were formulated. Considerable use will be made of sociological theories about ethnic prejudice.

5 units, Spr (Langmuir)


5 units, Win (Spitz) MTWTh 10

110. Age of the Reformation — Europe in early modern times with special emphasis on the Protestant Reformation and Catholic reform.

5 units, Win (Spitz) MTWTh 10 given 1967–68

114. Directed Reading in Medieval History.

3 to 5 units (Bark, Langmuir) by arrangement

115. Senior Research in Medieval History.

1 to 5 units (Bark, Langmuir) by arrangement.

116. Directed Reading in Renaissance-Reformation History.

3 to 5 units (Spitz) by arrangement

117. Senior Research in Renaissance-Reformation History.

1 to 5 units (Spitz) by arrangement

118. The Byzantine Empire—Major political, religious, social, and cultural development of the Byzantine or East Roman Empire from the founding of Constantinople in the Fourth Century to its fall in 1453.

3 units, Aut (Vucinich) given 1967–68

D. MODERN EUROPE

120a. Kievan and Muscovite Russia (to 1689).

4 to 5 units, Aut (Emmons)

120b. Imperial Russia 1689–1905.

4 to 5 units, Win (Emmons)

121. Twentieth Century Russia.

4 to 5 units, Spr (Emmons)


4 to 5 units, Aut (Lederer) given 1967–68

122b. Russian Foreign Relations Since 1917.

4 to 5 units, Win (Lederer) given 1967–68

123. Non-Russian Peoples of the Soviet Union—Major problems concerning the origins and history of some of the more important non-Russian peoples of the U.S.S.R.

3 units, Spr (Vucinich) given 1967–68

124. Russia and Eastern Europe: Relations in the Slavic World.

4 to 5 units, Aut (Lederer)


4 to 5 units, Win (Vucinich)

126. History of the Balkan Peoples Since 1914.

4 to 5 units, Spr (Vucinich)

128. Germany in the Nineteenth Century.

4 to 5 units, Aut (Craig)

129. Germany in the Twentieth Century.

4 to 5 units, Win (Craig)


5 units, Win (Dawson)

131. Europe in the Revolutionary Period, 1789–1815.

3 to 4 units, Win (Dawson) given 1967–68

132. Modern France—1848 to the Present.

3 to 4 units, Aut (Wright) MWF 10

135. European Diplomacy Since 1815.

4 to 5 units, Spr (Craig) given 1967–68

138. Directed Reading in Modern European History.

3 to 5 units (Craig, Dawson, Emmons, Harris, Lederer, Vucinich, Wright) by arrangement

139. Senior Research in Modern European History.

1 to 5 units (Craig, Dawson, Harris, Vucinich, Wright) by arrangement

E. THE BRITISH COMMONWEALTH AND EMPIRE

140. England to 1460.

5 units, Aut (Langmuir)
   4 to 5 units, Win (Seaver)

142. Stuart England.
   4 to 5 units Spr (Seaver)

143. Britain, 1714–1867—Emphasis on domestic political, economic and social history, but foreign and imperial affairs will be included as they influenced the country’s general development.
   4 to 5 units, Win (Lyman)

144. Britain Since 1867—See description of 143 (above).
   4 to 5 units, Spr (Lyman)

145. Directed Reading in British History.
   3 to 5 units (Lyman, Seaver)

146. Senior Research in British History.
   1 to 5 units (Lyman, Seaver)

F. AFRICA

147a. History of Tropical Africa to 1880—Geography and peoples of Africa, traditional African society and culture, early Sudanic empires, Islamic and Arabic impact, European explorations, the slave trade, later African states, missionaries and commerce, and early European colonial expansion.
   4 to 5 units, Aut (W. Johnson)

   4 to 5 units, Win (W. Johnson)

148a. France and Britain in West Africa—Comparative history of French and British involvement in West Africa: explorations, conquest, colonial systems, political institutions; varieties of African protest, rise of political parties, decline of colonial rule; assessment of colonial legacies; case studies of Ghana and Senegal.
   4 to 5 units, Spr (W. Johnson)

148b. Expansion of Europe Overseas—History of political, economic, and cultural imperialism of European nations from the Renaissance to the twentieth century. Emphasis on reaction of non-European societies to Western culture; problems of acculturation, assimilation, and institutional transfer. Special attention is paid to Africa.
   4 to 5 units, Spr (W. Johnson)

149a. Directed Reading in African History.
   3 to 5 units (W. Johnson)

149b. Senior Research in African History.
   1 to 5 units (W. Johnson)

G. THE UNITED STATES

150. The Colonial Period.
   3 units, Aut (Miller)

151. The Revolution, Confederation and Constitution.
   5 units, Win (Miller)

154. American Diplomatic History to 1898.
   4 to 5 units, Aut (Bailey) MTWTh 9

155. American Diplomatic History Since 1898.
   4 to 5 units, Win (Bailey) MTWTh 9

158. The Great West in American History—Exploration, settlement, and historical influence of the Trans-Mississippi West.
   4 units, Spr (Fehrenbacher) given 1967–68

159. History of California—From Spanish period to present, emphasis upon twentieth century.
   4 units, Spr (Fehrenbacher)

160. The South in American History to 1861—Factors of regional distinctiveness; the staple crop economy; the plantation system and its social structure; slavery; economic conditions of the Old South; the South as a minority; Southern political reactions and the development of the sectional crisis.
   4 to 5 units, Aut (Potter) MTWThF 11

161. The South in American History Since Reconstruction—Factors of regional distinctiveness; conditions in the post-bellum South; the rise of tenancy; the legend of the “New South”; Bourbonism and the Populist revolt; disfranchisement; the one-party system; the collapse of the cotton economy; the crisis of biracialism; industrialization, urbanization, and the passing of the traditional South.
   4 to 5 units, Win (Potter) MTWThF 11

163. A Political History of the American People, 1854–1914—Transformation of
American politics during sectional rivalry, Civil War, and industrial growth; government, the economy, and reform; urban culture, minorities, and a middle-class consensus.

4 to 5 units, Win (——)

164. A Political History of the American People Since 1914 — Political process and economic power during prosperity, depression, and two wars; accompanying transformation in American culture.

4 to 5 units, Spr (——)


4 to 5 units, Win (Knoles)

167. American Intellectual History: Twentieth Century—American thought and expression during twentieth century; influences acting upon intellectual, cultural development.

4 to 5 units, Spr (Knoles)

168. American Social History, 1600-1870—Development of American society from the first settlements to the decade of Civil War and Reconstruction. Particular attention is devoted to the content of national character and culture; the changing functions and forms of religion, the family and education; developing social structure; and the shifting nature of race relations.

4 to 5 units, Win (Bernstein)

169. American Social History Since 1870—Development of American society from Reconstruction until the present, with emphasis on the impact of industrialization and urbanization, the relations of classes, and racial and ethnic groups. These problems will be related to national character and culture, and the changing nature of American social institutions.

4 to 5 units, Spr (Bernstein)

174. Directed Reading in United States History.

3 to 5 units (Bailey, Bernstein, Fehrenbacher, Knoles, Miller, Potter)
by arrangement

175. Senior Research in United States History.

1 to 5 units (Bailey, Bernstein, Fehrenbacher, Knoles, Miller, Potter)
by arrangement

H. LATIN AMERICA

176. Latin America to 1825 — Discovery, conquest, growth of political, social, economic institutions; Wars of Independence in Spanish, Portuguese America.

4 units, Aut (J. Johnson) MTWTh 11

177. Modern Latin America—Political, social, economic institutions in leading republics since independence.

4 units, Win (J. Johnson) MTWTh 11

179. Historical Evolution of Mexico—Economic, social development since 1850 and Mexican foreign relations, especially with United States in twentieth century.

3 units, Spr (J. Johnson)

180. Nineteenth Century Brazil, 1808–1914 —Survey of neo-colonial Brazil from independence and the Imperial era through the First Republic to World War I.

3 units, Win (Wirth)

181. Contemporary Brazil, 1914–1965—Politics and society in transition from agrarian to industrial bases, the rise of nationalism, and Brazil's role in the hemisphere and international organizations.

3 units, Spr (Wirth)

184. Directed Reading in Latin American History.

3 to 5 units (J. Johnson, Wirth)
by arrangement

185. Senior Research in Latin American History.

1 to 5 units (J. Johnson, Wirth)
by arrangement

I. MIDDLE EAST


4 to 5 units, Aut (Vucinich)


3 units, Spr (Rentz)

188. History of the Islamic World, 1258–1803—Expansion and contraction of the Is-
I. HISTORY

255. Islamic domains and internal changes from the fall of the Abbasid Caliphate to the first occupation of Mecca by the House of Sa'ud.

3 units, Spr (Rentz) given 1967–68

189. History of the Islamic World Since 1803 — Advance and retreat of European colonialism in Islamic territories, development of modern Islamic states, and recent adjustments in Islamic society.

3 units, Spr (Rentz) given 1968–69

J. EAST ASIA

190. Chinese Social History—Problems in the history of Chinese social and economic development.

3 units, Win (Mancall) given 1967–68

192. Modern China — 1800 to the present, emphasis on rebellions, reforms, revolutions, and resistance to changes.

3 units, Win (Van Slyke)

193. Communist China—Origin and rise of the Chinese Communist party; internal developments and foreign policy of China under the Communists.

3 to 4 units, Spr (Van Slyke)

194a. Japan, 1600–1890 — Development of institutions and thought; early relations with the West; the Meiji Restoration and the beginnings of modernization. Emphasis on latter half of the period.

3 to 4 units, Aut (Smith)

194b. Japan Since 1890—Japan’s development as a modern nation; industrialization; urbanization; political and constitutional development; relations with the West; World War II; the Occupation; post-occupation Japan.

3 to 4 units, Win (Smith)

195. History of Sino-Soviet Relations.

4 units, Win (Mancall)

196. United States and the Far East—Genesis, growth of American interests, policies in Far East, emphasis on immediate background of contemporary period.

4 to 5 units, Sum (Buss)

197. History of Southeast Asia.

4 to 5 units, Spr (Buss)

198. Directed Reading in Far Eastern History.

3 to 5 units (Buss, Mancall, Smith, Van Slyke) by arrangement

199. Senior Research in Far Eastern History.

1 to 5 units (Buss, Mancall, Smith, Van Slyke) by arrangement

IV. GRADUATE COURSES

Courses numbered 200–299 are intended primarily for first-year graduate students, but more advanced graduate students may be admitted by permission of the instructor.

205. Graduate Seminar in Medieval History.

5 units, Spr (Bark)

210. Graduate Seminar in Early Modern Europe.

5 units, Win (Spitz)


5 units, Aut (Harris)

220. Graduate Seminar in Russian History.

5 units, Aut (Lederer)

221. Graduate Seminar in Russian History.

5 units, Spr (Emmons)


5 units, Win (Vucinich)

228. Graduate Seminar in Modern Germany.

5 units, Aut (Craig)


5 units, Spr (Dawson)

235. Graduate Seminar: Twentieth Century Europe.

5 units, Spr (Wright)

240. Graduate Seminar in Medieval English History.

3 to 5 units, Win (Langmuir)


5 units, Aut (Seaver)

243. Graduate Seminar in Modern British History.

5 units, Aut (Lyman)

248. Graduate Seminar: Topics in African History.

5 units, Win (W. Johnson)
250. Graduate Seminar in American Colonial History.
   5 units, Spr (Miller)

252. Graduate Seminar in Nineteenth Century United States History.
   5 units, Win (Fehrenbacher)

253. Graduate Seminar in Twentieth Century United States History.
   5 units, Spr (——)

   5 units, Win (Bernstein)

255. Graduate Seminar in American Diplomatic History.
   5 units, Aut (Bailey)

258. Graduate Seminar in American Intellectual History.
   5 units, Aut (Knoles)

260. Graduate Seminar in History of the South.
   5 units (Potter) given 1967–68

262. Introduction to Doctoral Study in American History—Open only to first-year graduate students in American History.
   5 units, Aut (Potter)

280. Graduate Seminar in Latin American History.
   5 units, Aut (J. Johnson)

282. Graduate Seminar in Latin American History.
   5 units, Win (Wirth)

290. Graduate Seminar in the History of Modern China.
   5 units, Aut (Van Slyke)

292. Graduate Seminar in the History of Japan.
   5 units, Spr (Smith)

   5 units, Aut (Buss) given 1967–68

V. ADVANCED GRADUATE COURSES

Courses numbered 300–399 are intended primarily for second- and third-year graduate students, but first-year graduate students may be admitted by permission of the instructor.

300. Historiography—Writings, influence of great historians, Herodotus to present. Required of all doctoral candidates in history.
   5 units, Aut, Win, Spr (Staff)

301. American Historiography—Main currents in historical research and writing relevant to United States from earliest days.
   5 units, Spr (Bailey)

302. The Teaching of History—Methods of teaching history at the college level.
   1 unit, Aut, Win, Spr (Staff) by arrangement

309. Graduate Colloquium: Topics in Medieval History.
   5 units, Win (Langmuir)

310. Graduate Colloquium: The Fall of the Roman Empire.
   5 units, Win (Bark)

314. Directed Reading in Medieval History.
   Units by arrangement (Bark, Langmuir)

315. Graduate Research in Medieval History.
   Units by arrangement (Bark, Langmuir)

316. Directed Reading in Renaissance and Reformation.
   Units by arrangement (Spitz)

317. Graduate Research in Renaissance and Reformation.
   Units by arrangement (Spitz)

318. Graduate Colloquium: The Course of Christian Humanism.
   5 units, Spr (Spitz) given 1967–68

319. Graduate Colloquium: Humanism and the Reformation.
   5 units, Spr (Spitz)

320. Graduate Colloquium on Seventeenth Century Continental Europe.
   5 units, Win (Dawson) given 1967–68

   5 units, Spr (Seaver)

322. Graduate Colloquium: Europe, 1685–1789.
   5 units, Win (Dawson)

323. Graduate Colloquium: Russia.
   5 units, Aut (Emmons)

325. Graduate Colloquium: Topics in Balkan and Near East History.
   5 units, Spr (Vucinich)
328. Graduate Colloquium: Topics in Modern European History.
   5 units, Spr (Craig)
329. Graduate Colloquium: Problems in Nineteenth Century European History.
   5 units, Win (Craig)
335. Graduate Colloquium: Europe 1890–1950.
   5 units, Aut (Wright)
338. Directed Reading in Modern European History.
   Units by arrangement (Craig, Dawson, Emmons, Lederer, Vucinich, Wright)
339. Graduate Research in Modern European History.
   Units by arrangement (Craig, Dawson, Emmons, Lederer, Vucinich, Wright)
340. Graduate Colloquium: Topics in Modern British History.
   5 units, Spr (Lyman)
345. Directed Reading in British History.
   Units by arrangement (Lyman, Seaver)
346. Graduate Research in British History.
   Units by arrangement (Lyman, Seaver)
349a. Directed Reading in African History.
   Units by arrangement (W. Johnson)
349b. Graduate Research in African History.
   Units by arrangement (W. Johnson)
355. Graduate Colloquium in Colonial History.
   5 units, Win (Miller)
358. Graduate Colloquium: American Intellectual History.
   5 units, Spr (Knoles)
360. Graduate Colloquium: American Politics from Jackson to Lincoln.
   5 units, Aut (Fehrenbacher)
   5 units, Spr (Bernstein)
374. Directed Reading in United States History.
   Units by arrangement (Bailey, Bernstein, Fehrenbacher, Knoles, Miller, Potter)
375. Graduate Research in United States History.
   Units by arrangement (Bailey, Bernstein, Fehrenbacher, Knoles, Miller, Potter)
380. Graduate Colloquium in Latin American History.
   5 units Win (J. Johnson)
382. Graduate Colloquium: Latin American Historians.
   5 units, Spr (Wirth)
384. Directed Reading in Latin American History.
   Units by arrangement (J. Johnson, Wirth)
385. Graduate Research in Latin American History.
   Units by arrangement (J. Johnson)
390. Graduate Colloquium: Topics in Modern Chinese History.
   5 units Aut (Van Slyke)
395. Graduate Colloquium in Japanese History.
   5 units, Win (Smith)
398. Directed Reading in Far Eastern History.
   Units by arrangement (Buss, Mancall, Smith, Van Slyke)
399. Graduate Research in Far Eastern History.
   Units by arrangement (Buss, Mancall, Smith, Van Slyke)

**HUMANITIES (SPECIAL PROGRAMS)**

*Executive Head*: John W. Dodds  
*Director*: Lawrence V. Ryan (Graduate Program in Humanities)

*Professors*: Robert M. Brown (Religion), John W. Dodds (Humanities), Paul H. Kocher (English and Humanities), Philip H. Rhinelander (Philosophy and Humanities)

*Associate Professors*: William A. Clebsch (Religion), Edwin M. Good (Religion and Hebrew), Jeffery Smith (Humanities and Philosophy)

*Assistant Professor*: Michael J. Novak (Religion)

Special Programs in Humanities include:

1. Undergraduate Honors Program in Humanities.
2. Graduate Program in Humanities.
3. Curriculum in Religion.

UNDERGRADUATE HONORS PROGRAM

Committee in Charge: John W. Dodds (Chairman), Alfred Appel, Philip Dawson, Edwin M. Good, George Knoles, Kurt Mueller-Vollmer, Lucio P. Ruotolo, George F. Sensabaugh, Jeffery Smith

PURPOSE OF THE PROGRAM

The Honors Program aims to develop a greater sense of the relatedness of various fields, and to increase the student's awareness of basic values—intellectual, aesthetic, social, and ethical. The Committee in charge, composed of representatives of several departments in the Humanities, will help each student to plan a balanced and integrated program.

ADMISSION TO THE PROGRAM

A University average of at least B is required for admission to the program and for graduation with "Honors in Humanities."

Freshmen and sophomores interested in the program should consult with the chairman of the Honors Committee (Room 51M). If possible this should be done before the end of the freshman year, especially in the case of students going to overseas campuses, as scheduling adjustments may be necessary.

The program is open to majors in any field, and is usually taken in addition to a departmental major. In some cases, however, the student may enroll as a Humanities major:

1. If he is taking the pre-medical curriculum
2. If he elects a concentration in Religion in lieu of a departmental major
3. If he completes a 40-unit concentration carefully planned and approved by his tutor and the Honors Committee

REQUIREMENTS OF THE PROGRAM

1. World Literature—Humanities 61, 62, 63—15 units, sophomore year.
2. Humanities Seminars—12 units, junior year.
3. Senior Colloquia in Humanities — 2 units autumn and 2 units spring, senior year.
4. Senior Essay—A critical essay usually centered in the departmental field, but not confined to it (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."

Each student should plan a program that will give him a substantial background for his prospective senior essay. This is especially important for students majoring in the social, biological or physical sciences.

COURSES, FIRST AND SECOND YEAR

21. World Personalities—A study of the lives of selected individuals of world significance, such as Socrates, St. Francis, Leonardo da Vinci, Van Gogh, Madame Curie, Gandhi, Churchill, and Hitler. Each series will include representatives of several cultures, occupations and personality structures. Each student will write a term paper on a personality of his own choosing, preferably related to his field and special interest.

21. World Personalities I.
4 units, Win (Smith) MWF 1:15, given 1967-68

22. World Personalities II.
4 units, Win (Smith) MWF 1:15

#61, 62, 63. World Literature and the History of Ideas — An introduction to fundamental ideas of the past; lectures, discussions, reading of selected masterpieces of literature. The course is conceived of as a unity; it is strongly recommended that students take all three quarters in sequence. Students in the Undergraduate Honors Program will be enrolled in special two-hour discussion sections and will receive five units for each course.

#61. Classic Literature—Homer, Greek dramatists, Plato, Aristotle, Lucretius, Virgil, Gospels of Mark and John.
4 units (5 units for Honors students)
Aut (Otis, Staff) TWTh 11 and one hour by arrangement (two hours for Honors students)

#62. Medieval and Renaissance Literature—Augustine, medieval epics, Aquinas, Dante, Marlowe, Thomas More, Cervant-
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tes, Erasmus, Calvin, Montaigne, Spenser, Molière, others.

4 units (5 units for Honors students)
Win (Evans, Staff) TWTh 11
and one hour by arrangement
(two hours for Honors students)

#63. Literature of the Enlightenment and the Modern World—Camus, Dosto-
evsky, Flaubert, Goethe, Ibsen, Kafka, Rousseau, Sartre, Voltaire, others.

4 units (5 units for Honors students)
Spr (Sokel, Staff) TWTh 11
and one hour by arrangement
(two hours for Honors students)

THIRD AND FOURTH YEAR

175. Individual Work — For students with definite objectives not met by current course offerings.

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

176. Individual Study: Sequoia.

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

191, 192, 193. Interdepartmental Seminars on the Nature of the Humanities — These seminars are concerned with the nature of the humanities. In the first quarter emphasis is placed on principles and methods of humanistic study. The second quarter is concerned with the arts, both verbal and non-verbal, and with aesthetic principles involved in the study of them as part of the humanities. The third quarter focuses on philosophy and history and on problems relating to their humanistic interpretation.

In each quarter the broad subject is treated through specific works, which will vary from section to section, and from year to year. Each student presents a class report, which, following discussion, is developed into a term essay.

191. Seminar in Humanities.

4 units, Aut (Friedlander, Mueller-Vollmer, Smith) by arrangement

192. Seminar in Humanities.

4 units, Win (Harris, Rhinelander, Smith) by arrangement

193. Seminar in Humanities.

4 units, Spr (Clebsch, Dawson) by arrangement

199. Humanities Colloquium—The analysis and interpretation of significant documents and works of art in terms of fundamental meaning. Individual works discussed will center about a general theme selected for the quarter. Required of all honors students during senior year; open by permission of Director, Honors Program, to a limited number of students not enrolled in the Program.

2 units, Aut (Good, Hastings) by arrangement
Spr (Levin, Scowcroft) by arrangement

200. Senior Essay—An essay of about 15,000 words.

12 units (Staff) by arrangement
See also Senior Colloquia.

GRADUATE PROGRAM

Committee in Charge: John W. Dodds (Chairman), Raymond D. Giraud, John D. Goheen, Paul H. Kocher, Brooks Otis, Philip H. Rhinelander, Lawrence V. Ryan (Director), Friedrich W. Strothmann

The Graduate Program in Humanities supplements the doctoral programs of certain departments (Classics, English, French and Italian, History, Modern European Languages, Philosophy, Speech and Drama), with an interdepartmental program devoted to the study of the Western tradition as a whole. The degree offered is a joint Ph.D., awarded in "History and Humanities," "Philosophy and Humanities," "English and Humanities," etc.

Because the Graduate Program in Humanities is designed as a supplement to, and not as a substitute for, departmental specialization, its courses may be taken only by students who have been accepted for graduate work by one of the seven cooperating departments and whose applications have been approved by the Committee in Charge. Students entering the program should expect to take it in its entirety and should consult with the Director and their major advisers about its articulation with their departmental studies.

REQUIREMENTS

1. For entering the Program: Candidates may apply to the Director for entrance to the Program upon qualifying for graduate study in one of the participating departments.
2. Within the Program:
   a) Continued work in the candidate's major field in accordance with departmental requirements. For these requirements the prospective student should consult the departmental listings.

   b) Participation in one course for each of six quarters in the "Western Traditions" series — reading, interpretation, and discussion of significant writers. This Western Traditions course is divided, according to the Stanford quarter system, as follows: The Classical and Patristic Periods (1st and 2d quarters); The Medieval Period (3d quarter); The Renaissance (4th quarter); The Eighteenth and Nineteenth Centuries (5th quarter); The Modern Period (6th quarter).

   c) Participation in two Graduate Humanities Seminars. The Seminars discuss basic intellectual and educational problems of the present in the light of Western traditions. The themes of the first seminar may change from year to year. That of the latter is fixed. Topics to be treated in 1966–67 will be: Humanism and the Scientific Enterprise (2d quarter); The Functions of a University and the Meaning of Education (3d quarter).

   d) Submission of a Ph.D. dissertation acceptable to both the Humanities Committee and the major department, as well as to the University Committee on the Graduate Division.

   e) The passing of a reading examination in two foreign languages, one ancient and one modern. (Certain departments require a third language.) One of these examinations must be passed during the first two quarters of the candidate's second year of work beyond the A.B. degree.

   f) The passing of a comprehensive written examination in Humanities and the University oral examination.

FELLOWSHIPS

The Program awards a number of fellowships which are available to properly qualified students. Detailed information concerning these may be obtained by writing to the Director of the Program.

GRADUATE COURSES

301. The Classic Period: Greece.
   4 units, Aut (Rhinelander) MTWTh 9, given 1967–68

302. The Roman and Patristic Periods.
   4 units, Win (Clebsch, Otis) MTWTh 9, given 1967–68

303. The Middle Ages.
   4 units, Spr (Calin) MTWTh 9, given 1967–68

304. The Renaissance.
   4 units, Aut (Kocher, Ryan) MTWTh 9

305. The Eighteenth and Nineteenth Centuries.
   4 units, Win (Goheen, Weinstein) MTWTh 9

306. The Modern Period.
   4 units, Spr (Mueller-Vollmer) MTWTh 9

351, 353. Basic Humanistic Problems.

351. Basic Humanistic Problems.
   4 units, Win (Rhinelander) MW 2:15–4:05

353. The Functions of a University and the Meaning of Education.
   4 units, Spr (Wert) TTh 2:15–4:05

RELIGIOUS STUDIES

Committee in Charge: John W. Dodds (Chairman), Robert M. Brown, William A. Clebsch, Edwin M. Good, Robert M. Minto, Brooks Otis, Philip H. Rhinelander, Lawrence V. Ryan, Friedrich W. Strothmann, James T. Watkins IV

The Curriculum in Religious Studies is designed to provide the essentials for an understanding of Biblical Religion and of the Christian inheritance in its basic documents, in its history and doctrine, in its relation to contemporary life and to alternative worldviews. Certain of the offerings are listed in the General Studies Bulletin to which reference should be made.

CONCENTRATION IN RELIGIOUS STUDIES

A student taking the Honors Program in Humanities may declare a major in Humanities and offer a concentration in Religious Studies. The concentration, to be planned with the student's adviser, consists of 40 units in religion and related subjects, of
which no less than 25 units are in courses in the Curriculum in Religious Studies. The 40 units must be distributed as follows:

1. One full course (4–5 units each) in each of the methods of study of religion. This is fulfilled by one course from each of the four following groups of courses in the Curriculum in Religious Studies: 101–109; 120–139; 140–159; 160–179. Exceptions must be approved by the committee on the concentration in Religious Studies.

2. Four full courses (4–5 units each) which comprise a coherent plan of studying the bearing of religion on human existence. The plan, which is subject to approval by the student’s adviser, may be built around a period or episode in history (e.g., the Reformation, the Crusades, the settlement of New England), a form of human creativity (e.g., music, art, dance, poetry), a sociological grouping (e.g., the Negro American, Latin Americans, revolutionaries), or a typically human problem (e.g., freedom, identity, pain and evil). The plan must include at least one course in the Curriculum in Religious Studies and at least one relevant course in another department. Normally this plan will be related to the subject of the student’s Senior Essay in Humanities.

3. The remainder of the 40 units, if any, shall be in any courses proposed by the student and approved by his adviser.

**Courses**


5 units, Aut (Good) MTWTh 10


5 units, Win (Good) MTWTh 1:15

105. The Prophets of Israel — (Formerly R155) One or more of the most significant prophets as poets and thinkers. Major motifs: Covenant, Sin, Judgment, Mercy, Future Hope.

5 units, Spr (Good) given 1967–68


5 units, Spr (Good) MW 2:15–4:05


5 units, Aut (Good) given 1967–68


5 units, Aut (Good) given 1970–71

120. The Ancient Cultures of the Near East — (Formerly R101) Beginnings of civilization in Mesopotamia. Sumerian, Babylonian, Assyrian, Canaanite, Hittite cultures and religions.

5 units, Aut (Good) MW 2:15–4:05

#121. History of Classical Christian Thought — (Formerly R104) An introduction to the theological history of Christianity in ancient and medieval times; representative theologians and the relation of their thought to classical, Byzantine, and medieval culture.

5 units, Aut (Clebsch) given 1967–68

#122. History of European Christian Thought — (Formerly R105) An introduction to the theological history of Christianity in the Europe of the Renaissance, Reformation, and Enlightenment; representative theologians and the relation of their thought to imperial and national European culture.

5 units, Win (Clebsch) given 1967–68


5 units, Win (Clebsch) given 1967–68

127. Aquinas—A study of the ethical theory of Thomas Aquinas in its historical setting: the practical wisdom of the secular man and the charity of the Christian; natural law; personality and grace.

5 units, Win (Novak) MTWTh 9

131. English Religious Thought—(Formerly R188) Leading religious thinkers representing such movements as Reformation, Puri-
tanism, rationalism, pietism, romanticism; their relation to historical, intellectual and literary developments in England.

5 units, Win (Clebsch) MTWTh 10

132. American Religious Thought — (Formerly R120) Leading religious thinkers of the colonial and national periods; their relation to historical, intellectual, and literary movements in America.

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

141. Contemporary Trends in Religious Thought—(Formerly R115) Examination of the thought of present-day theologians such as Niebuhr, Bultmann, Tillich, Barth, and others, through study of their own writings.

5 units, Aut (Brown) MTWTh 9

145. The Ecumenical Movement — (Formerly R195) An examination of the development of ecumenical concern in the twentieth century in both Protestantism and Roman Catholicism. Particular attention will be given to the World Council of Churches, the Second Vatican Council, and the writings of ecumenical theologians. Prerequisite: permission of instructor.

5 units, Aut (Brown, Novak) given 1967-68

146. Ecumenical Theologians—A study of the roles assigned intelligence and love in selected ethical writings of contemporary Protestant and Catholic theologians.

5 units, Win (Novak) MTWTh 11

148. The Modern Catholic Renaissance — A survey of creative novelists, dramatists, philosophers, theologians, historians, and social thinkers whose work has revivified Roman Catholicism in the twentieth century: Moehler, Acton, Newman, Peguy, Mauriac, Claudel, Maritain, Guardini, Marcel, Greene, deLubac, Rahner, etc.

5 units, Aut (Novak) MTWTh 11

#154. Christian Ethics — (Formerly R114) Relationship of Christian faith to ethical decisions, both corporate and individual. Historical treatment will be followed by consideration of such contemporary problems as race, nuclear war, sex and marriage, political responsibility, compromise.

5 units, Win (Brown) given 1967-68

161. Introduction to Christian Theology — (Formerly R113) Major areas of doctrine, in ecumenical perspective. Particular attention to problem of revelation and reason, and Christian views of God, man, Christ, the church, providence and evil, death and resurrection.

5 units, Aut (Brown) MTWTh 9

162. Christian and Secular Ethics—In what ways does a strictly philosophical ethic differ from a Christian ethic? Problems of logic and language in both Christian and philosophical ethics. The historical influences of philosophy upon Christian ethics, and of Christianity upon philosophical ethics. This course considers the theoretical rather than the immediate issues of ethics.

5 units, Aut (Novak) MTWTh 9

165. Theologies of History — (Formerly R186) A historical study of various theological interpretations of history and culture in the classical, medieval, and modern periods.

5 units, Aut (Clebsch) given 1967-68

#172. Theology and Contemporary Literature — (Formerly R182) Theological issues raised by contemporary writers, both Christian and non-Christian. Consideration of Camus, Salinger, Greene, Eliot, Silone, Albree, Bellow, and others.

5 units, Spr (Novak) MTWTh 9

174. Philosophy and Christianity—A study of selected problems in the history of Western thought which arose from the confluence of philosophical inquiry and Christian faith: concepts of personality, conscience, freedom, history, love, decision, existence, science, social reform, God.

5 units, Win (Novak) given 1967-68

175. Belief and Unbelief — A study of the fundamental issues involved in the decision whether or not to believe in God, and of the differences in practice between atheism, agnosticism and belief which might follow upon this choice. The course is both historical and analytical in method; classical and contemporary sources will be studied.

5 units, Spr (Novak) MTWTh 9

#184. Christian Classics—(Formerly R150) One major thinker or controversy will be studied in religious and historical setting and for its permanent significance.

4 units, Win (Clebsch) given 1967-68

190. Senior Seminar in Religion.

5 units, Win (Brown) given 1967-68

199. Individual Work.

(Staff) by arrangement
MULTILINGUALISM

299. Directed Reading for Graduate Students.
(Staff) by arrangement

For related courses see the departments of Anthropology, Classics, English, History, Modern European Languages, and Philosophy. Hebrew Language—See Classics.

LATIN AMERICAN STUDIES

Committee in Charge: The Committee on Latin American Studies, a subcommittee of the Committee on International Studies
Chairman: John J. Johnson (Professor, History)

MASTER OF ARTS

1. Candidacy. The Master of Arts degree is the sole degree in Latin American studies offered by the University. All applicants for admission to the A.M. program must have completed an equivalent of the training represented by an A.B. or B.S. degree and must demonstrate a working knowledge of Spanish or Portuguese.

Applicants are also required to take the Aptitude Test of the Graduate Record Examination and to have the results of the examination sent to the Office of Graduate Admissions. 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, 20 Nassau Street, Princeton, New Jersey.

Students who wish to remain at Stanford after completing their A.M. degrees in the program must apply for Ph.D. candidacy in one of the participating departments. In special circumstances a qualified candidate may be permitted to design an interdisciplinary doctoral program focused on the area. For further information, see the section “Graduate Division Special Programs” in this Bulletin.

2. Requirements.

a) Language (Spanish or Portuguese) — Proficiency in translation from English, into English, free composition, aural comprehension, and oral skill, a level of achievement corresponding to Spanish 113 or Portuguese 113.

b) Courses—45 units work including:
1) Nine units in an interdisciplinary core seminar, three units per quarter.
2) Eighteen units in a single discipline.
3) Eighteen units divided among no less than two nor more than three participating departments.

The Departments of Anthropology, Economics, History, Modern European Languages, Political Science, and Sociology, and the Food Research Institute participate in the program. Relevant courses may be found under the listing for those departments.

The student's program is designed in consultation with a member of the Latin American Studies Committee. If Modern European Languages is his base discipline, he must show ability in Spanish and Portuguese, one at the advanced level, the other intermediate. Courses in Linguistics may be counted toward this concentration. Where the base discipline is not a language, one of the supporting disciplines must be a language, with courses to be determined by the student's level of proficiency.

c) Thesis—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.

Inquiries concerning this program should be directed to the Chairman, Committee on Latin American Studies, Bolivar House, Stanford, California 94305.

LINGUISTICS

Committee in Charge:
Chairman: Charles A. Ferguson
Professors: Robert W. Ackerman, Charles A. Ferguson, Joseph H. Greenberg, Alphonse Juilland, Robert L. Politzer
Associate Professor: Dorothy A. Huntington
Assistant Professor: Andrew M. Devine
PROGRAMS OF STUDY

MASTER OF ARTS

Candidacy—Candidates for the degree of Master of Arts in Linguistics must have completed an equivalent of the training represented by an A.B. or B.S. degree. The student's program should be prepared in advance in consultation with the Chairman of the Committee.

Requirements

1. Language. A reading knowledge of French and German, as established by Committee examination or certification.

2. Course. 40 units of graduate work, selected among courses listed below, and distributed approximately as follows:
   a) 15 units in general linguistics (descriptive, comparative, and historical linguistics; phonology, morphology, syntax; lexicology, dialectology, typology, etc.).
   b) 15 units in a particular language or language family (graduate courses of the chosen language department).
   c) 10 units in a particular linguistic discipline (e.g., Anthropological Linguistics, Psycholinguistics, Sociolinguistics, Statistical Linguistics, etc.).

3. Examination. Satisfactory passing of a written examination on the principles of Linguistics and on the particular language family chosen by the student.


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. Prospective candidates should consult the general requirements for the degree as outlined by the School of Education in this Bulletin and make inquiry of the Chairman of the Committee on Linguistics concerning the requirements for the academic major.

MINOR IN LINGUISTICS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The requirements of the Ph.D. minor in Linguistics are roughly equivalent to those of the A.M. major in Linguistics, above. Programs of courses are to be established in accordance with the student's interest, in consultation with a committee adviser. A substantial term paper is required instead of a thesis.

DOCTOR OF PHILOSOPHY

Candidacy—Candidates should read carefully the requirements governing the conferring of this degree, as described in the section “Degrees” of this Bulletin. For specific requirements and recommendations, the student should consult with the Chairman of the Committee. Candidates must have completed the equivalent of the course requirements for the Master of Arts in Linguistics, or in a given language (e.g., A.M. in French, or in German, or in Russian, etc.), or, with the Chairman's approval, in a related field (e.g., A.M. in Anthropology, or in Philosophy, or in Sociology, or in Psychology, or in Speech Pathology and Audiology, etc.).

Requirements

1. Language. A reading knowledge of French and German, and of one other research language, to be established by Committee examination or certification.

2. Course (beyond the A.M.) 40 units of graduate work, exclusive of dissertation units, selected among courses listed below, numbered 200 or above, and distributed approximately as follows:
   a) 15 units in general linguistics (descriptive, comparative, historical linguistics; phonology, morphology, syntax, lexicology, dialectology, typology, etc.).
   b) 15 units in a particular language or language family (graduate courses of a given language department).
   c) 10 units in a related discipline (e.g., Anthropological Linguistics, Mathematical Linguistics, Psycholinguistics, Sociolinguistics, Statistical Linguistics, etc.).

3. Examinations.
   a) Successful passing of a written Committee examination on:
      1) The principles of general linguistics (descriptive, comparative, and historical).
      2) The methods and techniques of the main linguistic disciplines (phonology, morphology, syntax, lexicology, dialectology, typology, etc.).
linguistics, morphology, syntax, lexicology, dialectology, typology, etc.)

3) One related discipline (e.g., Anthropological Linguistics, or Mathematical Linguistics, or Psycholinguistics, or Sociolinguistics, or Statistical Linguistics, etc.).

4) The language of specialization (e.g., Latin Linguistics, French Linguistics, English Linguistics, Russian Linguistics, etc.), or the language family of specialization (e.g., Indo-European Linguistics, or Amerindian Linguistics, or African Linguistics, etc.; Romance Linguistics, or Germanic Linguistics, or Slavic Linguistics, etc.).

b) Successful passing of an oral examination which will normally consist of a defense of the dissertation in the pre-final form.

4. Dissertation. An original dissertation of such substance and scope as would justify publication (15 units).

**Courses**

Courses recognized toward the A.M. and Ph.D. degrees in Linguistics are those listed below, and those approved by the Committee.

**200. Historical Linguistics**—Introduction to the principles and methods of historical linguistics; the development of modern schools and trends of historical linguistics in the nineteenth and twentieth centuries.

*3 units, Spr (——) M 4:15–6:05*

**201. Introduction to Comparative Linguistics (Indo-European)**—The emphasis is on phonology and special attention is paid to the development of English.

*3 units, Aut (Devine) T 1:15–3:05*

**202. Comparative Indo-European Phonology**—Continuation of 201. Some short early texts are also studied. Prerequisite: 201 or permission of instructor.

*4 units, Win (Devine) T 1:15–3:05*

**205. Comparative Indo-European Morphology**—Continuation of 202. Prerequisite: 202 or permission of instructor.

*4 units, Spr (Devine) T 1:15–3:05*

**299. Independent Study.**

*By arrangement*

**301. Seminar in Structural Linguistics**—Lectures, readings, and reports on the principles, methods, and techniques of the structural approach to language.

*3 units, Aut (Staff) by arrangement*

**302. Seminar in Structural Linguistics**—Lectures, readings, and reports on the principles, methods, and techniques of the structural approach to language.

*3 units, Win (Staff) by arrangement*

**303. Seminar in Structural Linguistics**—Lectures, readings, and reports on the principles, methods, and techniques of the structural approach to language.

*3 units, Spr (Staff) by arrangement*

**399. Independent Study.**

*By arrangement*

**GENERAL COURSES**

(See French and Italian)

**101. Science of Language.**

**ANTHROPOLOGY**

**160. Anthropological Linguistics.**

**165. Descriptive Linguistics.**

**167. Language and Culture.**

**262. Phonetics and Phonemics.**

**263. Morphology and Syntax.**

**264. Typology and Universals of Language.**

**ASIAN LANGUAGES**

Chinese **291. History of the Chinese Language.**

Japanese **291. History of the Japanese Language.**

**COMMUNICATION**

**211. Theory of Communication I.**

**212. Theory of Communication II.**

**ENGLISH**

**102. Introduction to the English Language.**

**208. Introduction to Modern Linguistics.**

**209. Principles of Standard English.**

**310. Old English.**
312. Middle English.
316. Seminar in Elizabethan Language.

**FRENCH**

(See French and Italian)

204. Etudes de style.
205. Modern French.
208. Methods of Teaching French.
310. Grammaire historique française.
311. Old French Texts.

**GERMAN**

(See Modern European Languages)

155. History of the German Language.
190. German Applied Linguistics.
205. Modern German.
221. Gothic and Historical German Grammar.
223. Old Norse.
225. Old Saxon.
227. Old High German.
228. Middle High German.
229. Advanced Middle High German.

**ROMANCE LINGUISTICS AND PHILOLOGY**

(See French and Italian or Modern European Languages)

180. An Introduction to General Linguistics.
203. Vulgar Latin.
204. Introduction to Romance Linguistics.
205. Old Provençal.
207. Old Italian.
250. Seminar in Romance Linguistics.
270. Topics in Structural Linguistics.

**PHILOSOPHY**

157a. Introduction to Logic.
157b. Intermediate Logic.
181. Philosophy of Language.

**SLAVIC**

(See Modern European Languages)

201. Synchronic Phonology, Morphology, and Syntax of Russian I.

202. Synchronic Phonology, Morphology, and Syntax of Russian II.
203. Synchronic Phonology, Morphology, and Syntax of Russian III.
204. Synchronic Phonology, Morphology, and Syntax of Russian IV.
211. Old Church Slavonic I.
212. Old Church Slavonic II.
221. Diachrony of East Slavic and Readings in Old Russian I.
222. Diachrony of East Slavic and Readings in Old Russian II.
226. Diachrony and Synchrony of South Slavic.
227. Diachrony and Synchrony of Western Slavic.
228. Divergence of Slavic Languages.
250. Graduate Seminar in Linguistics.

**SPANISH**

(See Modern European Languages)

205. Modern Spanish.
260. History of the Spanish Language.
261. Old Spanish.
263. Historical Spanish Linguistics I.
264. Historical Spanish Linguistics II.
266. Hispanic Dialectology.
299. Individual Work.

**SPEECH AND DRAMA**

1. Characteristics of Spoken Language.

**SPEECH PATHOLOGY AND AUDIOLOGY**

110. Principles of Phonetics.
112. Introduction to Phonetic Theory.
130. Introduction to Speech Science.
220. The Psychology of Speech.
222. Models of Communication.
223. Speech and Language Development.
252. Aphasia.
253. Aphasia in Children.
310. Experimental Phonetics I.
311. Experimental Phonetics II.
312. Experimental Phonetics III.
MATHEMATICS

Emeriti: Stefan Bergman, Charles Loewner, William A. Manning, George Polya, Gabor Szego (Professors)

Acting Executive Head: Donald C. Spencer


Assistant Professors: Mary V. Sunseri. Acting: Michael G. Crandall, Arthur M. Jaffe

Instructors: Stephen B. Agard, Robert O. Burdick, Alan Howard, Arnold S. Kas, Paul Rabinowitz, William J. Sweeney

OFFERINGS AND FACILITIES

The introductory courses consist of four alternative sequences in analytic geometry and calculus (10, 11, 21, 22, 23, 44, 45, 46, or 41, 42, 43, 44, 45, 46, or 41, 52, 53, 54, 55, or 41, 62, 63). These courses are provided for students who wish to graduate with a major in mathematics and for students in other departments who need or desire mathematics above the level of secondary school mathematics. Mathematics majors and others who plan further study in mathematics should elect one of the sequences including Mathematics 44 or 54. Students who desire a conventional introduction to analytic geometry and the calculus and plan no further study in mathematics should complete their course with Mathematics 24 following 23 or 43. Students electing one of the above series are expected to complete the work in that series. Changes from one series to another are permitted only by special arrangement.

Honors sequence Mathematics 52, 53, and 54 and 55 is an honors course in calculus for students intending to major in mathematics or the physical sciences. These courses cover the material contained in Mathematics 42, 43, and 44, 45 and 46, but students who take this sequence need to spend less time on drill, and consequently it is possible to explore some of the interesting implications of calculus in science, engineering, and mathematics. Prerequisites: Mathematics 41 and the consent of the instructor.

The calculus sequence 41, 62, 63 is a special version of the 41, 42, 43, 24 series primarily for students majoring in one of the behavioral sciences. This sequence stresses applications to probability theory and the behavioral sciences.

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 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. Advisers on advanced placement are currently Professors Mary Sunseri and H. M. Bacon.

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, 45, 46, or 41, 42, 43, 44, 45 and 46, or 41, 52, 53, 54, 55). These courses should be started during the first year.
Students intending to major in mathematics are advised to begin or continue the study of French, German, or Russian in the first year.

2. Two quarters of Algebra (113, 120); two quarters of Differential Equations (130, 131); two quarters of Fundamental Concepts of Analysis (115, 116); one quarter of Higher Geometry (142) [one quarter of Non-Euclidean Geometry (157), Introduction to Topology (159), or of Differential Geometry (217a) may be substituted for this course]; one quarter of Introduction to Functions of a Complex Variable (106).

3. Nine units of courses in mathematics numbered above 100 in addition to those listed in “2.” The average grade point ratio in these courses and the courses listed under “2” above must be not less than 2.00.

4. French 23, German 23, or Russian 52; Physics 51, 52, 53, 54, 55, 56, 57.

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 which will ordinarily consist of a minimum of 45 units, at least 36 of which will be in this department. The Master's Thesis is optional: If a thesis is presented, the candidate's program must contain 15 units of 200-level courses (in addition to the thesis). If no thesis is to be presented, the candidate's program must include 24 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. Certain exceptions to the 45 unit requirement above are possible. In particular, a student will be recommended for the M.S. degree upon completion of an approved program of 36 units of 200 level Mathematics courses with grades of B or better.

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). These courses should include Mathematics 205a, b, c, 206a, b, c, 210a, b. 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. This program must either display sufficient breadth in mathematics outside the student's field of specialization, or fulfill the requirements for a minor in another department. In addition, the student must pass his second language examination and the University oral examination, and submit an acceptable dissertation. 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.

A candidate for the Ph.D. degree in Mathematics may specialize in computer science and submit his dissertation in this area. He must satisfy the usual requirements for the degree as established by the Mathematics Department. Since he must also be expert in certain areas of computer science he should confer early with the Computer Science Department in planning his program. In view of the necessary work in computer science, consideration will be given to a reduction in the variety of other mathematics courses required for the 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 Department secretary.

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 41, 52, 53, 54) together with 15 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 and 46 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 41, 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 113, 120, 142, 152a, 157, and CS136 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 teachers with one or more years of experience and/or a regular teaching credential who wish to further 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 ten or more students enroll.

0. **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.

4 units, **Aut, Win (——) MTWThF 10 or 2:15**

#1. **Elementary Mathematical Analysis I**—Structure of the real number system; logic of algebra; fundamental concepts of geometry and trigonometry. No credit allowed if taken after courses numbered 10 or higher.

3 units, **Win (Bacon) MWF**

#2. **Elementary Mathematical Analysis II**—Introduction to the basic ideas of analytic geometry and calculus; applications. No credit allowed if taken after courses numbered 10 or higher. Prerequisite: 1.

3 units, **Spr (Bacon) MWF**

#10. **Analytic Geometry and Calculus**—Distance, slope, equations of lines, functions and graphs, derivative of a function, velocity and rates, properties of limits, polynomials and their derivatives, rational functions, rules for differentiation, implicit relations, chain rule for derivatives, differentials, continuity, related rates, curve tracing, maxima and minima with applications, Rolle's Theorem, Mean Value Theorem. Continuation in the course depends upon the student's passing a qualifying examination given during the first week of the course and covering algebra and trigonometry. Prerequisites: algebra and trigonometry.

3 units, **Aut (——) MWF 8, 10, or 2:15**

Win (——) MWF 10, 12, or 2:15

#11. **Analytic Geometry and Calculus**—Continuation of 10. Curves and equations, tangents and normals, Newton's method for finding roots, circle, parabola, ellipse, hyperbola, translation and rotation of coordinate axes, invariants, conics, indefinite integral, differentiation of sines and cosines, area under a curve, definite integral and the fundamental theorem of calculus, trapezoid rule. Prerequisite: 10.

3 units, **Win (——) MWF 8, 10, or 2:15**

Spr (——) MWF 10, 12, or 2:15

#21. **Analytic Geometry and Calculus**—Continuation of 11. Area between two curves, volumes, length of arc, surface of revolution, average value of a function, moments and center of mass, theorems of Pappus, hydrostatic pressure, work, trigonometric functions, inverse trigonometric func-
tions, the logarithmic and exponential functions. Prerequisite: 11.

3 units, Aut (——) MWF 8 or 3:15
Spr (——) MWF 8, 10, or 2:15

#22. Analytic Geometry and Calculus —

3 units, Aut (——) MWF 9, 11, or 1:15
Win (——) MWF 8 or 3:15

#23. Analytic Geometry and Calculus —
Continuation of 22. Polar coordinates, angle between tangent and radius vector, areas, parametric equations, vector components, differentiation of vectors, curvature, tangential and normal acceleration, space coordinates, vectors, scalar product, planes and lines in space, space curves, cylinders, quadric surfaces, partial derivatives, tangent plane, chain rule for partial derivatives. Prerequisite: 22.

3 units, Win (——) MWF 9, 11, or 1:15

#24. Analytic Geometry and Calculus —
Continuation of 23 or 43 (below). Recommended for students not expecting to take further courses in mathematics. Students who wish to continue in more advanced courses in mathematics should enroll in Mathematics 44 (below) following 23. Vector product, planes, product of three vectors, directional derivative, gradient, total differential, maxima and minima, higher order derivatives, exact differentials, double integrals and applications, cylindrical coordinates, triple integrals, spherical coordinates, surface area, series, convergence tests, power series, Taylor's theorem, Taylor's series, the Hospital's rule, absolute and conditional convergence, differential equations of first order (homogeneous, linear), special second order differential equations, the Hospital's rule. Prerequisite: 42.

5 units, Aut (——) MTWThF 8
Spr (Sunseri) MTWThF 8;
(Bacon) MTWThF 9;
(Sunseri) MTWThF 10

#42. Analytic Geometry and Calculus —
Continuation of 41.

5 units, Win (Sunseri) MTWThF 8;
(Bacon) MTWThF 9;
(Sunseri) MTWThF 10

#43. Analytic Geometry and Calculus —
Continuation of 42. Improper integrals, Simpson's rule, determinants, simultaneous equations, hyperbolic functions, inverse hyperbolic functions, polar coordinates, polar curves, angle between radius vector and tangent line, areas, parametric equations, vector components, differentiation of vectors, tangential and normal acceleration, space coordinates, vectors, scalar product, planes and lines in space, space curves, cylinders and quadric surfaces, functions of several variables, partial derivatives, tangent plane, chain rule for partial derivatives, differential equations of first order (homogeneous, linear), special second order differential equations, the Hospital's rule. Prerequisite: 42.

5 units, Aut (——) MTWThF 12
Spr (Sunseri) MTWThF 8;
(Bacon) MTWThF 9;
(Sunseri) MTWThF 10

#44. Advanced Calculus I—Infinite series, convergence tests, parallel topics on improper integrals. Uniform convergence. Power series. Prerequisite: 23 or 43 or concurrent registration in 23 or 43 and consent of instructor.

3 units, Aut (——) MWF 9, 11, or 1:15
Win (——) MWF 8 or 3:15

#45. Advanced Calculus II—Vectors in the plane and space, linear dependence, inner product, vector product. Geometry of lines and planes. Vector functions of one variable, curves and motion. Functions of several variables, gradient, partial derivatives, differentials, extreme values, line integrals, two dimensional integrals. Prerequisite: 44 or concurrent registration in 44.

3 units, Aut (——) MWF 9 or 11
Win (——) MWF 9, 11, or 1:15
Spr (——) MWF 2:15

#46. Advanced Calculus III—Multiple integrals, vector functions of several variables, divergence theorem, Stokes' theorem. Curvilinear coordinate systems, differential geom-
etry of surfaces. Vector spaces of higher dimension. Prerequisite: 45.

3 units, Win (——) MWF 9 or 1:15
Spr (——) MWF 9 or 2:15

#52. Honors Calculus—Honors version of 42, with greater emphasis on the fundamental concepts and rigorous development of the calculus and more extensive discussion of its applications. Prerequisites: 41 or equivalent, and consent of instructor.

5 units, Win (——) MTWThF 9

#53. Honors Calculus—Continuation of 52.

5 units, Spr (——) MTWThF 9

#54. Honors Calculus—54 and 55 together constitute an honors version of 44, 45, 46.

3 units, Aut (——) MWF 9

#55. Honors Calculus—54 and 55 together constitute an honors version of 44, 45, 46.

3 units, Win (——) MWF 9

#62. Calculus—(Enroll in Statistics 62.)

#63. Calculus—(Enroll in Statistics 63.)

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

Calculus through Mathematics 44 or consent of the instructor is required for the courses listed below:

106. Introduction to Theory of Functions of a Complex Variable—Complex numbers, analytic functions, Cauchy-Riemann equations, complex integration, Cauchy formula; elementary conformal mappings. Prerequisite: 45.

3 units, Aut (——) MWF 11:
(——) MWF 2:15
Spr (——) MWF 2:15
Sum (——)

107. Theory and Applications of Functions of a Complex Variable—Further development of the theory and applications of analytic functions, including the Schwarz-Christoffel transformation, asymptotic integration, differential equations and special functions in the complex domain, and conformal mapping. Prerequisite: 106 or equivalent.

3 units, Win (——) MWF 11

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;
(——) MWF 1:15
Win (——) MWF 10;
(——) MWF 1:15
Sum (——)

113h. Linear Algebra and Matrix Theory (Honors).

3 units, Aut (——) MWF 9

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
Spr (——) MWF 10

114h. Linear Algebra and Matrix Theory (Honors).

3 units, Win (——) MWF 9

115. Fundamental Concepts of Analysis—Rigorous treatment of real numbers, limits, function, continuity, differentiability, integral, infinite series, other infinite processes. Especially recommended for students who intend to take graduate work in mathematics.

3 units, Aut (——) MWF 11;
(——) MWF 2:15
Win (——) MWF 11;
(——) MWF 2:15


3 units, Win (——) MWF 11
Spr (——) MWF 11


3 units, Spr (——) MWF 11

120. Modern Algebra—Integral domains,
fields, polynomials, divisibility theory, groups. Prerequisite: 113.

3 units, Win (——) MWF 1:15
    Spr (——) MWF 1:15

121. Modern Algebra—Continuation of 120.
    3 units, Spr (——) MWF 1:15

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. The method of characteristic functions will be developed. Classical limit theorems for sequences of independent random variables are discussed in some detail. Some special types of stochastic processes will be covered as well as various examples of combinatorial problems.

3 units, Win (——) MWF 10

124. Theory of Probability — Continuation of 123.

3 units, Spr (——) MWF 10

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.

3 units, Aut (——) MWF 8, 11, or 2:15
    Win (——) MWF 10
    Sum (——)

130h. Ordinary Differential Equations (Honors).

3 units, Aut (——) MWF 11


3 units, Win (——) MWF 8, 11, or 2:15
    Spr (——) MWF 10

131h. Partial Differential Equations (Honors).
    3 units, Win (——) MWF 11


3 units, Spr (——) MWF 8, 11, or 2:15

136. Introduction to Algorithmic Processes—(Enroll in Computer Science 136.)

137. Numerical Analysis—(Enroll in Computer Science 137.)

138. Numerical Analysis—(Enroll in Computer Science 138.)

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, Aut (Bacon) MWF 8, alternate years, given 1967–68

152a. Elementary Theory of Numbers—Euclid’s algorithm, fundamental theorems on divisibility; prime numbers; congruence of numbers; theorems of Fermat, Euler, Wilson; congruence of first and higher degrees; Lagrange’s theorem, its applications; residues of power; quadratic residues; introduction to theory of binary quadratic forms.

3 units, Aut (——) MWF 2:15


3 units, Aut (Bacon) MWF 8, alternate years, given 1966–67

159. Introduction to Topology—This course will cover some of the basic properties of metric and topological spaces; compactness, connectedness, and continuity. Special attention will be paid to the Euclidean spaces; and the fixed-point and degree of mapping theorems will be developed. Enrollment is limited to undergraduates.

3 units, Win (——) alternate years, given 1967–68

160a. Symbolic Logic—(Enroll in Philosophy 160a.)

160b. Symbolic Logic—(Enroll in Philosophy 160b.) Continuation of 160a.

161. Introduction to Set Theory—(Enroll in Philosophy 161.)

162. Theory of Automata—(Enroll in Philosophy 162.)

195. Undergraduate Colloquium—Based on reading and discussion of topics in history and philosophy of mathematics. Prerequisite: consent of instructor.

3 units, Aut (——) T 2:15–5:05
199. Undergraduate Honors.
(Staff) by arrangement

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS


205a. 3 units, Aut (Ornstein) MWF 10
205b. 3 units, Win (Ornstein) MWF 10
205c. 3 units, Spr (Ornstein) 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, Riemann surfaces, Uniformization theorem. Prerequisite: 116 or equivalent.

206a. 3 units, Aut (Osserman) TTh 1:15–2:30
206b. 3 units, Win (Osserman) TTh 1:15–2:30
206c. 3 units, Spr (Osserman) TTh 1:15–2:30

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 (Cohen) MWF 1:15
210b. 3 units, Win (Cohen) MWF 1:15
210c. 3 units, Spr (Cohen) MWF 1:15

212. Proseminar — The emphasis is on the solution of problems of non-routine type. This course serves as an introduction to independent study and research, and is recommended to all first-year students.

3 units, Aut (Loewner) MW 4:00-5:30

217a,b,c. Differential Geometry — Classical differential geometry of curves and surfaces. Differentiable manifolds, tensors, and differential forms, connections, Riemannian metric, geodesics, spaces of constant and nearly constant curvature, Morse theory.

217a. 3 units, Aut (Samelson) MWF 11
217b. 3 units, Win (Samelson) MWF 11
217c. 3 units, Spr (Samelson) MWF 11

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 (Schiffer)
   TTh 11:00–12:15
220b. 3 units, Win (Schiffer)
   TTh 11:00–12:15
220c. 3 units, Spr (Schiffer)
   TTh 11:00–12:15

221a. Calculus of Variations — Euler-Lagrange equations, sufficient conditions; applications to eigenvalue problems, geometry, mechanics; direct methods, Dirichlet's principle.

3 units, Spr (——) MWF 1:15

229a,b,c. Mathematical System Theory — (Enroll in Engineering Mechanics 239a, b, c.)

3 units, Aut, Win, Spr (——) TTh 11:00–12:15

230a,b. Advanced Probability — (Enroll in Statistics 230a, b.)

232a,b,c. Topics in Stochastic Processes — Basic concepts. Markov chains in continuous time. Boundary theory. Markov processes and potential theory. Prerequisite 230a, b, or permission of instructor.

232a. 3 units, Aut (Chung) TTh 11:00–12:15
232b. 3 units, Win (Chung) TTh 11:00–12:15
232c. 3 units, Spr (Chung) TTh 11:00–12:15

237a,b,c. Advanced Numerical Analysis — (Enroll in Computer Science 237a, b, c.)

240. Topics in Function Theory — Nevanlinna theory and related topics. Meromorphic functions in the disk and in the plane. Introduction to meromorphic curves.

3 units, Spr (Osserman)


244a. 3 units, Aut (Royden) MWF 10
244b. 3 units, Win (Royden) MWF 10

246a,b,c. Complex Manifolds — Definition and examples of complex manifolds, vector
bundles, sheaves, Hermitian and Kähler metrics, cohomology with coefficients in sheaves, differential geometric method, Hodge manifolds, deformation of compact complex manifolds.

246a. 3 units, Aut (Kodaira) MWF 1:15
246b. 3 units, Win (Kodaira) MWF 1:15
246c. 3 units, Spr (Kodaira) MWF 1:15


247a. 3 units, Win (Kodaira) MW F3:15
247b. 3 units, Spr (Kodaira) MW 3:15

253a,b. Topics in Analysis.
253a. 3 units, Aut (Schiffer) MWF 11
253b. 3 units, Win (Schiffer) MWF 11

254a,b. Ordinary Differential Equations — Fundamental existence theorems, stability and asymptotic behavior of nonlinear systems, Poincaré-Bendixson theorem, linear systems and Sturm-Liouville eigenvalue problems; selected topics from equations in the complex domain; Fuchsian theory, Hamiltonian systems, optimal control problems, singular perturbations, existence of periodic solutions and orbital stability.

3 units, Win, Spr, alternate years, given 1967–68


256a. 3 units, Aut (Finn) MWF 2:15
256b. 3 units, Win (Finn) MWF 2:15
256c. 3 units, Spr (Finn) MWF 2:15

257a,b. Overdetermined Systems of Linear Partial Differential Equations — An introductory course in which compatibility conditions for overdetermined systems are defined and existence of local solutions is established in special cases. Applications to geometry are indicated.

257a. 3 units, Win (Spencer) MWF 10
257b. 3 units, Spr (Spencer) MWF 10


261a. 3 units, Aut (McGregor) MWF 9
261b. 3 units, Win (McGregor) MWF 9
261c. 3 units, Spr (Karlin) MWF 9

264. Topics in Abstract Analysis.
3 units, Aut (Katznelson) by arrangement


3 units, Aut (Phillips) TTh 1:30–2:45

271a,b. Mathematics of Wave Motion — Analytical techniques for the calculation of varied wave phenomena, with emphasis on the use of fundamental solutions (localized source functions), asymptotic integration and integral equations. Illustrative problems obtained from the subjects of elasticity, electromagnetic theory and magnetohydrodynamics.

271a. 3 units, Aut (Levine) MWF 1:15
271b. 3 units, Win (Levine) MWF 1:15


281a. 3 units, Aut (—) MW 1:15
281b. 3 units, Win (—) MW 1:15
281c. 3 units, Spr (—) MW 1:15

283a,b,c. Selected Topics in Topology — Topics from: fiber spaces and fiber bundles, characteristic classes, cohomology opera-
tions, sheaves, homology of groups. Prerequisite: 281 or equivalent.
283a. 3 units, Aut (Araki) MWF 9
283b. 3 units, Win (Araki) MWF 9
291a,b,c. Set Theory — (Enroll in Philosophy 291a, b, c)
   Given 1967–68
292a,b,c. Metamathematics — (Enroll in Philosophy 292a, b, c)
293a,b,c. Recursion Theory—(Enroll in Philosophy 293a, b, c)
360. Advanced Reading and Research.
   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

Executive Head: David Y. Nanney (Colonel, Artillery)
Professor: David Y. Nanney (Colonel, Artillery)
Assistant Professors: John W. Begbieing (Captain, Armor), James G. Bayer (Captain, Infantry), Robert R. Siderius (Captain, Signal Corps)

GENERAL

The Department of Military Science offers a course of instruction and training which, combined with a baccalaureate degree, qualifies a student for a reserve commission in the United States Army. A student must fulfill the enrollment requirements listed in this section of the Bulletin in order to take Military Science courses.

OBJECTIVE

The objective of the Army ROTC program is to produce junior officers who by their education, training and inherent qualities are suitable for continued development. The aim is to provide a basic military education and in conjunction with other University disciplines to develop individual character and attributes essential to an officer. The Army ROTC training is designed to develop and perfect the qualities of leadership required in both military and civilian life and to give the student an opportunity to reinforce his knowledge with actual practice in the techniques of leadership. In this respect, then, the ROTC is a training ground for tomorrow’s leaders in the armed forces as well as in private enterprise and government.

PROGRAM OF STUDY

The program consists of a two-year basic course, a two-year advanced course and a six-week summer camp. The program includes 25 credit units, which are military in nature and are taught by officers of the United States Army. An additional 11 units required by the program are nonmilitary subjects selected by the student with the approval of the PMS within the general fields of Effective Communication, Science Comprehension, General Psychology, or Political Development and Political Institutions. Normally, courses must be taken in numerical sequence. During the summer session courses are given by special arrangement.

CURRICULUM

The curriculum embraces general military science subjects common to all branches of the Army, such as psychology and techniques of leadership, United States Army and national security, United States role in world affairs, military history, teaching principles, basic tactics, map reading, command and staff problems and procedures. For the first year the course consists of one class-
room hour per week; and for the second year two classroom hours per week. Each of the last two years consists of two quarters of three classroom hours and one quarter of two classroom hours per week. Throughout the four years leadership laboratory is conducted one hour per week. Military science courses are accepted in lieu of the University physical education requirement and as fulfillment of the Group Activity requirement of the General Studies Program. Extra-curricular activities on a voluntary basis are sponsored to develop cadet interests and to provide opportunity to apply principles of leadership, management, and staff procedures.

Several awards for distinction are made each year to those who excel in the program.

**Deferrment—Delay**

Students in the Army ROTC program are granted deferment from selective service induction. Furthermore, this insures completion of schooling normally including graduate courses of study for advanced degrees before performing military service.

**Enrollment in ROTC**

Courses are open only to Stanford University men 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. Normally a student must have at least 12 quarters (exclusive of summer work) remaining at time of enrollment. Specific exceptions may be made to meet unusual situations in the latter case. 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 Professor of Military Science and his assistants. Interested candidates desiring further information should communicate with the Professor of Military Science.

**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.

**Emoluments, Uniforms, and Texts**

Four-year scholarships are available to high school students who will be chosen in nationwide competition. In addition to payment for tuition, books, and fees for four years, each scholarship cadet draws retainer pay of $50 per month. Students not on scholarship pursuing the last two years of the course will receive retainer pay of not less than $40 or more than $50 per month. Uniforms and texts are supplied without cost.

**Advance Course 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.

**Basic Course Summer Camp**

Students who have completed their sophomore year may attend a six-week Summer Camp, if otherwise qualified, in lieu of taking the First- and Second-year courses described below. Successful completion of this camp qualifies the student for enrollment in the Third-Year course. Applicants for this program should contact the Professor of Mil-
itary Science, Stanford University. It should be remembered that this Basic Course Summer Camp is designed primarily for institutions that do not have ROTC programs. Quotas for School Year 1965–66 processing were considerably oversubscribed. Therefore, a Stanford student should carefully evaluate the situation before selecting this method of taking the Basic Course.

**COURSES**

**LEADERSHIP LABORATORY**

Leadership laboratory is conducted on Tuesday from 3:15 to 4:15. Here students have the opportunity to develop their ability to lead. Advancement to command positions in the cadet corps depends on demonstrated ability in leadership.

**FIRST-YEAR COURSES**


   1 unit, (Aut (Staff) M 8, 9, 10, 1:15, 2:15 or 3:15, or T 10 or 11


   1 unit, Win (Staff) M 8, 9, 10, 1:15, 2:15 or 3:15, or T 10 or 11


   1 unit, Spr (Staff) M 8, 9, 10, 1:15, 2:15 or 3:15, or T 10 or 11

**SECOND-YEAR COURSES**

21. American Military History — American Military History from the origin of the United States Army, with emphasis on organizational, tactical, logistical, operational, strategic, and social patterns.

   2 units, Aut (Siderius) MW 10, 2:15 or 3:15, or TTh 10, 11, or 2:15

22. American Military History and Map and Aerial Photograph Reading—American Mil-
MODERN EUROPEAN LANGUAGES

Emeriti: Bayard Q. Morgan, Jack A. Posin, Juan B. Rael, Kurt F. Reinhardt (Professors); Sarra Kliachko, Grace Knopp, Elisabeth Stenbock-Fermor (Assistant Professors)

Executive Head: F. W. Strothmann


Assistant Professors: A. Peter Foulkes, William J. Lillyman, Lawrence L. Stahlberger. Acting: Gisela Luther, William C. Meads, Edward L. Nordby

Instructors: Santiago J. J. Luppoli, Gertrude Mahrholz, Luis S. Ponce de León, Laura T. Tarquinio

Lecturers: Victoria B. Emmons, Rudolph Morgan, Nicholas S. Pashin, Eugenie Skarginsky

The Department accepts candidates for the degree of Bachelor of Arts, Master of Arts, and Doctor of Philosophy, 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

The degree of Bachelor of Arts may be taken in German, Russian, or Spanish.

Candidates must have completed the first- and second-year courses in reading, composition, and conversation (or their equivalent) offered in the language of their choice.

Candidates are expected to complete a minimum of 35 units, selected with the approval of their adviser, from courses numbered 100 and higher, designated German, Russian, or Spanish. These 35 units must include:

For German majors: German 100, 110, 111, 112, 113, 131, 132, 133 or 134, and 185; certain seniors majoring in German who have completed the basic courses of the junior year may wish to devote one or two quarters of their last year exclusively to reading. They may, with the permission of their adviser, be relieved of certain elective course requirements, enrolling instead for 12 to 15 units of Individual Work;

For Russian majors: Russian 100, 110, 111, 112, 113, 191, 192, and three literature courses;

For Spanish majors: Spanish 110, 111, 112, 113, and three courses to be chosen from those numbered 131, 132, 133, 134 or 135, 151, 152, 186, 187, 188, 189. (Only one course of the series 121–126 may be used to satisfy major requirements.)

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.

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 teachers with one or more years of experience and/or a regular 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. Detailed requirements for the degree are outlined in the School of Education section. For requirements within the 25 units...
of language work the candidate should consult the Department.

**Graduate Program in Humanities**

The Department of Modern European Languages participates in the Graduate Program in Humanities leading to a joint Ph.D. degree. For a description of that program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)" in this Bulletin.

**Intensive Language Work in European Study Centers**

Each student accepted by the Committee on General Studies for work at a Stanford center in Germany or Austria will complete 12 units of Intensive German 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 German. All German courses taken at a study center, regardless of the level at which the work is completed, bear the designation 80, with the successive levels, the lowest 2 and the highest 6, indicated as second digit.

**Stanford Hamburg Program**

German undergraduate majors and A.M. candidates may apply for participation in the Stanford Hamburg Program, which permits students to study for two quarters in Germany both with Stanford staff and at the University of Hamburg. If judged desirable by the Department, individual Ph.D. candidates may also participate in the program.

**Master of Arts: German**

To be accepted as a candidate for the degree of Master of Arts, a student needs to establish that he has completed creditably either an A.B. degree with a major in German or an equivalent of this work. A working knowledge of Latin is also desirable. 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; however, if he continues his studies, it will shorten the time needed for completion of the Ph.D. degree.

The Departmental requirements for the completion of the Master of Arts degree are:

1. 29 units of graduate work in the major field, normally the following courses:

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<th>Units</th>
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<tbody>
<tr>
<td>a) 190. Phonemics and Morphology 2</td>
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<tr>
<td>b) 201 and 202. Advanced Composition 4</td>
</tr>
<tr>
<td>c) 205. Modern German Grammar 3</td>
</tr>
<tr>
<td>d) 228. Middle High German 4</td>
</tr>
<tr>
<td>e) 289. Proseminar 3</td>
</tr>
<tr>
<td>f) 290 or 291. Seminar 3</td>
</tr>
<tr>
<td>g) Two advanced courses in literature (one from series 230–280) 6</td>
</tr>
<tr>
<td>h) 299. Thesis work 4</td>
</tr>
</tbody>
</table>

2. 13–15 units of electives. These may be taken in or out of the Department according to the student's individual needs. 281 and 283 are recommended for students continuing to the Ph.D. degree.

3. Completion of a Master’s thesis which shows that the candidate can write and do independent work.

**Doctor of Philosophy: German**

Students should read carefully the University regulations governing the conferring of this degree as described in the section "Degrees" in this Bulletin.

The Master of Arts degree is a prerequisite for admission to the program. Exceptions are made only for those students who have completed a substantial equivalent at a foreign university.

Near-native proficiency in German is expected of all candidates, irrespective of their field of specialization. Early during the first year at Stanford, all graduate students will be given the MLA Foreign Language Proficiency Test for Teachers and Advanced Students to give them an indication of their achievement in listening - comprehension, speaking, reading, and writing.

**Departmental Requirements:**

1. A working knowledge of Latin and a reading knowledge of one modern language other than English or German.

2. Course Work. In addition to the course work listed under the requirements for the Master of Arts degree, the student is expected to complete the following program:

   If specializing in literature,

<table>
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<th>Units</th>
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<tbody>
<tr>
<td>a) at least three graduate seminars beyond the Master of Arts requirement 9</td>
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<tr>
<td>b) 4 units chosen from the following courses: Gothic, Old Norse, Old High</td>
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</tbody>
</table>
German and Old Saxon, or Advanced Middle High German  

- c) at least one course from each of the five groups listed under 231 to 275. These courses may be taken in any sequence  

- d) 15 units of electives, to be taken either in courses in German literature and philology (numbered 200 or higher), or in a unified complementary program such as comparative literature, taken outside of the Department in courses numbered 100 or higher.  

If specializing in language,  

- a) introductory work in each area not previously covered: the syntax of modern German, the historical development of Germanic grammar, Gothic, Old Norse, Old English, Old High German, and Middle High German  

- b) seminars or advanced courses in Modern German, Early New High German, Middle High German, Old Icelandic, Old English, or Linguistics. The choice depends on the area of specialization.  

- c) literature courses (230-280) in areas of special interest  

- d) as above  

3. Students may take a formal minor instead of requirement “2d” above. The requirements for such a minor are determined by the departments concerned.  

4. Whether candidates specialize in language or in literature, they will write a dissertation that embodies such results of research as would merit publication.  

5. A Departmental as well as a University oral examination may be required.  

6. Teaching experience is required of all candidates as a condition to receiving the Ph.D. degree. Teaching assistantships are available to help candidates fulfill this requirement, which may be waived only for those students who have had teaching experience in other institutions. All prospective teachers are required to enroll in 200.  

MASTER OF ARTS: RUSSIAN  

No student is accepted for candidacy for the degree of Master of Arts unless he has completed the equivalent of the training represented by the requirements for the A.B. degree. Students intending to work toward the Ph.D. degree are required to pass the reading examination in either French or German during their first year of graduate studies.  

Requirements:  

1. 30 units of graduate work to be distributed approximately as follows:  

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 191 and 192. Advanced composition 4</td>
</tr>
<tr>
<td>b) Graduate seminar 2-4</td>
</tr>
<tr>
<td>c) Philology or general linguistics 8</td>
</tr>
<tr>
<td>d) Three graduate courses in Russian literature 9-12</td>
</tr>
<tr>
<td>e) Thesis 3</td>
</tr>
</tbody>
</table>

2. 13 to 18 units of electives chosen with the approval of the student’s adviser to bring the total to 44 units.  

DOCTOR OF PHILOSOPHY: SLAVICS  

Candidates are not obliged to present a minor but they are urged to offer one. A minor in a second language is strongly recommended. If it is in French, German, or Spanish, it should be equivalent to the course requirements for the degree of Master of Arts.  

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 his adviser. 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 working knowledge of Latin and a reading knowledge of French and German. Knowledge of the modern languages must be demonstrated by passing an examination.  

2. Write a thesis that embodies such results of research as would merit publication.  

3. Pass an oral examination along the following lines:  

   a) The principles of general and descriptive linguistics and the outlines of the history of the Russian language in its relationship to the development of the other Slavic languages.  

   b) The history of Russian literature includ-
ing its relationship to the development of other Slavic literatures.

c) The essentials of the political and cultural history of the Slavic world.

4. Prove, by examination, that they can write and speak Russian correctly.

5. In addition to a reading knowledge of French and German, have a reading knowledge of two Slavic languages other than Russian.

**Specialization**—Candidates in Slavic Languages and Literatures specialize either in linguistics or literature. Candidates who specialize in linguistics must complete the amount of literary study required of candidates for the Master of Arts degree (i.e., three graduate courses in the history of literature, and one graduate seminar dealing with a literary problem). Candidates in literature must complete a minimum of 12 units in philology and linguistics.

**Course Work**—Candidates for the Ph.D. degree should arrange their course work in such a way as to fulfill all requirements for their major and minor within nine quarters after receiving the A.B. degree. This can be done by enrolling for a minimum of 12 units per quarter. Candidates who enroll for less must expect a corresponding delay.

**Master of Arts: Spanish**

To be accepted as a candidate for the degree of Master of Arts, 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. A working knowledge of Latin is also desirable. 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.

**Course Requirements:**

1. A working knowledge of Latin.

2. 32 units of graduate-level work, to be distributed approximately as follows:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) 202 and 203, Advanced composition and grammar</td>
</tr>
<tr>
<td>B) 248 and 249, 250 or 251</td>
</tr>
<tr>
<td>C) 190, 204, 205, and 260 or 261</td>
</tr>
<tr>
<td>D) Two graduate courses in the history of Spanish and Spanish American literature</td>
</tr>
<tr>
<td>E) Thesis</td>
</tr>
</tbody>
</table>

3. Six units in advanced or graduate courses dealing with Spain or Hispanic America other than in the fields of language and literature.

4. Electives in Spanish or related fields, chosen with the approval of the student's adviser, to bring the total to 44 units.

**Doctor of Philosophy: 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.

**Requirements** — All candidates for the Ph.D. degree in Spanish must fulfill the following requirements:

1. Have a working knowledge of Latin and a reading knowledge of French and Portuguese (or Italian). This knowledge must be demonstrated by passing a Departmental examination (preferably by the end of the first year of graduate work).

2. Pass a preliminary examination in the history of Spanish and Spanish American literature and in the essentials of the political and cultural history of the Hispanic world. This examination should normally be taken shortly after completion of the work for the A.M. degree.

3. Pass the final Departmental oral and written examinations, and the University oral examination, along the following lines:

   a) The principles of general and descriptive linguistics.

   b) The history of the Spanish language, and the outlines of the history of the other Romance languages.

   c) The history of Spanish and of Spanish American literature.

   d) The political and cultural history of the Hispanic world, with specialization in approved areas.
4. Write a dissertation that embodies such results of research as would merit publication.

5. Satisfactory teaching experience in the Department. Teaching assistantships are available to enable candidates to fulfill this requirement, which will be waived only in the case of students who have teaching experience in other institutions. All prospective teachers are required to enroll in 200.

Specialization—Candidates for the Ph.D. degree in Spanish specialize in one of the following fields: Spanish literature; Spanish American literature; philology and linguistics. In addition to specializing in one of these fields, all candidates must complete a substantial amount of work (normally, at least three advanced or graduate courses) in each of the other fields.

Minor:

1. Candidates are not obliged to present a minor, but they are urged to offer one. A minor in a second language is strongly recommended. The course requirements for such a minor are determined by the departments concerned.

2. Candidates who do not elect a formal minor and are not enrolled in the Graduate Humanities Program are required to take a substantial amount of work in a related minor field. If the minor field selected is French, German, or Russian, the amount of work completed should total not less than 18 units, or equivalent, of advanced work (including French 113, German 113, or Russian 113).

COURSES OPEN TO ALL STUDENTS

The courses in this section do not require a knowledge of any language other than English. Students desiring German, Russian, or Spanish language credit for these courses must secure the permission of the Department and do the assigned readings in German, Russian, or Spanish.

GENERAL COURSES

101. Europe as Seen Through Travel Literature—From the Ancients to Napoleon.

3 units, Aut (Hilton) MWF 11

102. Europe as Seen Through Travel Literature—From Napoleon to World War I.

3 units, Win (Hilton) MWF 11

103. Europe as Seen Through Travel Literature—From World War I to the present.

3 units, Spr (Hilton) MWF 11

Hitherto neglected, travel literature has come to be recognized as an invaluable means of perceiving the physical and spiritual development of the regions of the world. The vision of one society by a perceptive observer from another culture has produced a unique literary and historical form, the wealth of which is only now becoming apparent. In particular, our vision of countries of Europe is immensely enriched by this forgotten literature. The courses 101, 102, and 103 are of special interest for the Stanford students who plan to attend one of the European centers, or indeed who have already done so.

#152. Balzac, Dickens, Dostoevsky.
4 units, Win (Fanger) MWF 10

#185. The Existential Quest in the Continental Novel—Reading and discussion of works by Dostoevsky, Rilke, Kafka, Broch, Sartre, and Beckett.
3 units, Spr (Sokel) given 1967–68

GERMAN COURSES

#75. Goethe's Faust—Lectures in English, reading of Faust in translation. Not open to freshmen.

3 units, Spr (Lohner) MWF 1:15

103. German Literature—The roots of the contemporary crises of philosophy. Given only at Stanford in Germany.

2 units, Sum, Win (Freudenberg)

104. German Literature—Contemporary German philosophy. Given only at Stanford in Germany.

2 units, Aut, Spr (Freudenberg)

#146. Kafka—A discussion of his works.
3 units, Win (Sokel) given 1967–68

#156. Brecht—Representative works in English translation.
3 units, Win (Boeninger) MWF 9

#181. Nietzsche—His major works consid-
ered in relation to contemporary thought and literature.

3 units, Aut (Sokel) MWF 9

#183. Thomas Mann—Major works in both fiction and essay in English translation.

3 units, Aut (Boeninger) given 1967–68

GENERAL COURSES
(POLISH AND RUSSIAN)

150. Introduction to Polish Civilization and Culture.

2 units, Spr (Stahlberger) TTh 10

#145. Russian Literature in the Nineteenth Century—Major emphasis on the novel, exclusive of Tolstoy and Dostoevsky.

4 units, Aut (Fanger) MWF 10

#146. Russian Literature in the Twentieth Century—Major emphasis on the novel.

4 units, Spr (Fanger) MWF 10

153. Leo Tolstoy—Chief works of fiction in English translation. Open to all students except freshmen.

4 units, Win (Stahlberger) MWF 9

GENERAL COURSES (SPANISH)

#75. Don Quixote in Translation — Reading, interpretation of Don Quixote.

3 units, Win (Schevill), alternate years, given 1967–68

150. Unamuno and Ortega — Present-day conflicts in literary works of Unamuno, Ortega y Gasset.

2 to 3 units, Win (Schevill) alternate years, given 1967–68

#151. The Modern and Contemporary Spanish Novel in Translation—Analysis, discussion of representative works.

3 units, Spr (Ponce de León) MWF 2

152. Lorca and Other Contemporary Spanish Dramatists in Translation—Modern trends, tensions as reflected in significant Spanish dramatists of present day.

3 units, Aut (Schevill) alternate years, given 1967–68

171. The Civilization of Spain.

3 units, Aut (Hilton) TTh 8

172. The Civilization of Spanish America.

3 units, Win (Hilton) TTh 8

173. The Civilization of Portugal and Brazil.

3 units, Spr (Hilton) TTh 8

These courses, given in English, provide, with convenient regional subdivisions, a general picture of Spain, Portugal, and Latin America (geography, history, social organization, culture).

GERMAN COURSES
FIRST- AND SECOND-YEAR

(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.

4 units, Aut, Win, Spr (Staff)

#2. First-Year German—Continuation of 1.

4 units, Aut, Win, Spr (Staff)

#3. First-Year German—Continuation of 2.

4 units, Aut, Win, Spr (Staff)

5. Intensive First-Year German — Equivalent to 1, 2, and 3 combined. Enrollment limited.

12 units, Sum (Staff) MTWThF 8:00–9:30, 10:30–12:00 and W 2:15–4:05

10. Elementary German — Accelerated course for beginners, particularly for those seeking to fulfill University requirement of reading knowledge for Ph.D. degree. Open to senior and graduate students only.

4 units, Aut, Win (Staff) MTWTh 8

Sum (Staff) MTWThF 8 or 9

#22. Second-Year Reading — Prerequisite: 3.

3 units, Aut, Win, Spr (Staff)

#23. Second-Year Reading—Continuation of 22.

3 units, Aut, Win, Spr (Staff)

24. Second-Year Composition and Conversation—Prerequisite: 3 or equivalent.

3 units, Aut, Win (Staff)


3 units, Win, Spr (Staff)

#52. Second-Year German — Emphasizes speaking, writing in addition to reading.
Students with a grade of A or B in 3 (or equivalent) may apply for admission. Students electing this course may not take 22 and 24. Enrollment limited.

5 units, Aut (Staff) MTWThF 8, 9, or 1:15
Win (Staff) MTWThF 8

#53. Second-Year German — Continuation of 52. Students electing this course may not take 23 and 25. Enrollment limited. Prerequisite: 52 (or 22 plus 24).

5 units, Win (Staff) MTWThF 8 or 1:15
Spr (Staff) MTWThF 8

#54. Second-Year German — Continuation of 53. Satisfies General Studies Requirement under C. Prerequisite: 53 (or 23 plus 25).

5 units, Spr (Staff) MTWThF 8 or 1:15

#82-86. Intensive German — Given only at Stanford in Germany.

6 units for each of two quarters, Sum–Aut
or Win–Spr (Staff) MTWTh two hours daily

99. 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: 23 or 53.

1 to 2 units, each quarter (Staff) by arrangement

THIRD- AND FOURTH-YEAR

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: 54 or equivalent.

3 units, Aut (Luther) MWF 1:15
Spr (Luther) MWF 9

110. German Pronunciation — Prerequisite: 22.

3 units, Win (Luther) MWF 9

111. Third-Year German Composition — Prerequisite: 54 or equivalent.

2 units, Aut (Mahrholz) TTh 9

112. Third-Year German Composition — Continuation of 111.

2 units, Win (Luther) TTh 9

113. Third-Year German Composition — Continuation of 112.

2 units, Spr (Luther) TTh 9

120. German Cultural Readings — Training in careful reading of books with a significant cultural content. Prerequisite: 23.

4 units, Spr (Meads) MTWThF 12

121. German Newspapers — This course is especially designed for students who want to keep their German alive. Current newspapers from East and West Germany will be read and discussed. This course may be repeated once.

2 units, Spr (Mahrholz) TTh 11

131. Major Works of German Literature — The Classical Period. Prerequisite: 23 or 53.

4 units, Aut (Foulkes) MTWTh 10

132. Major Works of German Literature — Romanticism and Poetic Realism. Prerequisite: 23 or 53.

4 units, Win (Foulkes) MTWTh 10

133. Major Works of German Literature — From Naturalism to the Present. Prerequisite: 23 or 53.

4 units, Spr, Sum (Staff)

141. Deutsche Lyrik — This course will change content every year and may therefore be repeated once. Lyric poetry of the Twentieth Century will be studied in autumn of 1966–67. Prerequisite: 23 or 53.

3 units, Aut (Luther) MWF 11

143. Deutsche Dramen — This course will change content every year and may therefore be repeated once. In winter of 1966-67, post-war plays will be studied. Prerequisite: 23 or 53.

3 units, Win (Lillyman) MWF 11

145. Deutsche Novellen — This course will change content every year and may therefore be repeated once. In the spring of 1966–67, Novellen of the Twentieth Century will be read. Prerequisite: 23 or 53.

3 units, Spr (Foulkes) MWF 11

ADVANCED AND GRADUATE

180. Die Dramen Kleists, Grillparzers und Hebbels.

3 units, Aut (Foulkes) given 1966–69

181. Thomas Mann.

3 units (Sokel) given 1967–68
#182. Brecht und das moderne Drama.  
3 units, Win (Boeninger) given 1967–68

#183. Hölderlin und Rilke.  
3 units (Lohner) given 1967–68

#184. Goethe’s Faust.  
3 units, Win (Lohner) MWF 9

#185. History of the German Language.  
3 units, Win (Schuelke) MTTh 2:15

#186. Heine und das Junge Deutschland.  
3 units, Spr (Mueller-Vollmer) given 1968–69

#187. Die Literatur der Deutschen Demokratischen Republik—A discussion of the German literature published under the Communist regime of East Germany.  
3 units, Aut (Boeninger) MWF 1:15

#188. Die deutsche Literatur der letzten zwanzig Jahre—Open only to students with an advanced knowledge of German.  
3 units (Foulkes) given 1968–69

#189. Kafka and Musil—Eine kritische Interpretation ihrer dichterischen Welt.  
3 units, Spr (Sokel) MWF 9

190. German Applied Linguistics—Phonology and Morphology. (Same as Education 287.)  
2 units, Win (Politzer) T 2:15–4:05

199. Individual Work—Open only to German majors and to students working on special projects. May be repeated for credit.  
1 to 15 units, each quarter (Staff) by arrangement

GRADUATE COURSES IN GERMANIC STUDIES

200. Methods of Teaching German—(Same as Education 291.)  
3 units, Spr (Lohnes) MWF 11

201. Advanced Composition and Grammar—Prerequisite: qualifying examination.  
2 units, Aut (Boeninger) TTh 11

202. Advanced Composition and Grammar—Continuation of 201.  
2 units, Win (Boeninger) TTh 11

205. Modern German—The syntax of modern German.  
3 units, Aut (Strothmann) MWF 11

221. Gothic and Historical Germanic Grammar—Development of Germanic languages; reading of selected texts from the Gothic Bible.  
4 units, Aut (Schuelke) MTWTh 10

223. Old Norse.  
4 units, Aut (Schuelke) MTWTh 2:15

224. Old Icelandic Sagas.  
4 units, Win (Schuelke) MTWTh 10

225. Old Saxon.  
2 units, Win (Schuelke) alternate years, given 1967–68

227. Old High German.  
2 units, Win (Schuelke) alternate years, given 1967–68

228. Middle High German.  
4 units, Spr (Foulkes) MTWTh 10

229. Advanced Middle High German.  
4 units, Spr (Schuelke) alternate years, given 1967–68

231. Das mittelhochdeutsche Epos—Prerequisite: 228.  
3 units, Win (Strothmann) given 1968–69

233. Die mittelhochdeutsche Lyrik—Prerequisite: 228.  
3 units (Schuelke) given 1967–68

235. Die Mystik des Mittelalters—Prerequisite: 228.  
3 units, Win (Strothmann) MWF 11

241. Lyrik und Drama des Barock.  
3 units, Spr (Lohner) MWF 2:15

243. Die Mystik des Barock.  
3 units, Aut (Lohner) given 1968–69

245. Lessing, Wieland und die Aufklärung.  
3 units (Mueller-Vollmer) given 1967–68

252. Herder und der Sturm und Drang.  
3 units (Sokel) given 1967–68

254. Die Klassik Goethes und Schillers.  
3 units, Spr (Lohner) given 1968–69

256. Der späte Goethe.  
3 units, Spr (Lohner) MWF 3:15

261. Die Romantik.  
3 units (Mueller-Vollmer) given 1967–68

3 units, Win (Lillyman) MWF 3:15
3 units (Sokel) given 1967–68

3 units, Win (Lohner) given 1968–69

3 units, Spr (Sokel) given 1968–69

3 units, Aut (Sokel) MWF 3:15

281. Von der Aufklärung zur Romantik: Deutsche Geistesgeschichte I.
3 units, Win (Mueller-Vollmer) MWF 1:15

283. Von Hegel bis Nietzsche: Deutsche Geistesgeschichte II.
3 units, Spr (Sokel) MWF 1:15

3 units, Aut (Mueller-Vollmer) MWF 1

3 units, Aut (Mueller-Vollmer)
T 4:15–6:05

290. Seminar—Subject to be announced in Time Schedule.
3 units, Aut (Sokel) W 4:15–6:05
Win (Boeningger) M 4:15–6:05
Spr (---) W 4:15–6:05

291. Seminar—Subject to be announced in Time Schedule.
3 units, Win (Lohner) W 4:15–6:05

299. 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

PORTUGUESE COURSES
(Under the direction of Ronald Hilton)

11. Elementary Portuguese — Intensive course primarily for students specializing in Hispanic American literature, civilization. Cannot be taken to fulfill General Studies language requirements. Prerequisite: knowledge of Spanish or French.
4 units, Aut (Tarquinio) MTWTh 12

4 units, Win (Tarquinio) MTWTh 12

4 units, Spr (Tarquinio) MTWTh 12

99. Individual Reading—Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Prerequisite: 13.
1 to 3 units, each quarter (Tarquinio)
by arrangement

111. Intermediate Portuguese — Prerequisite: 13 or equivalent.
3 units, Aut (Tarquinio) MWF 1:15

112. Intermediate Portuguese — Continuation of 111.
3 units, Win (Tarquinio) MWF 1:15

113. Intermediate Portuguese — Continuation of 112.
3 units, Spr (Tarquinio) MWF 1:15

199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Prerequisite: 111.
1 to 3 units, any quarter (Tarquinio)
by arrangement

RUSSIAN AND SLAVIC COURSES
FIRST- AND SECOND-YEAR
(Under the direction of Edward L. Nordby)

#1. First-Year Russian.
5 units, Aut (Staff)

#2. First-Year Russian—Continuation of 1.
5 units, Win (Staff)

#3. First-Year Russian—Continuation of 2.
5 units, Spr (Staff)

5. Intensive First-Year Russian—Equivalent to 1, 2, and 3 combined. Enrollment limited. Consent of instructor necessary.
12 units, Sum (Staff) MTWThF 8:00–9:30, 10:30–12:00, and W 2:15–4:05

10. Elementary Russian — Accelerated course for beginners, particularly for those seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to senior, graduate students only.
4 units, Win (Staff) MTWTh 8
Sum (Staff) MTWThF 8
11. Readings in Russian — Training in the reading and translation of texts. Prerequisite: 10 or equivalent.
   2 units, Aut (Staff) TTh 8
   Spr (Staff) TTh 8

35. Intensive Second-Year Russian.
   12 units, Sum (Staff) MTWThF 8:00-9:30, 10:30-12:00, and W 2:15-4:05

#52. Second-Year Russian.
   3 or 5 units, Aut (Staff) MTWThF 12:00 or 1:15

#53. Second-Year Russian — Continuation of 52. Satisfies General Studies requirement under C. Prerequisite: 52.
   5 units, Win (Staff) MTWThF 12:00 or 1:15

#54. Second-Year Russian — Continuation of 53. Prerequisite: 53.
   5 units, Spr (Staff) MTWThF 12:00 or 1:15

99. Individual Reading — Enrollment only by special permission of Department. Not required for majors in Russian. Thirty-six hours of reading per unit; weekly conference with instructor. May be repeated for credit. Prerequisite: 52.
   1 to 2 units, each quarter (Staff) by arrangement

15. Elementary Polish.
   4 units, Spr (——) MTWThF 1:15

THIRD- AND FOURTH-YEAR

100. Third-Year Russian Conversation — Course may be repeated for credit. Prerequisite: 54 or equivalent.
   3 units, Win (Skarginsky) MWF 10
   Spr (Pashin) MWF 10

110. Russian Pronunciation — Prerequisite: 54 or equivalent.
   3 units, Aut (Pashin) MWF 1:15

111. Third-Year Russian Composition — Prerequisite: 54 or equivalent.
   3 units, Aut (Skarginsky) MWF 9

112. Third-Year Russian Composition — Continuation of 111.
   3 units, Win (Pashin) MWF 9

113. Third-Year Russian Composition — Continuation of 112.
   3 units, Spr (Pashin) MWF 9

#134. Russian Literature from the Eleventh to the Seventeenth Century.
   4 units, Aut (Stahlberger) MTWTh 11

#135. Russian Literature of the Eighteenth and Nineteenth Centuries.
   4 units, Win (Nordby) MTWTh 11

#136. Russian Literature of the Twentieth Century.
   4 units, Spr (Stahlberger) MTWTh 11

ADVANCED AND GRADUATE

#184. The Russian Short Story—Conducted in Russian. Prerequisite: 113.
   4 units, Aut (Pashin) MWF 11

#185. The Russian Novel — Conducted in Russian. Prerequisite: 113.
   4 units, Win (Pashin) MWF 11

#186. The Russian Drama—Conducted in Russian. Prerequisite: 113.
   4 units, Spr (Pashin) MWF 11

191. Russian Literary Criticism — Reading, discussion and writing. For graduating majors.
   2 units, Aut (Pashin) TTh 9

192. Russian Literary Criticism — Reading, discussion and writing. Continuation of 191.
   2 units, Win (Pashin) TTh 9

199. Individual Work—Thirty-six hours of reading per unit; weekly conferences with instructor. May be repeated for credit. Open only to majors in Russian.
   1 to 3 units, each quarter (Staff) by arrangement

GRADUATE COURSES IN SLAVIC STUDIES

201. Synchronic Phonology, Morphology, and Syntax of Russian I.
   3 units, Aut (Van Campen) MWF 2:15

202. Synchronic Phonology, Morphology, and Syntax of Russian II.
   3 units, Win (Van Campen) MWF 2:15

203. Synchronic Phonology, Morphology, and Syntax of Russian III.
   2 units, Aut (Van Campen) alternate years, given 1967–68

204. Synchronic Phonology, Morphology, and Syntax of Russian IV.
   3 units, Win (Van Campen) alternate years, given 1967–68
211. Old Church Slavonic I.
3 units, Aut (Van Campen) MWF 3:15

212. Old Church Slavonic II.
3 units, Win (Van Campen) MWF 3:15

221. Diachrony of East Slavic and Readings in Old Russian I.
2 units, Win (Van Campen) TTh 3:15

222. Diachrony of East Slavic and Readings in Old Russian II.
3 units, Spr (Van Campen) MWF 3:15

226. Diachrony and Synchrony of South Slavic.
2 units, Spr (Van Campen) TTh 2:15

227. Diachrony and Synchrony of Western Slavic.
2 units, Win (Van Campen) alternate years, given 1967–68

228. Divergence of Slavic Languages.
2 units, Spr (Van Campen) TTh 3:15

231. The Early History and Culture of the Slavs.
2 units, Aut (Stahlberger) TTh 10

250. Graduate Seminar in Linguistics — Subject to be announced in Time Schedule.
2 units, Aut (Van Campen) T 2:15-4:05

264. Russian Epic Tradition.
2 units, Win (——) alternate years, given 1967–68

270. Studies in Russian Realism.
3 units, Aut (Fanger) MWF 9

271. Russian Literature of the Seventeenth and Eighteenth Centuries.
2 units, Win (Stahlberger) alternate years, given 1967–68

272. Russian Symbolism.
2 units, Aut (——) alternate years, given 1967–68

277. Gogol.
3 units, Win (Fanger) MWF 9

278. Tolstoy.
3 units, Spr (——) every three years, given 1968–69

279. Dostoevsky.
3 units, Win (——) every three years, given 1968–69

280. Comparative Slavic Literature of the Early Medieval Period.
2 units, Aut (Stahlberger) alternate years, given 1967–68

281. Comparative Slavic Literature of the Late Medieval Period.
2 units, Win (Stahlberger) alternate years, given 1967–68

282. Comparative Slavic Literature: Renaissance, Baroque, Classicism.
2 units, Win (Stahlberger) alternate years, given 1967–68

3 units, Win (Stahlberger) MWF 10

299. Individual Work — Exclusively for graduate students in Slavic working on thesis or engaged in special work.
1 to 12 units, any quarter (Staff) by arrangement

300. Graduate Seminar in Literature — Subject to be announced in Time Schedule.
3 units, Aut (Stahlberger) TTh 10

Spr (Fanger) MW 10

Spanish Courses
FIRST- AND SECOND-YEAR
(Under the direction of Rudolph Morgan)

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.

#1. First-Year Spanish.
4 units, Aut, Win (Staff)

#2. First-Year Spanish — Continuation of 1.
4 units, Aut, Win, Spr (Staff)

#3. First-Year Spanish — Continuation of 2.
4 units, Aut, Win, Spr (Staff)

5. Intensive First-Year Spanish — Equivalent to 1, 2, and 3 combined. Enrollment limited. Consent of instructor necessary.
12 units, Sum (Staff) MTWThF 8:00–9:30, 10:30–12:00, and W 2:15–4:05

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 senior, graduate students only.
4 units, Spr (Staff) MTWTh 1:15
MODERN EUROPEAN LANGUAGES

#22. Second-Year Reading—Aims primarily at reading ability. Prerequisite: 3.
3 units, Aut, Win, Spr (Staff)

#23. Second-Year Reading—Continuation of 22. Reading material assigned will vary from section to section.
3 units, Aut, Win, Spr (Staff)

#23a. Second-Year Reading—The historical development of Latin America. Reading of Américo Castro’s Iberoamérica and training in the understanding of talks in Spanish. An alternative to 23. Prerequisite: 22 (or equivalent) with a grade of B or better. Taken in conjunction with 25 is the equivalent of 53.
3 to 4 units, Win (Staff) MWF 8

24. Second-Year Grammar and Composition—Students taking 52 may not take this course. Prerequisite: 3.
3 units, Aut, Win (Staff)

25. Second-Year Grammar and Composition—Continuation of 24. Students taking 53 may not take this course.
2 units, Win, Spr (Staff)

27. Second-Year Conversation—Students taking 53 may not take this course. Prerequisite: 3.
2 units, Win (Staff)

28. Second-Year Conversation—Students taking 54 may not take this course. Prerequisites: 24 and 27.
2 units, Spr (Staff)

#52. Second-Year Spanish—Emphasizes speaking, writing in addition to reading. Students with a grade of A or B in 3 (or equivalent) may apply for admission. Students electing this course may not take 22 and 24. Enrollment limited to 15.
5 units, Aut (Staff) MTWThF 9 or 1:15

#53. Second-Year Spanish—Continuation of 52. Students electing this course may not take 23, 23a, 25, and 27. Enrollment limited to 15. Prerequisite: 52 (or 22 plus 24).
5 units, Win (Staff) MTWThF 9

#54. Second-Year Spanish—Continuation of 53. Students electing this course may not take 28. Enrollment limited to 15. Satisfies General Studies Requirement under C. Prerequisite: 53 (or 23 plus 25 and 27).
5 units, Spr (Staff) MTWThF 9

99. Individual Reading—Enrollment only by special permission of Department. Thirty-six hours of reading per unit, weekly conference with instructor. Prerequisite: 23 or 53.
1 to 2 units, any quarter (Staff) by arrangement

THIRD- AND FOURTH-YEAR

100. Advanced Spanish Conversation—May be repeated for credit. Prerequisite: 28 or equivalent.
3 units, Win (Ponce de León) MWF 3:15

110. Spanish Pronunciation—Prerequisite: 22.
3 units, Aut (Espinosa, Morgan) TTh 11 and one hour by arrangement

111. Third-Year Spanish Grammar and Composition—Prerequisite: 53 or equivalent (23 or 23a plus 25).
3 units, Aut (Staff) MWF 9 or 11

112. Third-Year Spanish Composition—Prerequisite: 111 or equivalent.
2 units, Win (Staff) TTh 8 or 9

113. Third-Year Spanish Composition—Continuation of 112.
2 units, Spr (Staff) TTh 8 or 9

#121. Hispanic American Cultural Readings—The life of Simón Bolívar. Reading of Campos Menéndez, Se llamaba Bolívar, and training in the understanding of talks in Spanish. Prerequisite: 23 (23a is recommended) or equivalent.
4 units, Spr (Hilton) MTWTh 9

#125. Spanish Cultural Readings—Training in careful reading of books with significant cultural content. Prerequisite: 23 or 53 or equivalent.
4 units, Aut (———) MTWTh 1:15

#126. Cervantes—Reading and interpretation of selected passages from Don Quijote and the Novelas ejemplares. Prerequisite: 23 or equivalent.
4 units, Win (———) MTWTh 11

#131. Masterworks of Spanish Literature I—From its origins to end of fifteenth century. Prerequisite: 23 or equivalent.
3 to 4 units, Win (Espinosa) alternate years, given 1967–68

#132. Masterworks of Spanish Literature
II—Sixteenth and seventeenth centuries. Prerequisite: 23 or equivalent.
 3 to 4 units, Spr (——) MWF 10

#133. Masterworks of Spanish Literature III—From 1700 to 1898. Prerequisite: 23 or equivalent.
 3 to 4 units, Win (——) alternate years, given 1967–68

#134. Modern and Contemporary Spanish Literature I—The Generation of 1898. Prerequisite: 23 or equivalent.
 3 to 4 units, Aut (Schevill) alternate years, given 1967–68

#135. Modern and Contemporary Spanish Literature II—Outstanding writers of present-day Spain. Prerequisite: 23 or equivalent.
 3 to 4 units, Aut (——) MWF 10

#142. The Spanish Novel of the Nineteenth Century.
 3 to 4 units, Win (Ponce de León) MWF 10

#143. The Spanish Romantic Drama.
 3 to 4 units, Win (——) alternate years, given 1967–68

#151. Masterworks of Spanish-American Literature I—Prerequisite: 23 or equivalent.
 3 to 4 units, Aut (——) MWF 11

#152. Masterworks of Spanish-American Literature II—Prerequisite: 23 or equivalent.
 3 to 4 units, Win (——) MWF 11

ADVANCED AND GRADUATE

#180. Lope de Vega, Tirso y Calderón — Estudio e interpretación de cuatro o cinco comedias representativas.
 3 to 4 units, Spr (Espinosa) alternate years, given 1967–68

#182. Teatro español contemporáneo.
 3 to 4 units, Spr (Schevill) alternate years, given 1967–68

184. Spanish Speech and Drama—Reading and rehearsing of Spanish plays. May be repeated for credit. Prerequisites: 100 and 112 or permission of instructor.
 3 to 4 units, Win (Schevill, Ponce de León) TTh 4:15–6:05

185. Spanish Dramatics—Staging of a Spanish play. Prerequisite: 184 or permission of the instructor.
 2 units, Spr (Schevill, Ponce de León) by arrangement

#186. Literatura hispanoamericana I — Epoca colonial. Open only to graduate and advanced undergraduate students.
 3 to 4 units, Aut (——) MWTh 2:15

#187. Literatura hispanoamericana II — Romanticismo. Open only to graduate and advanced undergraduate students.
 3 to 4 units, Win (——) MWTh 2:15

#188. Literatura hispanoamericana III — Modernismo. Open only to graduate and advanced undergraduate students.
 3 to 4 units, Aut (Gicovate) alternate years, given 1967–68

#189. Literatura hispanoamericana IV — Siglo veinte. Open only to graduate and advanced undergraduate students.
 3 to 4 units, Win (Gicovate) alternate years, given 1967–68

190. Spanish Applied Linguistics—Phonology and Morphology. (Same as Education 283.)
 2 units, Win (Morgan) TTh 10

199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Open only to majors in Spanish.
 1 to 3 units, any quarter (Staff) by arrangement

GRADUATE COURSES IN SPANISH AND SPANISH LITERATURE

200. Methods of Teaching Spanish—(Same as Education 292.)
 2 units, Win (Morgan) TTh 3:15

201. Advanced Grammar—Intensive review of structural syntax. Prerequisite: qualifying examination.
 2 units, Aut (Schevill) W 7:15–9:05 p.m.

202. Advanced Composition and Grammar —Analysis of structural patterns. Translation and free composition. Prerequisite: 201 or equivalent.
 3 units, Win (Schevill) Th 7:15–10:05 p.m.
   2 units, Spr (Schevill) T 7:15–9:05 p.m.
204. Modern Spanish I—The phonology of modern Spanish.
   2 units, Aut (Espinosa) TTh 10
205. Modern Spanish II — The syntax of modern Spanish.
   2 units, Spr (Espinosa) TTh 10
211. Historia de la literatura española I—From the origins to 1500.
   4 units, Win (Espinosa) alternate years, given 1967–68
212. Historia de la literatura española II—Sixteenth and seventeenth centuries.
   4 units, Aut (——) MWF 11
213. Historia de la literatura española III—Desde 1700 hasta 1850.
   4 units, Win (Espinosa) MTWTh 11
214. Historia de la literatura española IV—Desde 1850 hasta 1923.
   4 units, Aut (Schevill) alternate years, given 1967–68
   4 units, Aut (Schevill) MTW 3:15
217. Teatro español del Siglo de Oro.
   4 units, Spr (——) alternate years, given 1967–68
218. Renaissance Prose and Mysticism.
   3 units, Aut (——) alternate years, given 1967–68
220. Cervantes.
   4 units, Win (——) TTh 4:15–6:05
223. La novela española moderna.
   3 to 4 units, Win (——) MWF 4:15
224. La novela hispanoamericana.
   3 units, Aut (——) MWTh 3:15
225. Novelistas de la Revolución Mexicana—Reflection of Mexican revolution in
   literature of this period.
   3 to 4 units (——) alternate years, given 1967–68
228. La poesía española contemporánea.
   3 to 4 units, Aut (Gicovate) MWFTh 3:15
230. Hispanic Folklore.
   3 units (Espinosa) every third year, given 1967–68
232. The Spanish Epic Tradition.
   3 units (Espinosa) every third year, given 1967–68
240. Spanish Versification.
   2 units, Win (Espinosa) every third year, given 1967–68
248. Proseminar: Problems and Methods of Research in Hispanic Literatures I.
   2 units, Win (Gicovate) W 7:15–9:05 p.m.
249. Proseminar: Problems and Methods of Research in Hispanic Literatures II.
   2 units, Spr (Gicovate) W 7:15–9:05 p.m.
250. Graduate Seminar in Spanish Literature—Subject announced in Time Schedule.
   3 units, Aut (Schevill) T 7:15–9:05 p.m.
   Win (——) W 4:15–6:05
   Spr (——) T 2:15–4:05
251. Graduate Seminar in Spanish-American Literature—Subject announced in Time Schedule.
   3 to 4 units, Win (——) T 7:15–9:05 p.m.
   Spr (——) T 7:15–9:05 p.m.
256. History of the Spanish Language.
   3 units, Spr (Espinosa) alternate years, given 1967–68
261. Old Spanish—Elements of phonology, morphology; reading of Old Spanish texts.
   3 units, Win (Espinosa) MWF 10
263. Historical Spanish Linguistics I—Pre-requisite: 260 or 261.
   3 units, Spr (Espinosa) MWF 10
264. Historical Spanish Linguistics II.
   3 units, Spr (Espinosa) alternate years, given 1967–68
266. Hispanic Dialectology.
   3 units, Aut (Espinosa) 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

TEACHER TRAINING COURSES
(Under the direction of Rudolph Morgan)
200. Use of the Language Laboratory—
   (Same as Education 295.)
   2 units, Aut (Morgan) 7–9 p.m.
   Sum (Morgan) TTh 9 or
   by arrangement
201. Seminar in the Development of Laboratory Techniques — (Same as Education 297.)

2 units, Sum (Morgan)— TTh 1:15 and one hour by arrangement

199. Individual Work — Exclusively for graduate students in Spanish in the Master of Arts in Teaching Program. May be repeated for credit.

1 to 4 units, Sum (Staff) by arrangement

See also Senior Colloquia.

MUSIC

Executive Head: William L. Crosten


Associate Professors: George L. Houle, Leeland C. Smith

Acting Assistant Professor: Arthur P. Barnes (Director of Bands)

Music Librarian: Edward E. Colby

Director of Men's Glee Club: Robert R. MacKinnon

Lecturers: Adolph Baller, Earle Blew (Piano), Charles R. Bubb (Brass Instruments), Marjorie Chauvel (Harp), Raymond H. Duste (Oboe), Philip Fath (Clarinet), Lloyd Gowen (Flute), Bonnie Hampton (Violoncello), Hazel Miloradovitch (Viola da Gamba), Ivan B. Rasmussen (Voice)

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 teachers, composers, performers, or research scholars.

Practice facilities are available in the Dinkelspiel Auditorium Building, which also includes a well-equipped modern theater for concert and operatic productions. In addition to practice pianos and a practice organ, rare instruments from the Harry R. Lange Historical Collection may be used by qualified students.

The Departmental library contains a comprehensive collection of complete editions, scores, books, and records. Supplemented this is the Stanford Memorial Library of Music, which is an invaluable collection of musical manuscripts and first editions.

PROGRAMS OF STUDY

BACHELOR OF ARTS

Undergraduate major—Prospective music majors are required to take an examination for the purpose of determining their proficiency in musical performance.

The following Departmental courses and proficiencies are required in addition to the University's basic requirements for the Bachelor's degree:

1. Theory of Music: 21, 22, 26, 27, 121, 122

2. Music History: 100, 101, 102, 103, 104

3. Musical Performance:
   a) All students are required to demonstrate a minimum proficiency in piano which will include sight-reading as well as playing two prepared pieces on the order of an easier Chopin Prelude or a Clementi Sonatina. This requirement should be fulfilled as early as possible and not later than the beginning of the junior year.
   b) Ensemble; at least six quarters of work elected from courses 160, 161, 162, 163, 165, 166, and 171.
   c) Six quarters of individual vocal or instrumental study, excluding Music 12. (In exceptional cases, students who can demonstrate on entrance a high degree of proficiency in solo performance may petition for exemption from this requirement.) Assignments to particular teachers will be made on the basis of auditions.

4. Musical Repertory. Supplementing the detailed study of individual compositions in the music history and theory courses, the student is expected on his own to develop a wide aural acquaintance with the music of the major composers. This acquaintance will be checked by a series of identification examinations which should be passed normally before the beginning of the senior year.

5. Listening and Reading Skills. The student's ability to hear music accurately and
to perform it at sight 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. A laboratory for the development of these skills will be offered.

Music majors will be expected to maintain a grade point average of at least 2.00 in music classes excluding performance activities.

Undergraduate minor—A program of 26–28 units of required work is offered as follows:

1. Music Literature: Any three courses in music history or literature given by the Department.
3. Musical Performance: At least three consecutive quarters of (a) ensemble and (b) vocal or instrumental study. The latter is available to music minors in the form of small-group instruction, for which no extra fee is charged.

(Note—The music minor may not enroll for vocal or instrumental instruction until he has completed Music 21, or unless he takes it concurrently.)

Senior Honors Program in Music—This program is designed as a mean of developing greater independence of thought in superior students who are capable of going beyond the regular requirements leading to the A.B. degree.

Applications for admission to the Honors Program will be reviewed by the entire music faculty and should be submitted during the last quarter of the student’s junior year. In order to be considered for admission, a student must: (1) present an average grade of B or better in all music courses and have demonstrated outstanding ability in some branch of music, (2) have completed at least 36 units of required undergraduate courses in music.

A faculty sponsor will be assigned to each student who is selected, and an independent study program totaling 12 units will be planned to extend over the senior year. This work may be centered on composition, musical research or musical performance.

An Honors Program in Humanities is offered for undergraduate majors in this Department who wish to supplement their Departmental major by a related and carefully guided program of studies. See Humanities (Special Programs) for a description of the Honors Program.

**Sample Schedule for Four-Year A.B. Program with Major in Music**

<table>
<thead>
<tr>
<th>First Year</th>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1, 2, 3</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Language 1, 2, 3. (If completed, substitute Western Civ.)</td>
<td></td>
<td></td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Music 21, 22, 26. Elements of Music and Counterpoint</td>
<td></td>
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<td>4</td>
<td>3</td>
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<tr>
<td>Ensemble (Music 160, 161, 162, 163, 165, 166, 168 or 171)</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Music 172. (Individual Vocal or Instrumental Instruction)</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Group activities</td>
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<tr>
<td>Electives (optional)</td>
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<td>14</td>
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<tr>
<td>Total</td>
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<td>14</td>
<td>14-17</td>
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<table>
<thead>
<tr>
<th>Second Year</th>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
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<tbody>
<tr>
<td>Language 22, 23. (If not completed)</td>
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<tr>
<td>History 1, 2, 3. Western Civ.</td>
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<tr>
<td>Music 100, 101, 102. History and Literature</td>
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<tr>
<td>Music 27, 121, 122. Counterpoint and Advanced Harmony</td>
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<tr>
<td>Ensemble</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172*</td>
<td></td>
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<td>2</td>
<td>2</td>
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<td>14-17</td>
<td>15-18</td>
<td>15</td>
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</table>

* Students who have not completed the language requirement and who do not wish to enroll for 18 units of credit may postpone Music 172.

<table>
<thead>
<tr>
<th>Third Year</th>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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<tbody>
<tr>
<td>Science (Biology 4, 5 or Physical Sciences 1, 2, 3)</td>
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<td>Social Science</td>
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<tr>
<td>Music 103, 104. History and Literature</td>
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<tr>
<td>Elective in Music History or Literature (optional)</td>
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<td>Additional A.B. requirement (i.e., language reading or Phil. 3)</td>
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<td>4-5</td>
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<tr>
<td>Ensemble (optional)</td>
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<td>1</td>
</tr>
<tr>
<td>Music 172 (optional)</td>
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<td>2</td>
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<tr>
<td>Total</td>
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<td>15</td>
<td>14-15</td>
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Fourth Year

<table>
<thead>
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<th>Subject</th>
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<tbody>
<tr>
<td>Additional science</td>
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<td>5</td>
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<tr>
<td>Senior Colloquia</td>
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<tr>
<td>Senior Honors Program in Music or Electives in music (optional)</td>
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<tr>
<td>Electives in Humanities</td>
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<td>5</td>
<td>5</td>
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<tr>
<td>Ensemble (optional)</td>
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<td>1</td>
</tr>
<tr>
<td>Music 172 (optional)</td>
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<td>2</td>
<td>2</td>
</tr>
<tr>
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<td>15-17</td>
<td>15-17</td>
<td>14</td>
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</tbody>
</table>

Students planning to work for the General Secondary Credential in Music should add the following courses to their A.B. program in place of electives or optional courses:

Third Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
</tr>
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<tbody>
<tr>
<td>Music 72b. Voice Class</td>
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<td>1</td>
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<tr>
<td>Music 72c, d. Instrumental Classes</td>
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Fourth Year

<table>
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<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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<tr>
<td>Music 72c, d. Instrumental Classes</td>
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<td>(1)</td>
<td>1 (1)</td>
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<tr>
<td>Music 127. Orchestration</td>
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<td>3</td>
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<td>Music 130a, b. Orchestral Conducting</td>
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<td>3</td>
<td>(3)</td>
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<tr>
<td>Music 131a, b. Choral Conducting (may be taken in third year)</td>
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<td>(3)</td>
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</tbody>
</table>

Teachers’ Credentials

Students in the Department may work for the Standard Teaching Credential (Secondary) with a teaching major in music.

The program for this credential extends over a summer quarter of full-time academic work at the University, plus a year divided between half-time study at the University and a half-time teaching internship in a public high school near Stanford.

Admission—Students are admitted to this program only at the beginning of the summer quarter each year, upon the recommendation of the Music Department and the Secondary Education Committee. Applicants must have completed the Stanford A.B. degree in music, or its equivalent, plus the following courses:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
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<tbody>
<tr>
<td>Music 127. Orchestration</td>
<td>3</td>
</tr>
<tr>
<td>Music 130, 131. Conducting</td>
<td>9</td>
</tr>
<tr>
<td>Piano: sufficient to pass piano proficiency test</td>
<td>3</td>
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<tr>
<td>Music 72b. Voice Class</td>
<td></td>
</tr>
<tr>
<td>Music 72c, d. Instrumental Classes</td>
<td>3-5</td>
</tr>
</tbody>
</table>

Proficiency examinations must be taken in piano, voice, and conducting.

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 possess a well-rounded general education as well as sound basic training in the theory, history, and performance of music. An entrance test will be given each applicant to measure his competence in the handling of musical materials, in analysis, and in verbal expression. Prior to his initial registration, each student will be given a comprehensive placement examination in the history and literature of music and in general musicianship (listening and reading skills). At the same time, the student should be prepared to demonstrate a moderate proficiency in piano.

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.

Master of Arts

The University’s basic requirements for the Master’s degree (residence, admission to candidacy, etc.) are discussed in the section “Degrees” in this Bulletin. Although the A.B. is the normal antecedent to the A.M. degree, persons holding the Bachelor of Music degree may be admitted to Stanford subject to the possibility that they may be asked to do extra work in humanistic fields outside music.

Foreign language requirement — 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 musical research, composition, music education, performance practice, or conducting. To be recommended for the A.M. degree, a candidate must complete a program of 40 units based on the graduate courses offered by the Department and must pass a comprehensive examination. The study program will include: (a) Music 200 and 240; (b) additional studies in music his-
history and theory as appear necessary; (c) seminars or special studies in the chosen field of concentration; (d) musical performance (individual or ensemble), three quarters; (e) Master of Arts Project. (Depending on the concentration, this will be an investigative essay, a composition, or a demonstration of performance supported by a written commentary. In any case, the A.M. Project should be completed during the last quarter of residence.)

**Doctor of Education**

In cooperation with the School of Education the Department offers work leading to the Doctor of Education degree with a concentration in music education. Students in this program normally will take about one-third of their work in Education and two-thirds in Music. General regulations covering this degree are discussed in the Manual on Advanced Graduate Degrees in Education, which may be obtained from the School of Education. The work in music education may center on curriculum studies, principles and methods of teaching, or supervision and administration of music.

**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, conducting, music education, or performance practice—the latter being taken to cover the study of modes of performance from medieval to modern times. Each concentration, however, will be given breadth through collateral studies in other branches of music and in relevant fields outside music. In all cases the work is planned especially with regard to possible careers in college or university teaching.

Enrollment is limited and, except in the field of music education, preference will be given to applicants who are not over thirty years of age.

**Admission**—The normal preparation for this program is the completion of the Stanford Master’s degree or its equivalent in the student’s field of concentration. In addition to completing the entrance test, an applicant will be asked to submit evidence of accomplishment in his particular 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 work must be done entirely in residence at Stanford and must include at least three consecutive quarters of full-time study.

**Study program**—Each candidate must complete a minimum of 72 units of work beyond the Master’s degree. It must be emphasized, however, that the degree will be awarded on the basis of demonstrated proficiency rather than on the accumulation of units. The student’s program of work will normally include:

1. tutorial study in his field of concentration,
2. doctoral seminar in musical analysis,
3. studies in the history, theory, or performance of music as appear necessary on the basis of the placement and advisory examinations,
4. electives,
5. final project or thesis,
6. public lecture-demonstration.

**Tutorial study**—Individual work under the guidance of the student’s major professor.

Concentrators in conducting or performance practice will make an extensive study of repertoire, leading to four demonstrations of their ability to perform music from different style periods. Each demonstration is to be supported by a written report containing stylistic analysis of the music in question, discussion of the special performance problems that are involved, and detailed proposals for the solution of those problems. Student conductors are also required to be members of one or more of the departmental performing organizations; credit may be earned for such participation but may not be applied toward the minimum unit requirements for the doctoral degree.

Concentrators 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, conducting, or performance practice.

Concentrators in composition will be expected to produce a number of original works demonstrating their ability to com-
pose 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 or thesis—(1) Composition: an extended work for chorus, orchestra, chamber ensemble, or a combination of voices and instruments. (2) Music education: a thesis based on independent research in the candidate’s field of specialization. (3) Conducting or performance practice: possibilities open to the candidate include (a) preparing a modern performing edition of an early score; (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 (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. Concentrators in conducting and performance practice are further required to demonstrate reading ability in a second language chosen from the three listed above. This proficiency 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 first year in residence, to determine whether he will be recommended to continue work for the degree. (2) A final qualifying examination to be taken not later than the quarter preceding that in which the candidate expects to receive his degree.

Teaching assistantships—It is the policy of the department to appoint each doctoral candidate to a teaching assistantship for at least one quarter.

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—The normal preparation for this program is the completion of the Stanford Master’s degree, or its equivalent in musical research.

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 of full-time study in residence to work on his dissertation.

Basic requirements — In addition to his doctoral dissertation, each candidate must complete a minimum of 60 units of study beyond the Master’s degree. The program will normally include work under the following headings:

(1) musical notation, (2) history of music theory, (3) performance practice, (4) historical studies in musical style and aesthetics, (5) electives.

Specialization — As soon as feasible the candidate will select the field of study in which he proposes to do independent research leading ultimately to the writing of 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 will be given toward the end of the student’s first year of doctoral study, to explore the strengths and weaknesses of his preparation; (2) a qualifying examination will be taken upon completion of the formal course requirements for the degree. This will deal with systematic and historical aspects of musical composition, music theory and notation, performance practice, and musical aesthetics.

Courses

For the General Student

Any of the following courses may be used as partial fulfillment of the Humanities requirement in the General Studies Program:
#1. Introduction to Music — Musical expression, style, structure explained, illustrated for the listener. No prerequisites.
   3 units, any quarter (Staff)

#2. Symphony—Selected symphonic works from Classic, Romantic, Modern repertories. Prerequisite: 1 or equivalent.
   3 units, autumn (Salgo)

#3. Opera — Opera as a musico-dramatic form; examples from Mozart to present. Prerequisite: 1 or equivalent.
   3 units, Win (Crosten)

#7. Concerto — Selected concertos, seventeenth century to present. Prerequisite: 1 or equivalent.
   3 units, Spr (Salgo)

#21, 22. Elements of Music—See below.

MUSIC THEORY AND COMPOSITION

#21, #22. Elements of Music — Basic rhythmic, melodic, and harmonic materials; relation of these to musical form. Written exercises in various textures, ear-training, analysis, elementary vocal and instrumental scoring, keyboard drill. Lectures and laboratory sections. Open to all students desiring basic technical knowledge of music. No prerequisite for Music 21 except ability to read music.
   21. 4 units, Aut (Harmon); Win (——)
   22. 4 units, Win (Harmon); Spr (——)

   3 units, Spr (Houle)

27. Counterpoint — Eighteenth century style. Prerequisite: 22.
   3 units, Aut (——)

121, 122. Advanced Harmony — Harmonic materials of nineteenth and early twentieth centuries. Prerequisites: 22, either 26 or 27, and satisfactory completion of first listening and reading test.
   121. 4 units, Win (Ratner)
   122. 4 units, Spr (Ratner)

123. Composition — Individual projects in creative work. May be repeated for credit. Prerequisite: permission of instructor.
   3 units, any quarter (Smith)

127. Orchestration — Prerequisite: 26 or equivalent.
   3 units, Aut (Smith)

221. History of Music Theory.
   3 units, Spr (Ratner)

223. Seminar in Composition—May be repeated for credit.
   4 units, any quarter (Smith)

224, 225. Solfege and Score Reading.
   224. 4 units, Win (Barnes)
   225. 4 units, Spr (Barnes)

   3 units, Aut (Ratner)

227. Advanced Orchestration — Prerequisite: 127.
   3 units, Win (Smith)

228. Studies in Thorough-Bass — Prerequisites: 26 and 27.
   4 units, Win (Aldrich)

229. Tonality and Structure—Graduate review of harmonic functions; relation between details of progression and total structure.
   4 units, Aut (Smith)

HISTORY AND LITERATURE OF MUSIC

Unless otherwise stated, prerequisite for any course in this section is Music 22 or equivalent.

100. Medieval and Renaissance Music.
   4 units, Aut (Aldrich, Houle)

   4 units, Win (Aldrich, Houle)

102. Music of the Classic Period.
   4 units, Spr (Nanney)

   4 units, Aut (Crosten)

104. Music of the Modern Period.
   4 units, Win (Smith)

142. The String Quartets of Beethoven — Prerequisite: 102.
   4 units (Ratner)

143. Chamber Music of the Classic Period —Prerequisite: 102.
   4 units (Ratner)

144. Twelve-tone and Serial Music — Prerequisite: 104.
   4 units, (Smith)
150. Studies in Opera.  
4 units (Crosten)

4 units (Schmidt)

4 units (Nanney)

155. Keyboard Music to 1700.  
4 units (Aldrich, Nanney)

199. Individual Work — For advanced undergraduates who wish to do work in fields not covered by regular curriculum. Projects for study must be specific and must be submitted for faculty approval before registration in the course. Credit not to exceed 4 units per quarter.  
Any quarter (Staff) by arrangement

240. Seminar in Music History and Analysis—May be repeated for total of 8 units.  
4 units, Aut, Win (Aldrich, Ratner)

**MUSICAL PERFORMANCE**

12. Introductory Piano — Class for music majors.  
1 unit, Aut, Win, Spr (Blew)

72. Group Instruction — For music majors and minors.  
1 unit, Aut, Win, Spr (Staff)

72a. Piano Class (Blew).  
72b. Voice Class (Rasmussen).  
72c. Stringed Instruments Classes (Hampton, Kuhn).

72d. Wind Instruments Classes (Barnes, Houle).

72e. Recorder Class (Houle).

72f. Viola da Gamba Class (Miloradovitch).

172, 272. Individual Vocal and Instrumental Instruction—Restricted to music majors.  
2 units, Aut, Win, Spr (Staff)

Before registering for any branch of this instruction, the student must obtain approval of the staff member in charge of the division in which he wishes to enroll.

172a, 272a. Keyboard Instruments (piano, organ, harpsichord).  
Piano, organ: Professor Nanney in charge  
Harpsichord: Professor Aldrich in charge

172b, 272b. Voice.  
Mr. Rasmussen in charge

172c, 272c. Stringed Instruments (violin, viola, violoncello, viola da gamba, contrabass, harp).  
Professor Salgo in charge

172d, 272d. Wind Instruments (flute, recorder, oboe, clarinet, bassoon, trumpet, horn, trombone).  
Professor Houle in charge

Note—A special fee of $40 per quarter is charged for enrollment in any branch of 172 or 272.

130a,b. Orchestral Conducting — Prerequisite: 127.  
130a. 3 units, Aut (Salgo) given 1967–68  
130b. 3 units, Win (Salgo) given 1967–68

131a,b. Choral Conducting.  
131a. 3 units, Aut (Schmidt)  
131b. 3 units, Win (Schmidt)

230a,b. Advanced Orchestral Conducting.  
230a. 4 units, Aut (Salgo)  
230b. 4 units, Win (Salgo)

231a,b. Advanced Choral Conducting.  
231a. 4 units, Aut (Schmidt)  
231b. 4 units, Win (Schmidt)

269. Seminars in Performance Practice.  
269a. Renaissance and Early Baroque.  
4 units, Aut (Houle)  
269b. Eighteenth Century.  
4 units, Win (Houle)  
4 units, Spr (Houle)

**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.

160. University Orchestra.  
1 unit, Aut, Win, Spr (Salgo) M 7:45 p.m. and Th 7:15 p.m.
161. University Bands.
161a. Concert Band.
1 unit, Aut (Barnes) T 7:15 p.m.
   Win (Barnes) MWF 4:15–5:30 p.m.
   Spr (Barnes) MWF 4:15–5:30 p.m.
161b. Studio Band.
1 unit, Aut, Win, Spr (Barnes) by arrangement
161c. Marching Band.
1 unit, Aut (Barnes) MWF 4:15–5:30 p.m.
162. University Chorus.
1 unit, Aut, Win, Spr (Schmidt),
   M 7:30–9:30 p.m., W 4:00–5:30
163. University Choir—Official choir of Memorial Church, which furnishes music for Sunday services, special occasions in Church calendar. Eight members chosen by audition may receive an honorarium for performing duties other than those required of regular Choir.
2 units, any quarter (Schmidt) T 4:15–5:30 and Th 7:00–8:30 p.m. and Sunday 10–12 a.m.
1 unit, Aut, Win, Spr (Schmidt) (I)
   MTh 12; (II) 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 and Th 4:15–5:45 p.m.
1 unit, Aut, Win, Spr (Barnes)
171. Chamber Music—Open to any student with sufficient technical ability to play in combinations for strings, wind instruments, piano, harpsichord.
1 unit, Aut, Win, Spr (Salgo, Staff)

MUSIC EDUCATION
280. Seminar in Music Education.
4 units, any quarter (Kuhn)
281. Administration and Supervision of Public School Music.
4 units, Spr (Kuhn)

265a,b,c,d. Curriculum and Instruction in Secondary School Music—(Same as Education 265a, b, c, d.)
265a. 3 units, Sum (Kuhn) MTWTh 3:15
265b. 1 unit, Aut (Kuhn) T 4:15–6:05
265c. 1 unit, Win (Barnes) T 4:15–6:05
265d. 1 unit, Spr (Kuhn) T 4:15–6:05

GRADUATE RESEARCH AND SPECIAL STUDIES
200. Music Bibliography — Use of bibliographical materials in graduate study; introduction to methods of research.
   3 units, Win (Colby)
251. Seminar in Choral Repertory.
   4 units, Aut (Schmidt)
299. Master of Arts Project.
   4 units, any quarter (Staff)
300a. Seminar in Musical Notation.
   4 units, Aut (Aldrich)
300b. Seminar in Musical Notation — Continuation of 300a.
   4 units, Win (Aldrich)
300c. Seminar in Musical Notation — Continuation of 300b.
   4 units, Spr (Aldrich)
301a. Doctoral Seminar in Musical Analysis.
   4 units, Aut (Ratner)
301b. Doctoral Seminar in Musical Analysis—Continuation of 301a.
   4 units, Win (Crosten)
301c. Doctoral Seminar in Musical Analysis—Continuation of 301b.
   4 units, Spr (Smith)
302. Doctoral Research in Musicology.
   Aut, Win, Spr (Aldrich, Crosten, Ratner) by arrangement
321. Readings in Music Theory.
   3 units (Aldrich, Ratner)
   Any quarter (Aldrich, Crosten, Ratner) by arrangement
390. Tutorial—For Doctor of Musical Arts candidates.
   4 units, any quarter (Staff)
399. Doctor of Musical Arts Project.
   Any quarter (Staff) by arrangement
NAVAL SCIENCE

Executive Head: Carroll W. Brigham (Captain, USN), Commanding Officer

Executive Officer: Douglas J. Jackson (Commander, USN)

Professor: Carroll W. Brigham (Captain, USN)

Associate Professor: Douglas J. Jackson (Commander, USN)

Assistant Professors: Robert L. Milbrad (Major, USMC), Richard A. Baeky (Lt. Commander, USN), Phillip A. Livengood (Lieutenant, USN)

OFFERINGS AND FACILITIES

The Naval Science Department affords the opportunity for selected male 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 $50 per month.

Four-Year Contract NROTC students are selected by the Professor of Naval Science at the beginning of the academic year from among applicants of the incoming freshman class.

Two-Year Contract NROTC students are selected from applicants in the final quarter of their sophomore year. Candidates selected will attend a six-week summer training session prior to enrollment in their junior year. During the last two years of their undergraduate work, all Contract students receive an allowance of $40 per month. Applicants for the Contract NROTC program should communicate directly with the Professor of Naval Science, Stanford University.

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.

Regular Midshipmen must complete three summer cruises with Fleet units. Contract students must complete one such cruise, normally between their junior and senior years.

REQUIREMENTS FOR COMMISSIONING

1. All NROTC students must complete the entire sequence of Naval Science courses offered.

2. Regular NROTC Midshipmen must satisfactorily complete one year of college physics, including laboratory, by the end of their second year. Contract students should complete this requirement if their schedule permits.

3. Regular NROTC Midshipmen must satisfactorily complete one year of college mathematics by the end of their second year. Contract students must complete mathematics through trigonometry (in secondary school or college) prior to the end of their second year.

4. All NROTC students must satisfactorily complete Psychology 1 or Industrial Psychology 122 by the end of their sophomore year.

5. All NROTC students must take such instruction in swimming as is necessary to achieve proficiency equal to that of a First Class swimmer prior to graduation.

6. All NROTC students majoring in engineering who have completed Engineering 41, 41A, 42 and 42A and one of the following: Engineering 31, Chemistry 173, or Physics 170, are exempt from Naval Science 411 and 412.

COURSES

Naval Science courses are three-quarter courses. The third digit of the course number determines the quarter in which it is given (1-autumn; 2-winter; 3-spring). Courses with A as a suffix are for candidates for a Marine Corps commission. Course numbers are assigned by the Navy Department and do not correspond to the general
University plan for numbering, i.e., none are graduate courses. Prerequisite: consent of instructor for enrollment of non-NROTC students.

111. Naval Orientation — Mission, ideals, standards, traditions, and customs of the Naval Service. Introduction to seamanship, naval warfare, and naval leadership.
3 units, Aut (Livengood) MWF 8 or 12; lab. Th 8 or 12

112. Evolution of Sea Power I — Develops understanding of significant principles of sea power. These are examined in terms of the influence of sea power on historical development throughout the world.
3 units, Win (Livengood) MWF 8 or 12; lab. Th 8 or 12

113. Evolution of Sea Power II — Continuation of 112.
3 units, Spr (Livengood) MWF 8 or 12; lab. Th 8 or 12

211. Naval Weapons I — Develops understanding of naval weapons and weapons systems and their application to maintain control of the sea. Stress is placed on basic scientific principles underlying determination of weapons systems requirements, design, and employment, rather than study of specific weapons systems.
3 units, Aut (Staff) MWF 8 or 2:15; lab. Th 8 or 2:15

212. Naval Weapons II — Continuation of 211. Jet and rocket propulsion, aerodynamics, inertial guidance systems, principles of nuclear physics.
3 units, Spr (Staff) MWF 8 or 2:15; lab. Th 8 or 2:15

3 units, Aut (Staff) MWF 10 or 12; lab. Th 10 or 12

3 units, Win (Staff) MWF 10 or 12; lab. Th 10 or 12

3 units, Spr (Staff) MWF 10 or 12; lab. Th 10 or 12

311A. Evolution of the Art of War I — Development of the art of warfare through consideration of historical examples of evolutionary and technical trends in strategy and tactics.
3 units, Aut (Milbrad) MWF 10 or 2:15; lab. Th 10 or 2:15

312A. Evolution of the Art of War II — Continuation of 311A.
3 units, Win (Milbrad) MWF 10 or 2:15; lab. Th 10 or 2:15

313A. Modern Basic Strategy and Tactics — Rationale of basic strategic concepts. Offensive, defensive combat in light of past and present U.S. and foreign military policies.
3 units, Spr (Milbrad) MWF 10 or 2:15; lab. Th 10 or 2:15

411. Naval Engineering — Application of thermodynamics to design, installation and operation of naval propulsion plants. Introduction to principles of nuclear reactors, problems of radiation shielding and instrumentation. Principles of stability, experimental determination of righting moment, metacentric height, list and trim.
3 units, Aut (Staff) MWF 11 or 1:15; lab. Th 11 or 1:15

412. Naval Engineering and Introduction to Naval Leadership — Continuation of 411. Stress on preparation of Midshipmen for immediate assumption of command responsibilities upon graduation and commissioning.
3 units, Win (Staff) MWF 11 or 1:15; lab. Th 11 or 1:15

412E. Introduction to Naval Leadership — Stress on preparation of Midshipmen for immediate assumption of command responsibilities upon graduation and commissioning. (Open to Engineering majors only.)
1 unit, Win (Staff) by arrangement

413. Naval Leadership — Management principles governing the administration of large complex organizations. Purposes and administration of UCMJ. Psychological, sociological, and anthropological factors underlying leadership in the naval environment.
3 units, Spr (Staff) MWF 11 or 1:15; lab. Th 11 or 1:15
411A. Amphibious Warfare I — Historical development of amphibious warfare. Current doctrine.

3 units, Aut (Milbrad) MWF 11 or 1:15; lab. Th 11 or 1:15

412A. Amphibious Warfare II — Continuation of 411A.

3 units, Win (Milbrad) MWF 11 or 1:15; lab. Th 11 or 1:15


3 units, Spr (Milbrad) MWF 11 or 1:15; lab. Th 11 or 1:15

Naval Science Laboratory — Two hours a week of Naval Science Laboratory required of all NROTC students. Monday session held on Drill Field at 3:15 p.m. Thursday session practical work conducted in regular classroom.

PHILOSOPHY

Executive Head: Patrick Suppes
Director of Graduate Study: Donald H. Davidson
Director of Undergraduate Study: John D. Goheen
Professors: Donald H. Davidson, John D. Goheen, K. Jaakko Hintikka, John L. Mothershead, Jr., Philip H. Rhinelander, Patrick Suppes
Associate Professors: David S. Nivison, Jeffrey Smith
Assistant Professor: Joseph D. Sneed. Acting: David J. Berlinski
Instructors: Bruce Landesman, Warren Quinn

Logic Division

Director: Dana S. Scott
Professor: Georg Kreisel
Associate Professors: Solomon Feferman, Dana S. Scott. Visiting: Robin Gandy
Visiting Assistant Professor: Andrzej Ehrenfeucht

Offerings and Facilities

Courses in philosophy give the student a knowledge of major philosophical ideas as they have developed historically and in terms of their contemporary analysis. The historical courses listed below emphasize change and development of philosophical ideas over a period of time, whether in the form of a widespread movement or the intellectual history of an individual philosopher. Other courses, such as those in systematic philosophy (cf. the listing which follows), or, in some instances, in the single work of a philosopher, emphasize the analysis, clarification, and elaboration of ideas. In recognition of the fact that philosophy gains significance as it draws from and contributes to other fields of human interest and knowledge, the programs of all philosophy majors will be planned to include courses outside the Department.

The Tanner Memorial Library of Philosophy, situated in the Philosophy Building, contains an excellent working library and ideal conditions for study.

The Philosophy Colloquium, to which guest speakers are invited, meets once a month during the academic year. The Hume Society, the undergraduate and graduate philosophical group, holds frequent meetings at which student speakers or their guests discuss philosophical issues.

A number of scholarships for undergraduate majors in Philosophy are available. In addition to general university scholarships, undergraduate majors in the Department may apply for tuition scholarships available from the Crossett fund.

Programs of Study

Bachelor of Arts

The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor’s degree:

The major program shall consist of 48 units within the Department including, in the case of qualified and interested students, 9 to 24 units of tutorial work as described below and 24 to 39 units of regular course work. The course work shall include at least one course from each of the following groups of courses: Group A: 3, 157, 160, 161, 181; Group B: 2, 170, 172, 174, 177; Group C: 164, 168, 182, 184, 188, 189; and Group D: 100, 101, 102, 103, 104. Majors who do not take senior tutorial will select, in consulta-
tion with their Departmental advisers, a pro-
gram of courses emphasizing one of the ma-
jor areas of philosophy indicated by the four
groups of courses. All majors will select, in
consultation with their Departmental advis-
ers, programs of courses outside the Depart-
ment which will complement their major
programs or enable them to further an in-
terest in some other area of knowledge.

Philosophy courses taken in fulfillment of
General Studies requirements may also be
counted in fulfillment of Departmental
requirements. Majors in philosophy must
maintain at least a C average in their work
in the Department.

TUTORIAL WORK

The Department offers intensive tutorial
instruction for qualified and interested jun-
iors and seniors. Juniors whose grade point
averages warrant, and who wish to, shall do
9 units total of tutorial work. This work shall
consist of extensive reading in, and the writ-
ing of weekly essays on, important works of
either Plato or Aristotle and either Hume or
Kant. At the end of the year juniors will take
a comprehensive examination, their perfo-
rance on which, balanced by their written
and oral performances in the tutorial session,
shall determine both their grades for the
year in tutorial and their qualification for
participation in Senior Tutorial. Exceptions
to this rule may be made in special cases,
e.g., cases where the student has not had
the opportunity to take Junior Tutorial. In
such a case, the student must pass a com-
prehensive examination equivalent to the
Junior Tutorial Examination with distinc-
tion.

Senior Tutorial involves 15 units total of
tutorial work. For the academic year 1966–
67 all students accepted for Senior Tutorial
automatically became candidates for De-
partmental Honors. To achieve Departmen-
tal Honors, the Senior Tutorial Essay must
be distinguished. Failing to attain Depart-
mental Honors, a student may nevertheless
qualify for Senior Tutorial credit.

COMBINED MAJOR IN CLASSICS
AND PHILOSOPHY

Students may, with the consent of the
Heads 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 Heads of each of
the departments concerned.

HONORS PROGRAM IN HUMANITIES

An Honors Program in Humanities is of-
ferrred for philosophy majors who wish to sup-
plement their Departmental work for the
A.B. degree by a related carefully guided
program of studies. See the section "Hu-
manities (Special Programs)" for a descrip-
tion of the Honors Program.

HONORS PROGRAM IN BEHAVIORAL SCIENCES

Philosophy majors with a central inter-
rest in methodological problems may partici-
pate in an Interdepartmental Program in
Quantitative Methods in the Behavioral Sci-
ences. See the section "Behavioral Sciences
(Honors Program in Quantitative Methods)"
for a description.

ADVANCED DEGREES

The members of the Department are pre-
pared to direct and supervise individual
study and research to supplement instruc-
tion offered in courses listed below. In addi-
tion, advanced seminars, unlisted in the cata-
log, are frequently organized in response to
student interest. Candidates for advanced
degrees are urged to discuss their entire pro-
gram of study with their Departmental ad-
viser as early as possible.

Applicants for admission to graduate
standing in the Department of Philosophy
should apply to the Director of Admissions.
Applicants are requested to take, in their
senior year or later, the Graduate Record
Aptitude Test and the Graduate Record Ad-
vanced Test in Philosophy.

The Department will not ordinarily admit
students who wish to become candidates for
the Master's degree only.

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 aver-
age 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 work within the Department to be chosen according to the student’s interests in consultation with a Departmental adviser. Departmental approval of the program of studies is required. One hour of the doctoral oral examination is ordinarily 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.

Preliminary Examinations

1. All first-year graduate students will take a three-hour written examination during the winter quarter of their first year of graduate study at Stanford. It is expected that this examination will ordinarily be given in the first two weeks in February. A student is required to pass this examination in order to continue as a second-year student in the Department.

2. Written preliminary examinations are set for all students in the middle of their second year of graduate study. These examinations are offered in the following four areas: logic and philosophy of science, epistemology and metaphysics, ethics and the theory of value, the history of philosophy. The examinations must be passed as a group, subject to the modification described in the next paragraph. It is expected that a student must pass these examinations in order to continue as a graduate student. In special circumstances a student may be permitted to take these examinations a second time. The second-year examinations will ordinarily be set in the middle of February. If they so desire, first-year students may ask the Department for the option of taking the second-year examinations.

A student may substitute a group of courses for at most one of the four examinations. Such a group consists of at least four courses in each of which the student has a mark of B or better. Courses taken at another university cannot be included. The following groups of courses satisfy the present requirement:

Logic and Philosophy of Science: 157a, 157b, 164, and 166.

Epistemology and Metaphysics: 184 plus three additional courses from the following: 181, 182, 189, and 202.

Ethics and the Theory of Value: 156, 170, and two of the following: 172, 174, 177.

History of Philosophy: 100, 101, 102, 103.

In each area, more advanced courses or seminars may be substituted for the recommended courses with Departmental permission.

On or before February 1 of the first year in which a student plans to take the preliminary exams, he must file with the Department secretary a declaration of his intention to take the examinations. This should include a statement of the examination (if any) for which courses are to be substituted, and a list of the courses the student wishes to substitute. If this list differs from that given above, it must be approved by the Department. Courses may not be offered in lieu of an examination in an area in which the student has already taken the preliminary examination but failed, and the area in which exemption is requested cannot be changed if the examinations are taken a second time. The four courses offered in substitution for one examination must be completed before the student’s formal candidacy for the Ph.D. degree is accepted, and generally no later than the end of the second year of graduate work. The courses need not be completed prior to taking the written preliminary examinations.

Language Requirements—Candidates for the Ph.D. must demonstrate a reading
knowledge of French and German. When it is relevant to a proposed dissertation topic, the department will give permission to substitute other modern languages, or ancient languages, for one or both of the required languages.

Dissertation—Upon passing the preliminary examinations the candidate will submit a brief written statement of his dissertation topic to the Department, and a committee will be appointed to direct the research for and writing of the dissertation. Departmental approval of the dissertation topic is required for formal admission to candidacy for the doctoral degree.

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.

Immediately after passing the preliminary examinations, the candidate will file a formal application for candidacy as prescribed by the University. 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 repassing the preliminary examinations.

Oral Examination—The University oral examination is taken after completion of the dissertation. The oral examination is to be considered primarily as a defense of the dissertation, but it may range over related topics as well.

Graduate Fellowships and Assistantships

A number of fellowships, including those provided by the Weiss and Locke funds which are reserved for students of philosophy, are available to graduate students.

In addition, the department has six teaching assistantships which may be held separately or combined with additional scholarship funds. Teaching assistants are expected to devote about half their time to their teaching duties. There are sections taught by teaching assistants in Philosophy 2, 3, 5, 6a and 6b.

Application forms for fellowships and teaching assistantships may be secured by writing the Office of Financial Aids; applicants for teaching assistantships should in addition address a specific request to the Director of Graduate Studies in Philosophy.

In general, teaching assistantships are not offered to first-year graduate students. Students who do not intend to become candidates for the doctor's degree are ineligible for graduate fellowships and teaching assistantships.

Graduate Program in Humanities

The Department of Philosophy also participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Philosophy and Humanities. For a description of that program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."

Graduate Program in Logic and Foundations of Mathematics

This program is intended to lead to a doctorate in mathematics or in philosophy. Candidates for the Doctor's degree must meet the requirements of the department concerned. For further information concerning this program, students should write Professor Dana Scott, Director, Division of Logic.

At the elementary level there are courses in Intermediate Logic (160a, b), Introduction to Set Theory (161), and Theory of Automata (162), designed in such a manner as to permit the entering graduate student either to start his logical studies from the beginning or, if he has had some previous training, to make up his deficiencies with a view to bringing his level up to that required by the three basic groups of courses.

These three basic groups comprise a three-quarter sequence in Metamathematics (292a, b, c), a three-quarter sequence in Recursion Theory (293a, b, c), and a three-quarter sequence in Set Theory (291a, b, c). Students working for a Ph.D. under the Program will be required to take two quarters of each of these courses and three quarters of at least one. From time to time special courses may be offered as warranted by student interest. In particular in 1966–67 courses in Intuitionistic Logic (163a, 294) and in Modal Logic (163b) will be given. Satisfactory completion of graduate courses offered under the Program will be counted toward fulfilling the basic course requirements for a Ph.D. in either mathematics or philosophy.
At least one seminar at the Ph.D. level is given every quarter. The purpose of the Seminars is to prepare the student for creative research: they will be flexibly arranged to suit the students’ interest and to aid their selection of Ph.D. topics.

Aside from these courses, which are all concerned directly with logic and the foundations of mathematics, there are related courses in the philosophy of language, decision theory, and the application of the axiomatic method to the empirical sciences. Directed reading courses can also be arranged for individual students.

**Elementary Courses**

**#2. Introduction to Ethics**—An introduction to the study of human values, the grounds of reasonable choice and standards of right and wrong. Problems of ethics will be examined in light of materials drawn from such fields as psychology, sociology, politics, as well as from works of philosophers.

5 units, Win (Davidson) MTWTh 2:15 and Th or F section

**#3. Introduction to Logic**—An introduction to the methods and principles of formal logic. Exploration of modern techniques of deduction. Applications to philosophy and the exact sciences. This course is not a General Studies Humanities course.

5 units, Aut (Sneed) MTWTh 1:15 and Th or F section

Spr (Suppes) MTWTh 2:15 and Th or F section

Sum (——) MTWThF 11 and Th or F section

**#4. Introduction to Chinese Philosophy**—Examination of selected problems in Chinese political thought, ethics, metaphysics, and art criticism. Comparison with similar problems in Western philosophy.

4 units, Aut (Nivison) MTWTh 2:15

**#5. Introduction to Philosophy**—Principal problems with which philosophy deals. Emphasis on conflicts in points of view which result from attempts to deal with these problems, and on practical consequences of various solutions offered.

5 units, Aut (Mothershead) MTWThF 10

Sum (——) MTWThF 1:15 and one hour by arrangement

**#6a,b. Problems of Good and Evil**—The problem posed in the Book of Job is taken as central, and various attitudes toward this problem are considered in chronological order. In the first quarter the works covered include the Old Testament, several Greek tragedies, selections from Plato, Aristotle, the Stoics, Lucretius, New Testament, and Dante’s Divine Comedy. In the second quarter, authors covered include Montaigne, Shakespeare, Leibniz, Hume, Marx, Mill, Dostoevsky, and Camus. The course will be given as a continuous course over two quarters, but the first quarter (6a) may be taken for credit without the second. The course is open to Freshmen. 6a is prerequisite for 6b.

6a. 3 units, Win (Rhinelander) MWF 10, given 1967–68

6b. 3 units, Spr (Rhinelander) MWF 10, given 1967–68

**#8. Philosophy of Art**—Nature and function of artistic creation and expression. Unique and common characteristics of various arts. Relation of arts to other human interests.

4 units, Aut (Smith) MWF 9

**#10. Introduction to Philosophical Analysis**—An analysis of selected philosophical problems. Readings will include important historical texts as well as contemporary writers.

5 units, Spr (Goheen) MTWTh 11 and Th or F section

**#21. Sophomore Seminar in Plato**—An introduction to the philosophy of Plato. Readings will include the Republic and several shorter dialogues. Enrollment limited to 15.

3 units, Aut (Rhinelander) T 2:15–4:05, given 1967–68

**#24. Sophomore Seminar in Berkeley**—An introduction to the philosophy of Berkeley. The reading and analysis of some of the principal works of Berkeley will be considered. Enrollment limited to 15.

3 units, Win (——) W 4:15–6:05, given 1967–68

**#30. Sophomore Seminar on the Problems of Philosophy**—An introduction to the questions philosophy has traditionally set itself to answer. Enrollment limited to 15.

3 units, Aut (Quinn) W 4:15–6:05
PHILOSOPHY

COURSES FOR ADVANCED UNDERGRADUATE AND GRADUATE STUDENTS

I. HISTORY OF PHILOSOPHY FROM ANCIENT TIMES TO THE PRESENT

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, and the Skeptics. Prerequisite: some general course in philosophy, such as 2, 5, 6a, or 10.

4 units, Aut (Goheen) MTWTh 11


4 units, Win (Mothershead) MTWTh 11


4 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; 102 is recommended.

4 units, Win (Mothershead) MTWTh 11

104. Contemporary Philosophy — Some principal developments in contemporary philosophical thinking. Prerequisite: a total of two philosophy courses.

4 units, Spr (Goheen) MTWTh 9

106. Introduction to Philosophy — For graduate students. Lectures same as Philosophy 5.

4 units, Aut (Mothershead) MTWTh 10 and Th or F Section
4 units, Sum (———) MTWThF 1:15 and Th or F Section

110. Development of Scientific Concepts—A survey of the historical development of selected concepts in the physical sciences oriented toward consideration of philosophical problems associated with them and general questions about concept formation in science.

4 units, Win (Sneed) MTWTh 3:15

II. COURSES IN THE PHILOSOPHY OF A PERIOD AND IN INDIVIDUAL PHILOSOPHERS

The following courses will be offered in 1966-67 or 1967-68. Others will be announced in subsequent years or announced from quarter to quarter depending on the interests of students and instructors. Prerequisite: permission of instructor.

136. Seminar in the Philosophy of Aristotle — Reading (in English translation) and class discussion of a number of basic philosophical writings of Aristotle. Prerequisite: 100 or equivalent.

3 units, Win (Hintikka) M 4:15-6:05, given 1967-68

137. Seminar in the Philosophy of Plato—A study of selected dialogues. Prerequisite: 100 or equivalent.

3 units, Win (Goheen) WF 4:15-6:05

140. The Philosophy of St. Thomas Aquinas.

4 units, Spr (———) MTWTh 2:15, given 1967-68

141. Seminar: Problems in Mediaeval Philosophy—Prerequisite: 100 or 101 or equivalent.

3 units, Aut (Berlinski) M 1:15-3:05

142. Seminar in the Philosophy of Descartes—Prerequisite: 102 or equivalent.

3 units, Win (Hintikka) M 4:15-6:05

144. Seminar in the Philosophy of Spinoza—A study of the basic works of Spinoza.

4 units, Aut (Rhinelander) TTh 2:15-4:05, given 1967-68
145. The Philosophy of David Hume—Prerequisite: 102 or equivalent.
4 units, Spr (Quinn) MTWTh 10

147. The Philosophy of Kant—A selection of representative problems in Kant's philosophy are discussed in the light of recent developments.
3 units, Spr (Hintikka) M 4:15-6:05, given 1967-68

148. Seminar in Kant's Ethics—Reading and discussion of the Critique of Practical Reason and other ethical writings of Kant with a view to their relevance to philosophy today.
3 units, Spr (Mothershead) T 2:15-4:05, given 1967-68

150. Seminar in the Philosophy of A. N. Whitehead.
3 units, Win (Goheen) Th 2:15-4:05, given 1967-68

3 units, Aut (——) by arrangement, given 1967-68

III. SYSTEMATIC PHILOSOPHY

Unless otherwise specified the prerequisite for the following courses is one course in philosophy or permission of the instructor.

156. Introduction to Ethics—For graduate students. Lectures same as Philosophy 2. Special section for graduate students.
4 units, Win (Davidson) MTWTh 2:15 and Th or F section

157a. Introduction to Logic—For graduate students. Lectures same as Philosophy 3.
5 units, Aut (Sneed) MTWTh 1:15 and Th or F section
Spr (Suppes) MTWTh 2:15 and Th or F section
Sum (——) MTWThF 11 and Th or F section

3 units, Win (——) MWF 11:00

160a. Symbolic Logic—Thorough treatment of validity, provability, consistency,
completeness, definability and decision problems for logical calculi, and axiomatic theories.
3 units, Win (Ehrenfeucht) TTh 11:00-12:15

160b. 3 units, Spr (Ehrenfeucht) TTh 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, Spr (Scott) 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 (Ehrenfeucht) TTh 11:00-12:15

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, Win (Kreisel) T 2:15-3:05, Th 2:15-4:05

163b. Modal Logic—Semantics and axiomatizations for several model propositional and predicate calculi. Discussion of deontic and tense logics. 163a is not prerequisite to 163b. Prerequisite: 157b or 160a or equivalent.
3 units, Spr (Scott) MWF 1:15

164. Philosophy of Science—Detailed analysis of the structure and methods of empirical science with emphasis on set-theoretical models, probability, induction, causality and the testing of theories.
4 units, Win (Suppes) MWF 2:15 and one hour by arrangement

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, Spr (——) TTh 4:15–5:30, given 1967–68

166. Probability and Induction—The most important approaches to induction and to probability are discussed and compared, with emphasis on the theories of inductive probability.

3 units, Spr (Hintikka) MWF 3:15

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, Win (Smith) MTWTh 9

170. Theory of Value — Definitions of “value”; psychological and social conditions of different values; function of value judgments; nature of standards and their role in criticism—in art, science, morals. Foundations of the normative disciplines, i.e., logic, ethics, aesthetics. Prerequisite: 2 or permission of instructor.

4 units, Win (Quinn) MTWTh 10

172. Seminar in Ethical Theory — Analysis of selected writings in contemporary ethical theory. Emphasis will be placed on the possibility of constructing a naturalistic theory that will provide guidance in decision-making (first person) and standards enabling justification or lack of justification for the decisions and actions of others (third person). Prerequisite: 2, 170, or permission of the instructor.

3 units, Spr (Mothershead) T 2:15–4:05


4 units, Spr (Quinn) MTWTh 1:15

177. Political Philosophy — An analysis of fundamental political conceptions and problems: State, law, natural law, rights, natural rights, political obligations, and others.

4 units, Aut (——) MTWTh 1:15, given 1967–68


3 units, Spr (——) MWF 10, given 1967–68

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

#180. Philosophy of Religion—Critical enquiry into the nature and validity of religious experience, its unity and variety, its relation to other human interests.

4 units, Spr (Smith) MWF 9

181. Philosophy of Language—Nature and uses of language. Concepts of meaning, reference, truth, name, syntax, metaphor, ambiguity, vagueness, definition. Comparison and study of scientific, poetic, philosophic, legal, other uses of language. Applications in the fields of psychology, linguistics, anthropology, literary criticism. Prerequisite: 3 or permission of instructor.

4 units, Aut (Davidson) MTWTh 2:15

182. Metaphysics—This course will undertake to examine and clarify the traditional metaphysical distinction between particulars and universals, or substances and attributes, or subjects and predicates. Some traditional and some contemporary positions bearing on this distinction will be considered critically; for example, some theses of Aristotle, Plato, Leibniz, and Hume, in the former instance, and some theses of Frege, Wittgenstein, Russell, and Strawson in the latter instance.

4 units, Aut (Goheen) MTWTh 3:15

184. Theory of Knowledge—A survey of the central problems in the theory of knowledge emphasizing the uses of modern techniques in clarifying classical epistemological issues.

4 units, Win (Hintikka) MTWTh 3:15

189. The Concept of Mind—This course will attempt to give an account of the concepts of action and behavior and to investigate the logical relations in which these concepts stand to those of belief, desire, sensation, and perception.

4 units, Win (——) MTWTh 11, given 1967–68
190. Selected Topics of Contemporary Philosophy—Topics will change from year to year. The central theme will be announced in the Time Schedule in any quarter in which this course is offered.

By arrangement

191. Tutorial—Junior year.

3 units, each quarter (Berlinski, Landesman, Quinn) by arrangement

192. Ideas in Literature—This course will explore ways in which philosophical ideas receive literary expression. Readings in such authors as Homer, Greek dramatists, Augustine, Dante, Montaigne, Marlowe, Shakespeare, Milton, Wordsworth, Hardy, Kafka, Eliot, Joyce.

4 units, Spr (Davidson) MTWTh 1:15, given 1967-68

193. Formal Aspects of Social Decision Making—The following topics to be discussed: Relation between individual values and social policy. Critique of logical basis of democracy. Relations between political theory and recent work in welfare economics. Political and social values in light of general theory of value. Prerequisite: 3 or permission of the instructor.

3 units, Win (Sneed) TTh 1:15 and one hour by arrangement

196. Tutorial—Senior year.

5 units, each quarter (Staff)
by arrangement

197. Individual Work for Undergraduates.

Each quarter (Staff) by arrangement

199. Seminar in Recent Philosophical Literature—Open to junior and senior students with consent of instructor.

Topic: Historical Explanation.

3 units, Win (Nivison) Th 4:15-6:05

Topic: Concept of Intention.

3 units, Spr (Davidson) T 8-10 p.m.

Topic: Marxism.

3 units, Spr (Nivison) Th 4:15-6:05

Topic: Wittgenstein.

3 units, Spr (Berlinski) W 4:15-6:05

Courses Intended Primarily for Graduate Students


3 units, Win (Davidson) T 8-10 p.m.

204. Induction and the Theory of Rational Behavior—Axiomatic development of probability; survey of recent work in confirmation theory. Discussion of the traditional problem of induction in light of recent work on rational behavior in the theory of games and theory of statistical decisions. Prerequisite: 3 or permission of instructor.

3 units, Aut (Sneed) TTh 3:15 and one hour by arrangement

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 (Sneed) TTh 3:15 and one hour by arrangement

206. Mathematical Models in Behavioral Sciences: Measurement and Utility Theory—(Same as Statistics 206.) 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. Prerequisite: Mathematics 63 or equivalent.

3 units, Aut (Suppes) TTh 2:15 and one hour by arrangement

207. Mathematical Models in Behavioral Sciences: Behavior Theory—(Same as Statistics 207.) Stimulus sampling and linear models for learning will receive the main emphasis. Modification of the basic models to deal with concept formation and perceptual problems will be discussed. Prerequisite: Mathematics 63 or equivalent.

3 units, Win (Suppes) TTh 2:15 and one hour by arrangement

240. Individual Work for Graduates.

Each quarter (Staff) by arrangement

242a,b,c.—Seminar in the Philosophy of Science—The seminar in 1966-67 will concen-
brate on theories of perception and concept formation.

242a. 3 units, Aut (Suppes) T 4:15–6:05
242b. 3 units, Win (—) W 4:15–6:05
242c. 3 units, Spr (Sneed) W 4:15–6:05

243. Seminar in Foundations of Mathematical Behavior Theory — (Enroll in Psychology 272.)
2 to 3 units, Spr (Estes, Suppes) M 3:15–5:05

244. Seminar in Metaphysics.
3 units, Aut (Davidson) T 8–10 p.m.

Each quarter (Staff) by arrangement

291a, b, c. Set Theory—Full development of set theory on an axiomatic basis. Discussion of various axioms of infinity. Problems of consistency and independence. Prerequisites: 160a, b, and 161 or equivalent.
291a. 3 units, Aut (—) given 1967–68
291b. 3 units, Win (—) given 1967–68
291c. 3 units, Spr (—) given 1967–68

292a, b, c. Metamathematics — Formalized theories and their models. Validity and definability. Complete and decidable theories; applications to algebra. Recursively axiomatizable theories; incompleteness of elementary number theory; Gödel's theorems. Introduction to Hilbert's consistency problem; proof theory and questions of constructivity. Prerequisites: 160a, b, and 161 or equivalent.
292a. 3 units, Aut (Feferman) MWF 11
292b. 3 units, Win (Feferman) MWF 11
292c. 3 units, Spr (Feferman) MWF 11

293a, b, c. Recursion Theory — Recursive functions of natural numbers and recursively enumerable sets. Degrees of unsolvability and applications to mathematical problems. Recursive ordinals, hierarchies and hyperarithmetic sets. Recursive functionals of higher order. Abstract and model theoretic foundations of recursion theory. Computable recursive functions of ordinals. Prerequisites: 160a, b, and 161 or equivalent.
293a. 3 units (Gandy) TTh 11:00–12:15
293b. 3 units (Gandy) TTh 11:00–12:15
293c. 3 units (Gandy) TTh 11:00–12:15

294. 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, Spr (Kreisel) T 2:15–3:05 and Th 2:15–4:05

299. Advanced Seminar in Recent Philosophical Literature.
Topic: Some Philosophical Problems in Logic.
3 units, Spr (Hintikka) M 4:15–6:05

391a, b, c. Seminar in Foundations of Mathematics.
391a. Aut (—) Th 4:15–6:05, units by arrangement
391b. Win (Kreisel) T 4:15–6:05, units by arrangement
391c. Spr (Kreisel) T 4:15–6:05, units by arrangement

PHYSICAL SCIENCES (GENERAL PROGRAM)

Professor: Claudio Alvarez-Tostado
Lecturer: William A. Perkins
Physical Sciences Subcommittee: (Chairman), Claudio Alvarez-Tostado, Willis W. Harman, Leonard I. Schiff

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 1, 2, 3, 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.
A reading knowledge of a modern foreign
language, preferably French or German. This will normally mean the completion of a course numbered 23 in one of the modern languages.

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. A reading knowledge of French or German is required. 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**

#1, 2, 3. Physical Science—Survey of physical sciences as an expanding field of knowledge. Lectures, demonstrations, laboratory work in astronomy, chemistry, physics, geology, to give a concept of the general field rather than emphasize its divisions. Primarily for freshmen. No credit will be given for Physical Science 3 following Geology 1.

1. 3 units, Aut (Alvarez-Tostado) TTh 8 or 9; lab. by arrangement
2. 3 units, Win (Alvarez-Tostado) TTh 8 or 9; lab. by arrangement
3. 3 units, Spr (Alvarez-Tostado) TTh 8 or 9; lab. by arrangement

#5, 6, 7. Physical Science—Survey of physical sciences as an expanding field of knowledge. Similar to Physical Science 1, 2, 3, but no laboratory work; lectures have greater emphasis on history of science.

5. 2 units, Aut (Alvarez-Tostado) TTh 11
6. 3 units, Win (Alvarez-Tostado) MWF 11
7. 3 units, Spr (Alvarez-Tostado) MWF 11

#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

#100. Physical Science and Modern Life—Review of important conclusions, theories of modern physical science; discussion of methods, values, limitations of scientific inquiry; survey of relations of science to technology, economics, sociology, philosophy, religion. Prerequisite: junior or senior standing.

3 units, Aut (Alvarez-Tostado)alternate years, given 1966–67

140. Electron Tubes in Research—Elementary study of electron tubes, their characteristics and application to control, measurement. Emphasis on applications, particular attention to photo tube, d.c. amplifier circuits. Prerequisite: Physics 23, or equivalent.

3 units, Aut (Alvarez-Tostado) alternate years, given 1966–67


Any quarter (Staff)

**Physics**

*Emeriti: Joseph G. Brown, Paul H. Kirkpatrick, David L. Webster (Professors)*

*Executive Head: Arthur L. Schawlow*


*Associate Professors: David M. Ritson, Mason R. Yearian*


*Affiliated Faculty: Matthew Sands (Professor, Stanford Linear Accelerator Center)*

**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 Labora-
Physics laboratories (Physics, Microwave Laboratory, and Biophysics Laboratory) form a closely related complex housing a range of physics activities from general courses through advanced research, and including several accelerators up to 1.2 Bev in size. Separated from this group is the Stanford Linear Accelerator Center (SLAC), a very high energy physics laboratory now under construction which will contain as its principal tool a two-mile-long 45-Bev electron accelerator, and which should produce its initial 20-Bev beam in 1966. Professor W. Carlisle Barber is the Director of the High Energy Physics Laboratory; Professors Hofstadter, Mozley, Ritson, and Yerian 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 Division, Biophysics Laboratory, 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, and German, 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.

Graduate students find opportunities for research in the fields of theoretical physics, low temperature physics, electron and nuclear resonance, nuclear physics including the Mossbauer effect, high energy physics, coherent optical radiation, and solid state physics. The fields of microwave physics, plasma physics, ferrites, biophysics, and others of a similar nature are offered in the Applied Physics Division and in the Biophysics Laboratory. The number of graduate students admitted to the Physics Department is strictly limited. Students should complete application by January 15, 1967, 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 are planned to 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, 52, 53, 54, 61, 100, 101, 110, 111, 120, 121, 122, 130, 131, 132, 170, 171, 200, 201; 9 units of a sequence, to be decided with the concurrence of the Department adviser, in a science other than physics or mathematics (in the event that the chemistry background of the student is judged inadequate, the Department will require that this sequence be Chemistry 4 and 5); Language, completion of French 3, German 3, or Russian 3 (or placement in more advanced courses). Another language may be substituted by petition at the discretion of the Department.

The mean grade for all courses taken in physics and chemistry must be C or higher. Students may reach the level of the 200-series courses via a normal sequence or an accelerated sequence. Exceptionally able students with an especially good preparation in physics will find the accelerated sequence advantageous. It requires fewer courses and provides more opportunity for electives in either physics or other fields. Admission to the accelerated sequence requires A grades in 51 and 53 or permission of the Physics Department Undergraduate Study Committee.

Sample programs under the two sequences are shown below. The sequence of courses during the first two years is relatively inflexible, but considerable freedom exists during the upper-class years. The sample programs emphasize mathematics and phys-
ics electives only as one possibility. The arrangement of language, chemistry, and general studies courses is also rather arbitrary. Students are urged to work out, in consultation with their advisers, a program which will best fulfill their individual aims. The 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</td>
<td>Mechanics, Electricity</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Physics 52, 54</td>
<td>Mechanics Laboratory, Electricity Laboratory</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Math. 41, 42, 43</td>
<td>Analytic Geometry and Calculus</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>History 1, 2, 3</td>
<td>History of Western Civilization</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>English 1, 2, 3</td>
<td>Freshman English</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Social Science</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Total units</strong></td>
<td></td>
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<td>17</td>
<td>17</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, 61</td>
<td>Light and Heat, Atomic Physics, Optics and Wave Motion</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 56</td>
<td>Light and Heat Laboratory</td>
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<tr>
<td>Physics 110, 111</td>
<td>Intermediate Mechanics</td>
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</tr>
<tr>
<td>Math. 44, 45, 46</td>
<td>Advanced Calculus</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
</tr>
<tr>
<td>Math. 130, 131, 132</td>
<td>Ordinary Differential Equations, Partial Differential Equations</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
</tr>
<tr>
<td>Chem. 4, 5</td>
<td>General Chemistry</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Total units</strong></td>
<td></td>
<td>15</td>
<td>16</td>
<td>12</td>
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</tbody>
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#### 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 105, 100, 101</td>
<td>Introductory Electronics, Intermediate Physics Laboratory</td>
<td>(3)*</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Physics 120, 121, 122</td>
<td>Intermediate Electricity and Magnetism</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 130, 131, 132</td>
<td>Atomic and Nuclear Structure</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Math. 113, 114 or 120</td>
<td>Linear Algebra and Matrix Theory, or Modern Algebra</td>
<td>(3)</td>
<td>3</td>
<td>3*</td>
</tr>
<tr>
<td>German 1, 2, 3</td>
<td>First-Year German</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Social Science</td>
<td></td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Total units</strong></td>
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<td>16</td>
<td>15</td>
<td>17</td>
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#### Fourth Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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</thead>
<tbody>
<tr>
<td>Physics 170, 171, 172</td>
<td>Thermodynamics, Kinetic Theory and Introduction to Statistical Mechanics, Physics of Solids</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
</tr>
<tr>
<td>Physics 200, 201, 202</td>
<td>Advanced Physics Laboratory</td>
<td>2</td>
<td>2</td>
<td>(3)*</td>
</tr>
<tr>
<td>Physics 210, 211, 212</td>
<td>Introductory Theoretical Physics</td>
<td>(3)</td>
<td>3</td>
<td>(3)*</td>
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<tr>
<td>Math. 106</td>
<td>Complex Variable</td>
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<tr>
<td>Humanities</td>
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<td><strong>Grand total of units</strong></td>
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<td></td>
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</table>

* Not required for degree in physics.
† Additional elective units must be added to bring this total to 180 as required by the University.

### ACCELERATED 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</td>
<td>Mechanics, Electricity</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Physics 52, 54</td>
<td>Mechanics Laboratory, Electricity Laboratory</td>
<td>1</td>
<td>1</td>
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</tr>
<tr>
<td>Math. 43, 44</td>
<td>Analytic Geometry, Calculus, and Advanced Calculus</td>
<td>5</td>
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<tr>
<td>History 1, 2, 3</td>
<td>History of Western Civilization</td>
<td>4</td>
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<tr>
<td>English 1, 2, 3</td>
<td>Freshman English</td>
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<tr>
<td>Social Science</td>
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<td><strong>Total units</strong></td>
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<td>15</td>
<td>12</td>
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#### Second Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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<tbody>
<tr>
<td>Physics 61</td>
<td>Optics and Wave Motion</td>
<td></td>
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<tr>
<td>Physics 110, 111</td>
<td>Intermediate Mechanics</td>
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<td></td>
</tr>
<tr>
<td>Physics 105, 100, 101</td>
<td>Introductory Electronics, Intermediate Physics Laboratory</td>
<td>(3)*</td>
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<tr>
<td>Physics 120, 121, 122</td>
<td>Intermediate Electricity and Magnetism</td>
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<td>3</td>
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</tr>
<tr>
<td>Math. 45, 46</td>
<td>Advanced Calculus</td>
<td>3</td>
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<td>Math. 130, 131, 132</td>
<td>Ordinary Differential Equations, Partial Differential Equations</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
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<tr>
<td>Chem. 4, 5</td>
<td>General Chemistry</td>
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<td><strong>Total units</strong></td>
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<td>16</td>
<td>18</td>
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#### Third Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>A</th>
<th>W</th>
<th>Sp</th>
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</thead>
<tbody>
<tr>
<td>Physics 130, 131, 132</td>
<td>Atomic and Nuclear Structure</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 170, 171, 172</td>
<td>Thermodynamics, Kinetic Theory and Introduction to Statistical Mechanics, Physics of Solids</td>
<td>3</td>
<td>3</td>
<td>(3)*</td>
</tr>
<tr>
<td>Physics 210, 211, 212</td>
<td>Introductory Theoretical Physics</td>
<td>(3)</td>
<td>3</td>
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</tr>
<tr>
<td>Math. 113, 114, or 120</td>
<td>Linear Algebra and Matrix Theory or Modern Algebra</td>
<td>(3)</td>
<td>3</td>
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</tr>
<tr>
<td>German 1, 2, 3</td>
<td>First-Year German</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Social Science</td>
<td></td>
<td></td>
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<td><strong>Total units</strong></td>
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<td>16</td>
<td>16</td>
<td>18</td>
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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</td>
<td>2</td>
<td>2 (3)*</td>
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<td></td>
</tr>
<tr>
<td>Physics Laboratory</td>
<td>(3)</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 220, 221, 222. Classical Electrodynamics</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Physics 230, 231, 232. Quantum Mechanics</td>
<td>(3)</td>
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<td>3</td>
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</tr>
<tr>
<td>Math. 106. Complex Variable</td>
<td>(3)*</td>
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<tr>
<td>Humanities</td>
<td>4</td>
<td>4</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

Total units .................................. 15 12 9

Grand total of units 178†

* Not required for degree in physics.
† Additional elective units must be added to bring this total to 180 as required by the University.

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, 202, 210, 211, 212, 240, 241, and, if no thesis is submitted, at least 9 additional units of course work above the 200 level (not including 290 or 390).

A reading knowledge of German, French, Italian, or Russian is also required, and must be demonstrated by an examination administered by a member of the Department faculty.

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, two quarters of Advanced Laboratory (202, 203), 210, 211, 212, 220, 221, 222, 230, 231, 232, 240, 241, 242. 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.

Each candidate for the Ph.D. is required to pass a written comprehensive examination on undergraduate-level physics, given annually in the winter quarter, and a Departmental oral examination on graduate-level physics prior to his applying for Ph.D. candidacy and taking the University oral examination. Also prior to applying for candidacy and taking the University oral, each candidate is required to demonstrate to a Physics Department faculty member a good reading knowledge of any one of four languages: French, German, Italian, or Russian.

Each student must either choose a minor subject or request a waiver of this requirement from his adviser. In the latter case, he must take nine units of graduate (200-series) courses in one of the following fields: mathematics, chemistry, or electrical engineering. Other fields may be substituted only on petition to the Physics Department Graduate Study Committee. The courses taken must be passed with a B average. No course listed by the Physics Department or Applied Physics Division may be counted to fulfill the requirements necessary for the waiver of a minor.

The Physics Department strongly encourages all graduate students to engage in teaching before receiving their degrees.

(The student interested in applied physics and biophysics research should also be aware of the Ph.D. granted independently by the Applied Physics Division and by the Biophysics Laboratory. See elsewhere in this Bulletin.)

Minors in physics must take either Physics 210, 211, and 212 or Physics 130, 131, and 132 or Physics 170, 171, and 172, with the appropriate prerequisites. All physics minors must pass the comprehensive examination given to physics majors, but need take this examination only when they feel prepared for it.

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 col-
Applicants for these credentials should consult the Credential Secretary of the School of Education for details of the requirements in connection with the teaching of physics.

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular 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. 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 course are outlined in the "School of Education" section.

**Fellowships and Assistantships**

Besides the University fellowships open to all graduates, there are available in the Department a few special fellowships and several assistantships involving teaching or research. Applications for fellowships, scholarships, and assistantships are made to the Financial Aids Office; they must be completed by January 15, 1967.

**Courses**

Of the two series into which beginning courses are divided, 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, 52, 53, 54, 55, 56, 57) includes courses for students of engineering, chemistry, geology, and physics.

The two series are similar in content and objectives. Both comprise demonstration lectures on fundamental principles of physics, problem work on application of these principles to actual cases, and laboratory experiments closely correlated with the lectures. Their objectives are not only to give information on particular subjects, but also to provide training in the use of the scientific method. The primary difference between the two series of courses lies in the fact that topics are discussed more thoroughly and are treated with greater mathematical rigor in the Fifty series.

Courses beyond 61 are numbered in accordance with the following three-digit code. The first digit indicates the approximate level of the course: sophomore and junior courses (1), senior and first-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), microwaves (5), structure of matter (7), independent study and research (9). Graduate courses in microwave physics, plasma physics, solid state physics and biophysics are offered in the Applied Physics Division and the Biophysics Laboratory.

**#21. Mechanics and Heat** — Equilibrium, uniform and accelerated motion, force, work, momentum and energy; heat, temperature, properties of matter. Prerequisite: working knowledge of elementary algebra, geometry, i.e., ability to pass examination in these subjects.

4 units, Aut (Schawlow) lec. and lab.

**#23. Electricity and Optics** — Electric charges and currents, magnetism, induced currents; wave motion, interference, diffraction, geometrical optics. Prerequisite: 21.

4 units, Win ( ) lec. and lab.

**#29. Modern Physics** — Basis of modern atomic theory, structure and properties of atoms, the nucleus, radioactivity. Prerequisite: 23.

4 units, Spr (Schwartz) lec. and lab.

**#51. Mechanics** — Vectors, particle kinematics and dynamics, work, energy, momentum, angular momentum; conservation laws; rigid bodies; oscillations; fluids. Discussions based on use of calculus. Prerequisites: Mathematics 41 or 11 and continuation in Mathematics 42, or permission of instructor.

4 units, Win (Sands) lec.; (Martin) discussions

**#52. Mechanics Laboratory** — Concurrent registration in Physics 51 is required.

1 unit, Win (Bevington)
#53. Electricity — Electric charges and currents, magnetism, induced currents, electric oscillations; atomic origin of electromagnetic phenomena. Prerequisites: 51 and Mathematics 42 or 21, or permission of instructor.

4 units, Spr (Little) lec.; (Ritson) discussions

#54. Electricity Laboratory — Concurrent registration in Physics 53 is required.

1 unit, Spr (Bevington)

#55. Light and Heat — Reflection and refraction of light, lens systems; light as electromagnetic waves; temperature, properties of matter, introduction to kinetic theory of matter. Prerequisites: 53 and Mathematics 43 or 23, or permission of instructor.

4 units, Aut (Ritson) lec.; (—) discussions

#56. Light and Heat Laboratory — Concurrent registration in Physics 55 is required.

1 unit, Aut (—)

#57. Atomic Physics — Experimental basis of quantum theory; atoms, nuclei, X-rays, atomic structure, radioactivity. Prerequisite: 55.

3 units, Win (Hofstadter)

TTh 11:00-12:15
3 units, Sum (—) MTWF 8

61. Optics and Wave Motion — Theory of wave motions from point of view of Huygens' principle, superposition; interference, diffraction phenomena. Prerequisites: 55 or admission to Accelerated Sequence, Mathematics 42, and concurrent or prior registration in 43.

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

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 during two quarters. Prerequisites: 111 and concurrent or prior registration in 121 and 122.

100. 2 units, Win (—, Yearian) by arrangement

101. 2 units, Spr (—, Yearian) by arrangement

105. Introductory Electronics — Practical electronics for the research physicist with the emphasis on circuits, covering both vacuum tubes and transistors. Topics include basic amplifier principles, frequency considerations, feedback, power supplies, oscillators, and pulse and digital circuits. Laboratory work is covered in 100, 101. Prerequisite: 53; concurrent or prior registration in 120 is recommended.

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


110. 3 units, Win (Martin) MWF 11

111. 3 units, Spr (Martin) MWF 11

120, 121, 122. Intermediate Electricity and Magnetism — Electrostatics, dielectrics; magnetostatics; solutions of Laplace and Poisson equations; passive d.c., a.c. circuits; Maxwell's equations; propagation of electromagnetic waves; motion of charged particles in electromagnetic fields; introduction to special relativity. Prerequisite: 53. Concurrent or prior registration in Mathematics 130 and 131 with Physics 120 and 121, respectively, is required.

120. 3 units, Aut (Dietrich) MWF 10

121. 3 units, Win (Dietrich) MWF 10

122. 3 units, Spr (Dietrich) MWF 10

130, 131, 132. Atomic and Nuclear Structure — Fundamental concepts of quantum mechanics and its physical basis. Elementary properties of the Schrödinger equation. Some applications to atoms, molecules, and atomic nuclei. Prerequisites: 57 or admission to Accelerated Sequence, 61, and 111. Concurrent or prior registration in Physics 120, 121, 122, or equivalent, and in Mathematics 130 and 131 is required.

130. 3 units, Aut (Hearn) MWF 11

131. 3 units, Win (Hearn) MWF 11

132. 3 units, Spr (Hearn) MWF 11

140. Elementary Nuclear Physics — Elements of nuclear structure, systematics of nuclei, radioactivity, interactions of nuclear radiations with matter, nuclear models, nuclear reactions. Prerequisites: 57 or 130 and knowledge of calculus.

3 units, Aut (Hofstadter) TTh 11:00-12:15
170. Thermodynamics—Derivation of laws of thermodynamics from basic postulates. Macroscopic properties of matter as consequences of these laws. Prerequisites: 55 or admission to Accelerated Sequence and Mathematics 130.

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

171. Kinetic Theory and Introduction to Statistical Mechanics — Kinetic theory of gases; introduction to statistical concepts from Boltzmann point of view, including quantum statistics, applications. Prerequisites: 130 and 170, or equivalent.

3 units, Win (Little) TTh 11:00-12:15

172. Physics of Solids—Introduction to the principal types of solids, with emphasis on their electrical and magnetic properties. Elementary treatment of electrons in metals, energy bands, semiconductors, rectification, and ferromagnetism. Prerequisites: 171, or 57 and Electrical Engineering 255.

3 units, Spr (——) 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

200, 201, 202, 203. Advanced Physics Laboratory—Experiments in atomic physics, nuclear physics, solid state physics, low temperature physics, and cosmic rays, including Zeeman effect, isotope shift, gyromagnetic ratio of the electron, β spectra, α-particle scattering, Compton effect, π-μ decay, X rays, nuclear magnetic resonance, lasers, Mössbauer effect, superconductivity, and others. Experiments in 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.)
physical bases, uses, and limitations. Alpha, beta, and gamma decay processes. Basic scattering processes. Nuclear reactions. Prerequisite: 132 or equivalent.

240. 3 units, Aut (Schwettman) MWF 11
241. 3 units, Win (Schwettman) MWF 11

3 units, Spr (Schwettman) MWF 11

270. Statistical Mechanics — Development of concepts, methods of classical and quantum-statistical mechanics from ensemble viewpoint; microscopic basis for thermodynamics. Prerequisite: 171. Concurrent or prior enrollment in Physics 232 and Mathematics 106 is required.
3 units, Spr (Hofstadter) TTh 11:00-12:15

290. Literature of Physics—Intensive study of literature of any special topic. Chiefly preparation, presentation of reports upon topics studied. Prerequisites: 25 units of college physics and permission of instructor.
Any quarter (Staff) by arrangement

330. 3 units, Aut (Walecka) TTh 9–11
331. 3 units, Win (Walecka) TTh 9–11
332. 3 units, Spr (Walecka) TTh 9–11

3 units, Spr (——) alternate years, given 1967–68

336. Advanced Topics in Theoretical Physics—Discussion of selected topics of current interest in theoretical physics. Prerequisite: 330.
3 units, Spr (——) by arrangement

3 units, Aut (——) alternate years, given 1967–68

341, 342. Nuclear Theory — Theory of nuclear structure, including nuclear forces, nuclear matter, electromagnetic properties of nuclei, nuclear spectra, nuclear models, weak interactions, and nuclear reactions. Prerequisites: 222, 232, and 241.
341. 3 units, Win (——) alternate years, given 1967–68
342. 3 units, Spr (——) alternate years, given 1967–68

3 units, Spr (——) alternate years, given 1966–67

370, 371. Structure of Condensed Matter— Topics such as the following from solid state and low temperature physics: liquid helium 3, helium 4, superconductivity, superfluidity, long-range order in momentum space, including quantized flux and rotation and the many-body Bose and Fermi systems. The first quarter will emphasize the macroscopic properties and theories of these systems. The second quarter will emphasize microscopic theories. Prerequisites: 172 and 230.
370. 3 units, Aut, alternate years, given 1967–68
POLITICAL SCIENCE

Emeriti: Thomas S. Barclay, Philip W. Buck, Anthony E. Sokol, Graham H. Stuart (Professors)

Executive Head: Gabriel A. Almond


Visiting: Robert G. McCloskey

Associate Professor: Charles A. Drekeimer

Assistant Professors: David B. Abernethy, Richard A. Brody, Richard R. Fagen (on leave 1966-67), Ole R. Holsti, Giuseppe Mammarella (Director of Administration, Stanford in Italy), Robert A. Packenham, Hans N. Weiler, Raymond E. Wolfinger.


Lecturers: Dennis J. Doolin, Milorad M. Drachkovitch (on leave 1966-67), Robert M. Rosenzweig

OFFERINGS AND FACILITIES

The purpose of instruction in the Department of Political Science is (1) to offer all students courses designed to introduce them to the political aspects of society, to train them in the analysis of political problems, and to equip them for the exercise of their duties as citizens; (2) to provide undergraduate majors with a program of study leading to the A.B. degree in political science as a foundation for a liberal education, (3) to prepare students for postgraduate executive management programs in government and industry, (4) to give candidates for graduate degrees training preparatory to careers in government, research, teaching, or private enterprise where a knowledge of domestic politics and foreign affairs is in demand, and (5) to prepare students for a career in the foreign service.

The University Library has excellent resources for study and research in all fields of political science. Special collections are also found in the Hoover Institution and the Library of the Law School. The West Memorial Library which is housed in the same building with the Department's offices is maintained as a working collection serving political science students. Through participation in the Inter-University Consortium for Political Research, the faculty and students of the Department of Political Science have access to an extensive pool of data on political behavior in a great variety of institutional settings as well as to the research facilities and training programs in survey research and analysis sponsored by the Consortium at the Survey Research Center of the University of Michigan. Professors Eulau and Wolfinger serve as coordinators of the program.

During the summer quarter the Political Science Department offers courses and seminars in three fields: Comparative Politics, International Relations, and American Politics. The specific offerings depend on the summer quarter faculty.

PROGRAMS OF STUDY

BACHELOR OF ARTS

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, a C average or better in all requirements for the major, and a minimum of 15 units of work offered by this Department.

2. The completion of 45 units of political science, including:

   a) One of the following combinations of two courses:
      
      Political Science 10 and
      Political Science 20.
Political Science 15a and
Political Science 15b.
Political Science 10 and
Political Science 15a or
Political Science 15b.
b) Political Science 150.
c) An advanced course or a seminar in at
least three of the following fields: ad-
ministration, comparative government,
international relations, political theory,
politics, and public law. Political Sci-
ence 150 may be counted as an ad-
vanced course in the field of political
theory.
d) At least one seminar, which may be
counted toward completion of require-
ment (b) above.

HONORS PROGRAM IN
POLITICAL SCIENCE

The Honors Program provides well quali-
fied students with special opportunities for
intensive training and research. The honors
candidate will enjoy a close relationship
with members of the Department through
his participation in seminars, tutorials, and
research projects.

Application for admission to the Honors
Program normally should be made no later
than the second quarter of the junior year.
Applicants must have achieved a 3.00 aver-
age or better in all University work, and a
3.30 average or better in political science
courses.

Honors candidates will complete all re-
quirements for a major in political science
and will also submit an honors thesis during
their senior year. Honors candidates
will normally take Political Science 198,
Honors Seminar, unless a substitute is ap-
proved. The thesis will be awarded a maxi-
um of 15 credits. Following his selection
of a thesis topic, the honors candidate will
be assigned an adviser who will supervise
his thesis research and writing.

Graduation with Honors in Political Sci-
ence will require (1) a 3.00 average or better
in all University work; (2) a 3.30 average or
better in political science; and (3) the sub-
mission of an acceptable honors thesis. Stu-
dents who successfully complete the pro-
gram will graduate “With Honors in Po-
litical Science.” Interested students should
consult the chairman of the Honors Program
Committee in their junior year.

SPECIAL CURRICULA

International Relations Program — Students
interested in international relations,
diplomacy, and the foreign service may
work toward the A.B. degree in Political
Science or the A.B. degree in Political Sci-
ence: International Relations (see descrip-
tion at end of political science offerings).

Law—Many students desiring to com-
plete an undergraduate liberal arts educa-
tion before entering law school take a politi-
ical science major since “law” and “govern-
ment” are inseparable. Preparation should
include study of political, social, and eco-
nomic theories and institutions and compet-
tence in the use of English. Interested stu-
dents should consult with Department fac-
ulty in public law.

Studies of the Communist System—The
Department offers a wide range of courses
on the communist system. For these courses
see below under Comparative Government,
International Law and Relations, Political
Theory, and Public Law, and under Gradu-
ate Courses. Research fellowships for Stud-
ies of the Communist System are available
for qualified graduate students.

Administered through the Department
of Political Science, the Studies in Interna-
tional Conflict and Integration offer a lim-
ited number of assistantships for inter-dis-
ciplinary research and training in interna-
tional crises and the behavior of states.

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 Bul-
letin. Overseas applicants, who may not re-
cieve the Information Bulletin promptly,
should write directly to the Educational
Testing Service, 20 Nassau Street, Prince-
ton, New Jersey. Preference is given to those
applying by January 15; normally applica-
tions will not be considered after April 1.
Ordinarily graduate students enter the De-
partment at the beginning of the academic
year.

Except in unusual circumstances, the De-
partment 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.

Ordinarily graduate applicants over the age of 40 will not be accepted.

**MASTER OF ARTS**

A candidate for the Masters degree must have a creditable record (with average grade of B or better) of undergraduate work in political science and other social science subjects. Applications from students who plan to terminate their graduate study at the Master's level are not ordinarily encouraged; preference is given to applicants who seek the doctorate.

The faculty of the Department recommends a candidate for this 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. By special permission, work done in related departments may be accepted in lieu of a portion of the work in political science. Normally, grades below the level of B in graduate seminars will not be considered acceptable for A.M. candidates.

The University’s basic requirements for the Master’s degree are discussed in the section “Degrees” in this Bulletin.

(The Master’s degree may also be awarded to doctoral candidates who have completed the above requirements.)

**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 teachers with one or more years of experience and/or a regular teaching credential who 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**

The candidate for the Ph.D. degree will prepare for and submit himself to examination in three of the following fields of political science: American politics, comparative politics, international relations, political theory, public administration, and public law.

In addition, the candidate is required to take:

1. Further specialized work within one of the three fields of political science he offers for the degree; or
2. Relevant work in a part of one of the fields of political science he does not offer for the degree; or
3. Relevant work in cognate disciplines.

The candidate will be examined upon this work. The normal expectation is that the candidate will take these examinations at the end of his second year in residence at Stanford.

The Ph.D. candidate is required to demonstrate one of the following:

1. A reading knowledge of two Western languages (e.g., French and German); or
2. A reading knowledge of one non-Western language (e.g., Arabic, Chinese, or Japanese) or of Russian; or
3. A reading knowledge of and conversational ability in one language (e.g., French, German, Spanish, Italian); or
4. A reading knowledge of one language and knowledge of statistics and/or related skills.

The skill requirement may be fulfilled as follows:

1. By successfully completing a program of at least 15 quarter units of selected courses; or
2. By successfully passing a written examination offered by the Department.

The language or skill alternatives shall be those most likely to be useful in connection with the student’s program of study for the degree and his predoctoral and postdoctoral research program. (The native language of a foreign student may be accepted in fulfillment of the requirement.) The Department decides on the language or skill program proposed by the candidate.

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. Deficiencies in undergraduate preparation in political science and other social sciences should be made up at the earliest possible time after admission. Ph.D. candidates are encouraged to participate in the Departmental Research Seminar.

Not later than the end of the third week of his third quarter in residence, the candidate will submit to the Department a statement of: (a) the three fields of political science in which he is to be examined, (b) the additional work he expects to do in one of these fields, another field of political science, or in cognate disciplines, (c) his program for making up deficiencies, (d) his program for fulfilling the language and/or skill requirements, and (e) the proposed field of investigation for his dissertation. This statement will be the subject of an interview of the candidate by a faculty committee. After this interview and an evaluation of the proposed program, the faculty decides whether the candidate will be permitted to proceed toward the Ph.D. degree in the Department. Upon approval, a date for the Departmental and University examinations will be set in the light of the candidate's total program.

After the candidate has completed his preparation in all his fields, and after he has fulfilled the language and/or skill requirements, he takes the written Departmental examinations. These examinations are scheduled in the autumn and spring quarters. Upon successful completion of the written examinations the candidate proceeds to the University oral examination.

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.

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. They are then interviewed, prior to admission, by a committee of the faculty. The same committee determines the required preparation in the two fields, but no candidate shall take less than 10 units, 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 10 and 20. For a minor, the applicant should have completed 24 units, including course 10.

ASSISTANTSHIPS, SCHOLARSHIPS, AND PRIZES

The Department has teaching assistantships in Political Science 1, 10, and 150 and graduate assistantships in connection with its other courses. These customarily are granted to applicants only after they have been at Stanford for at least one quarter.

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.

I. INTRODUCTORY COURSES

#1. Major Issues of American Public Policy—Alternative public policies in selected areas, including control of monopoly, labor relations, civil rights, social welfare, foreign policy. Political process; influence of cultural, economic, political factors on determination of public policy. Prerequisites: History 1 and 2.

5 units, Aut (Marshall) MTWThF 10
Win (Marshall) MTWThF 11
Spr (Holsti) MTWThF 1:15

10. American Government—What the informed citizen and specialist should know about the organization and operation of American government. The Constitution and what it means today; Congress, political parties, pressure groups; growth of the Presidency; Supreme Court, judicial review;
federalism; separation of powers; Bill of Rights. Prerequisite: third-quarter freshman standing.

5 units, Aut (Horn) MTWThF 11
Spr (Eulau) MTWThF 11

15a. Introduction to Political Science — Basic concepts and problems in political science. Social and psychological factors affecting political beliefs and behavior.
5 units, Aut (Almond, Verba, Staff)
lec. MW 10 plus section

15b. Introduction to Political Science — The development and formulating of political systems.
5 units, Win (Abernethy, Verba, Staff)
lec. MW 10 plus section

15c. Introduction to Political Science — The international system.
5 units, Spr (North) MTWTh 2:15

20. Introduction to Comparative Government and Politics — Governmental institutions and political processes in selected foreign political systems, such as England, the Soviet Union, Japan, and Brazil.
4 to 5 units, Win (Packenham) MTWThF 8
Spr (Steiner) MTWThF 8

99. International Relations: Advanced Practice — Practice work in executive positions of the Institute of International Relations, with weekly conferences. Restricted to undergraduate officers of the Institute of International Relations admitted by consent of the instructor. May be taken for a maximum of three quarters.
1 unit, Aut, Win, Spr (Watkins)
by arrangement

II. 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. Public Administration — Relation of policy to administration, planning, principles of organization, problems of supervision and personal motivation, public relations, decision making, the budget, administrative responsibility. Prerequisite: 1 or 10.
5 units, Aut (——) MTWThF 10

104. Local Government Laboratory — Field course in municipal affairs offered in cooperation with Coro Foundation (San Francisco).
2 units, Spr (——) T 2:00-4:30

Seminars

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. Economics 1 is desirable.
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.
5 units, Aut (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. Prerequisite: 100.
5 units, Win (Walker) MTWThF 11

For graduate courses in Administration, see Part III.

COMPARATIVE GOVERNMENT

112. Government and Politics in Asia — Survey of governmental institutions and the political process in Asian countries. Desirable prerequisites: 20 or previous study of the area.
4 to 5 units, Aut (Ike) MTWThF 1:15

113. Latin American Politics — Survey of political systems of Latin America, with special attention to Brazil, Argentina, Mex-
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 prerequisites: 20 or 112.

4 to 5 units, Win (Steiner) MTWThF 11

115. Government and Politics of Communist 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 prerequisites: 20 or 112; History 190, 191, 192, or 193; or Anthropology 117.

4 to 5 units, Win (Oksenberg) MTWThF 10


4 to 5 units, Aut (Finley) MWF 1:15

117. Government and Politics of Africa South of the Sahara—Focuses on the colonial situation, the growth of nationalism, the one-party state, and such current problems as tribalism and regionalism, administrative weakness, and race relations in plural societies.

4 to 5 units, Aut (Abernethy) MTWThF 10

118. Interstate Relations in Africa—Analysis of emerging patterns of interstate relations in Africa, with reference to the role of non-African influences.

4 to 5 units, Spr (Weiler) MTWThF 9

120. Introductory Seminar in Comparative Government. Prerequisite: 20.

5 units, Aut (Steiner) T 4:15-6:05

120a. Seminar in Comparative Government: Japan — (Graduate students register for 220a.)

5 units, Spr (Steiner) T 4:15-6:05


5 units, Aut (Ike) T 2:15-4:05

122. Seminar in Comparative Government: Patterns of Politics in Non-Western Countries. Prerequisite: 20 or 12.

5 units, Win (Ike) T 2:15-4:05

123. Seminar in Comparative Politics: Brazil—See 223.

124. Seminar in Comparative Government: Local Government—Survey of local government structures; theories of local government and politics; functions of the local community in the political system (political socialization and recruitment, communication, etc.) with emphasis on the relations between local government and democracy. (Graduate students register for 224.)

5 units, Win (Steiner) Th 4:15-6:05

125. Seminar in Comparative Government: Communist China—Focus on comparative politics. (Graduate students register for 225.) Permission of instructor required.

5 units, Spr (Doolin) M 4:15-6:05

125a. Seminar in Comparative Government: Communist China—Focus on domestic problems. (Graduate students register for 225a.) Permission of instructor required.

5 units, Win (Oksenberg) Th 7-10 p.m.


5 units, Aut (Finley) F 2:15-4:05

126a. Seminar on Soviet Military Doctrine—Background of recent developments in Soviet military thinking in an attempt to understand the roles of communist ideology, Russian nationalism, and military technology in the development of this thought. Prerequisite: Advanced course on Soviet politics.

5 units, Win (Brody) T 2:15-4:05

127. Undergraduate Seminar in Education and Politics in Developing Countries—Interaction of educational and political systems, as seen in school crises over language and religion, pressure to expand educational facilities, and efforts to cope with unemployment among school-leavers.

5 units, Win (Abernethy) F 2:15-4:05

129. Directed Reading in Comparative Government — Advanced individual study in comparative government. Prerequisites: 10 and 20.

Any quarter (Staff) by arrangement
For graduate courses in Comparative Government, see Part III.

INTERNATIONAL LAW AND RELATIONS

130. Introduction to International Law—
Prerequisite: third-year standing or consent of the instructor.
5 units, Spr ( — — — ) given 1967–68

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) MWF 9

132. Principles and Problems of American Foreign Policy—
The great traditions and their contemporary application; neutrality, freedom of the seas, Monroe Doctrine, Pan-Americanism, pacific settlement, international cooperation, etc.
4 to 5 units, Aut (Watkins) MTWThF 10

135. International Relations—Introductory survey of the national state system, its characteristic forms and the principal forces making for conflict and adjustment. Nationalism, imperialism, economic relations, war, diplomacy, international organization given special attention.
4 to 5 units, Spr (Watkins) MTWThF 10

136. The Soviet Union in World Politics—
Contemporary Soviet foreign policy decision making; instruments of Soviet foreign policy, Soviet relations with the communist system, developing countries, the West.
4 to 5 units, Win (Finley) MWF 9

137. The United Nations and Its Antecedents—
Development of cooperative arrangements within national state system: nineteenth century public unions, League of Nations, United Nations; specialized agencies: their organization, procedure and work.
4 to 5 units, Win (Watkins) MTWThF 10

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 (Oksenberg) MTWThF 9

POLITICAL THEORY

150. Introduction to the History of Political Thought—The first half of the course will
be primarily devoted to Greek philosophy. Medieval and modern political and legal theorists will be discussed in terms of four conceptions of the nature and conditions of political freedom. Prerequisite: third-year standing or consent of the instructor.

4 to 5 units, Aut (Drekmeier)
MTWThF 11

151. Roman, Medieval, and Early Modern Political Thought—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. Prerequisite: third-year standing or consent of the instructor.

5 units, Win (Drekmeier) given 1967–68

152. Modern Political Thought—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, Win (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) MTWThF 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.

4 to 5 units, Aut (North) MTWThF 2:15

157. American Political Thought: 1865 to the Present—The American political tradition since the Civil War. Special reference to the contributions of clergyment, businessmen, politicians, lawyers, economists, reformers and agitators.

4 to 5 units, Win (Rogow) MWF 10

158. Theoretical Foundations of Political Sociology—The major contributions of social and political theorists to our understanding of social and psychological phenomena and their impact on political behavior, roles, institutions, and values. Critics and analysts such as Marx, Weber, Freud, Michels and Parsons will be discussed.

5 units, Spr (Drekmeier) MTWThF 11

Seminars
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 Part III.

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; exclusive national and concurrent state powers; emphasis on nature of legal reasoning and judicial process. Prerequisite: third-year standing. (Graduate students register for 270.)

5 units, Aut (Horn) MTWThF 1:15

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; recent expansion of congressional currency, commerce, taxing and spending, and war powers used to regulate property and the economy. Prerequisite: third-year standing; 170 desirable. (Graduate students register for 272.)

5 units, Win (Horn) given 1967–68

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 for religious, political, economic groups; rights of aliens, ethnic minorities; fair trial, rights of accused persons. Prerequisite: third-year standing. (Graduate students register for 273.)

5 units, Spr (Horn) given 1967–68

175. Aspects of the American Democratic Tradition—The content of this course will vary depending on the interests of the Stanford Lecturer in American Democracy. This lecturership enables us to bring to Stanford each year a distinguished scholar from other universities in the United States or abroad to give an undergraduate course on aspects of the American political tradition. The sub-
jects to be covered by this program include American political ideas, political history, and public law.

5 units, Spr (McCloskey)

Seminar

179. Directed Reading in Public Law — Advanced individual study in public law.

Each quarter by arrangement with Public Law faculty

For graduate courses in Public Law, see Part III.

POLITICS

181. Attitude Formation and Voting Behavior — The formation of opinions, perceptions of political events, political participation, voting behavior; the significance for democratic government of findings in these areas. Prerequisites: third-year standing and 10.

5 units, Aut (Wolfinger) MTWThF 11

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.

5 units, Win (Wolfinger) MTWThF 11

Seminars

187. 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) T 2:15-4:05

188. Seminar in Political Parties — Conventions, nominations, primary elections and voting; types of party organizations; money in politics; party reform and responsible parties. Prerequisites: third-year standing and 10.

5 units, Spr (Wolfinger) MF 11

189. Directed Reading in Politics — Advanced individual study in politics. Prerequisite: 10.

Any quarter (Staff) by arrangement

For graduate courses in Politics, see Part III.

UNDERGRADUATE HONORS

198. Honors Seminar — Open only to honors candidates in their senior year.

5 units (Almond) by arrangement

199. Senior Honors Thesis.

Each quarter (Staff) by arrangement

III. GRADUATE COURSES

Conducted as seminars or reading and discussion groups. Courses numbered 200-299 are limited to graduates and, with the consent of the instructor, to qualified seniors. Courses numbered 300 and above are limited to graduates. All students should consult the instructor before enrolling in any graduate course.

201. Seminar in Public Administration.

5 units, Spr (Staff)

210. Administrative Behavior — See 110.

211. Seminar in the Theories of Comparative Politics — Introduction to various systematic approaches to the study of comparative politics.

5 units, Aut (Verba) M 7:30-9:30 p.m.

213. Latin American Politics — See 113.


223. Seminar in Comparative Politics: Brazil — Advanced undergraduates admitted with special permission of the instructor. Reading knowledge of Portuguese strongly recommended.

5 units, Aut (Packenham) M 4:15-6:05


225. Seminar in Comparative Government: Communist China — See 125.


5 units, Spr (Abernethy) M 2:15-4:05

229. Directed Reading in Comparative Government.

Any quarter (Staff) by arrangement

232. Seminar in International Relations Thought.

5 units, Win (Watkins) T 2:15-4:05
   5 units, Win (Brody) given 1967–68

234. Seminar in International Politics—A survey of central concepts.
   5 units, Aut (Brody) T 2:15–4:05

236. Seminar in Soviet Foreign Policy.
   5 units, Win (Finley) Th 2:15–4:05

241. International Relations—See 141.

242. Seminar in Egyptian Nationalism and International Politics—See 142.

243. Seminar on Great Powers in the Middle East in the Twentieth Century—See 143.

244. Seminar in American Policy Toward the Middle East—See 144.

246. Seminar on De-Stalinization—See 146.

247. Seminar in International Organization.
   5 units, Spr (Watkins)

248. Seminar in Theories of War.
   5 units, Win (Holsti) F 2:15–4:05

249. Directed Reading in International Law and Relations.
   Any quarter (Staff) by arrangement

251. Seminar in Roman, Medieval, and Early Modern Political Thought—See 151.

   5 units, Aut (Rogow) T 4–6

   5 units, Spr (Rogow) T 4–6

254. Essentials of Political Theory.
   5 units, Win (Drekmeier) T 4:15–6:05

258. Seminar in the Theoretical Foundations of Political Sociology—See 158.

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 1967–68

279. Directed Reading in Public Law.
   Any quarter (Staff) by arrangement

   5 units, Aut, Spr (Eulau) given 1967–68

283. Seminar in Politics: The American Party System—The party system as a means of coordinating political decisions; bases of party organization; fragmentation, consensus and leadership in American politics. Open to advanced undergraduates with the consent of the instructor.
   5 units, Aut (Wolfinger) T 2:15–4:05

289. Directed Reading in Politics.
   Any quarter (Staff) by arrangement

300. Thesis.
   Each quarter (Staff) by arrangement

302. Research Seminar in Public Administration.
   5 units, Win (Staff) by arrangement

312. Research Seminar on Comparative Politics—Problems in the politics of development.
   5 units, Spr (Verba) M 7:30–9:30 p.m.

321. Advanced Seminar on British Political System—A study in depth of the development, functioning, and performance of the British political system.
   5 units, Aut (Almond) T 10–12

322. Research Seminar on Western European Political Systems—Comparative studies of the development and performance of the political systems of Western Europe—France, Germany, Italy and the smaller democracies.
   5 units, Win (Almond) T 10–12

323. Research Seminar on Western European Political Systems—Comparative studies of the development and performance of the political systems of Western Europe; im-
lication for theories of political development and political development policy.

5 units, Spr (Almond) T 10–12

325. Advanced Seminar in Reform and Revolution in Twentieth Century China and Japan.

5 units, Spr (Ike) T 2:15–4:05

331. Advanced Seminar in International Political Theory.

5 units, Spr (North) T 4:15–6:05

333. Research Seminar in International Relations Theory: Decision Making—An examination of alternative models of decision processes; the role of individual, organizational, and situational factors in decision making.

5 units, Aut (Holsti) F 2:15–4:05


5 units, Spr (Finley) M 4:15–6:05

360. Advanced Seminar in Power and Authority.

5 units, Spr (Drekmeier) T 4:15–6:05

380a. Advanced Seminar in the Psychodynamics of Political Behavior—The seminar will concern itself with approaches to the study of the political personality, the relationship between mental states and decision making, and the relationship between psychiatry and political science.

5 units, Aut (Rogow) M 4:15–6:05

380b. Advanced Seminar in the Psychodynamics of Political Behavior—Continuation of 380a.

5 units, Win (Rogow) M 4:15–6:05

380c. Advanced Seminar in the Psychodynamics of Political Behavior—Continuation of 380a and 380b.

5 units, Spr (Rogow) M 4:15–6:05

382a, 382b. Research Seminar in American Politics: Public Opinion and Voting Behavior—Survey of current findings on attitude formation, political participation, and voting behavior; student research on numerous aspects of individual political behavior using data from the Inter-University Consortium for Political Research. This is a two-quarter course.

383a, 383b. Research Seminar in Political Behavior—Small groups in the political process.

383a. 5 units, Win (Eulau) W 7:30–9:30 p.m.

383b. 5 units, Spr (Eulau) W 7:30–9:30 p.m.

See also Senior Colloquia.

INTERNATIONAL RELATIONS PROGRAM

Director: James T. Watkins IV

The Program in International Relations is designed to serve two purposes: (1) to provide an undergraduate major for students interested in the whole field of international relations; and (2) to provide professional preparation for students expecting to enter one of the fields of work in international relations. Professional occupations exist in governmental service, in international agencies, in business and commercial activities, in the work of foundations and charitable institutions, and in teaching.

The program leads to the degree of Bachelor of Arts, Political Science: International Relations. Candidates for the degree of Bachelor of Arts, with professional interests, are especially urged to consult promptly with the faculty advisers to whom they will be assigned.

Attention of officers in the Institute of International Relations is directed to the opportunities available in Political Science 99.

BACHELOR OF ARTS IN POLITICAL SCIENCE: INTERNATIONAL RELATIONS

The minimum requirements for recommendation for the degree of Bachelor of Arts with Political Science: International Relations as the major subject are:

1. Registration in this major for at least one quarter, and a minimum of 25 units taken at Stanford in fulfillment of the major requirements.

2. Completion of the following requirements with a C average:

a) The required courses:
   Economics 1. Elementary Economics
Geography 4. Economic Geography (or equivalent)
History 31. Europe in the Nineteenth Century
History 32. Twentieth Century Europe
History 154. American Diplomatic History to 1898
or
History 155. American Diplomatic History Since 1898
Political Science 10. American Government
Political Science 20. Foreign Governments
Political Science 100. Public Administration
Political Science 137. The United Nations and Its Antecedents
Political Science 150. Introduction to the History of Political Thought (each to be taken for 5 units)

b) Twenty additional units (of which ten must be in Political Science) of appropriate courses or seminars in Anthropology, Communication, Economics, Food Research, Geography, History, Modern European Languages, Political Science, or other departments.

**Laboratories**

Aside from lecture and seminar rooms and offices, the Department has well-equipped laboratories comprising some 50 rooms which are adapted to research and laboratory course work. Special facilities are available, in addition to the general laboratory, for experimentation with animals.

**Nursery School**

The Department maintains a nursery school in the Escondido married students' housing area. This provides a laboratory for child observation, for training in nursery school practice, and for research.

**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, 1967.

**Programs of Study**

**Bachelor of Arts**

For the Bachelor's degree, 45 units of psychology are required, including courses 1, 60, and one laboratory course from among 103a, 103b, 103c, and 103d. The following courses in other fields allied to psychology may be counted as fulfilling up to 10 of the nonlaboratory units for the degree. A year of physics counts as 3 units toward the major requirement.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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<tbody>
<tr>
<td>Anthropology 126. Cultural Dynamics</td>
<td>4</td>
<td></td>
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<tr>
<td>Anthropology 158. Culture and Personality</td>
<td>4</td>
<td></td>
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<tr>
<td>Biology 153. The Physiological Basis of Behavior</td>
<td>3</td>
<td></td>
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<tr>
<td>Communication 70. Introduction to Survey Research</td>
<td>3</td>
<td></td>
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<tr>
<td>Statistics 27. Introduction to Probability Theory</td>
<td>3</td>
<td></td>
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<tr>
<td>Statistics 116 (Math. 123 or Econ. 270). Theory of Probability</td>
<td>4</td>
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<tr>
<td>Philosophy 3. Introduction to Logic</td>
<td>5</td>
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<tr>
<td>Sociology 103. Introduction to Social Psychology</td>
<td>5</td>
<td></td>
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<tr>
<td>Sociology 104. Interpersonal Behavior</td>
<td>5</td>
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</tbody>
</table>

A student must have an average grade of C or better for his work in psychology and have taken at least 15 units in the department in order to receive the Departmental recommendation for graduation.

A Psychology Honors Program is designed for those exceptionally able students who
SCHOOL OF HUMANITIES AND SCIENCES

wish, in their major, to pursue an intensive and somewhat independent study of psychology, and to engage in psychological research. It 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 their first two years of concentrated study in the field. The plan will include arrangements for continuous supervised research activity from the beginning of the student's junior year until the end of the winter quarter of his senior year, at which time he will submit a written report of his work as a thesis.

It is possible for a student to elect both the Psychology Honors Program and the Honors Program in Quantitative Methods in Behavioral Sciences. See the section “Behavioral Sciences (Honors Program in Quantitative Methods)” in this Bulletin.

ADVANCED DEGREES

An applicant for admission to graduate work 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 American colleges (see your registrar for further information). Admission to both clinical and nonclinical training programs is strictly limited. Except for students who wish to concentrate in the preschool area or are also enrolled in the Medical School 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. It is contrary to the policy of the Department to accept candidates for the major or minor who have reached the age of 40. A Stanford graduate is ordinarily not accepted for an advanced degree in the Department of Psychology unless he is also registered in the Medical School or the Graduate School of Business.

MASTER OF ARTS

For the degree of Master of Arts, at least 27 units in psychology beyond the equivalent of an undergraduate major are required as well as sufficient additional units outside of psychology to make up a program totaling 45 or more units. In partial fulfillment of this unit requirement Psychology 151, 152, and 207 must be elected as well as two other courses from the content areas, one to be selected from 208, 209, and 210, and one to be selected from 211, 212, and 213. The student must spend half his time in research and present a thesis based on a portion of his research. Holders of halftime research assistantships do not need to register for formal research. All other students are limited to 9 units a quarter in addition to the research units they must elect.

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, must be met 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. A written examination must be taken in the area of general psychology, including history and systems. A second, more individualized examination, with topics drawn chiefly from the fields represented by courses 208–213, will be arranged by the candidate's dissertation committee.

3. Completion of a university minor, or its equivalent, satisfactory to the University Committee on the Graduate Division. Candidates for the Ph.D. degree may have the minor waived by selecting 12 units outside the Department and additional work in general psychology.

4. Demonstrated reading knowledge of a foreign language, preferably Russian, German, or French. Upon petition to the Department faculty another modern language may be substituted for one of these.

5. Passing of the University oral examination which may either be a defense of the dissertation or cover the areas of the major and the minor.
6. A dissertation satisfactory to a Departmental reading committee. 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.

Ph.D. candidacy expires five years after admission to candidacy by the University Committee on the Graduate Division. 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. 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 examination 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 which 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, seminars, and reading lists 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. Beyond the first-year graduate courses mentioned above, there are no required courses for any of the areas of concentration. The curriculum has been designed to offer as much help as possible for such learning, of course, and a glance at the list of courses and seminars available will suggest some of the help that may be gained in preparation for the doctoral examinations.

A second aspect of training is one that cannot be gained from reading or seminars. This is the firsthand knowledge of, and practical experience with, the methods of psychological investigation and study. These methods do not exist in the abstract; they are ways of behaving with the people or animals who are being studied. They are skills, and they require guided practice for their perfection. Doctoral training involves experience in the actual processes of working with people. Some areas require more intensive practice than others; for example, the diagnostic testing of emotionally disturbed children is a more difficult skill for a psychologist to learn than is the presentation of verbal learning tests to normal adults. Hence, the amount of supervised practicum experience required for doctoral training in such an area as clinical psychology is likely to be greater than that needed for the experimental psychology of human learning. Again, however, as with formal courses, there are no specific requirements; students are provided with whatever practicum opportunities they need to reach those levels of competence representative of doctoral standing.

For this purpose, the Department maintains a Nursery School and an Animal Laboratory, and provides supervised practice experiences in various hospitals, clinics, community agencies, and other facilities. 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.

For certain areas, particularly clinical psychology, the amount of supervised practice ordinarily needed by students is quite substantial. For example, a clinical psychologist who plans a career to include professional employment will require practicum work during his doctoral training because he will need to have a variety of skills. Preparation for the degree in clinical psychology, therefore, requires at least four full years. On the other hand, a student who plans an academic career, in which college teaching rather than professional clinical work would accompany his research activities, may find himself able to complete his training in less time. So far as is practicable, the Department attempts to offer remunerative work opportunities (or other stipends) in connection with supervised practicum experiences.

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 and Assistantships**

The Dr. C. Annette Buckel Foundation, supplemented by additional support from the Board of Trustees of the University, has provided a teaching assistantship in child psychology and the University provides several fellowships and scholarships. The Thomas Welton Stanford Fellowship in Psychic Research is a postdoctoral fellowship for research in psychic phenomena, established by the Trustees, in 1913, from the "Psychic Fund" created by Thomas Welton Stanford. There are teaching assistantships in general and experimental psychology, statistics, clinical psychology, developmental psychology, and the nursery school. Several research assistantships are available in connection with special investigations. Readers are employed to assist in course examinations. Veterans Administration assistantships are available locally, and United States Public Health Service stipends can be assigned.

**Courses Open to All Students**

#1. General Psychology — Introduction, survey.

5 units, Aut (Carlsmith, Landauer, Geiwitz) MTWThF 2:15 and sections
Win (Wallace, Pribram) MTWThF 10 and sections
Spr (Atkinson, Crothers) MTWThF 2:15 and sections
4 to 5 units, Sum (—) MTWThF 9 and sections

#60. Statistical Methods.

5 units, Aut (Horowitz) MTWThF 11
Win (Cooper) MTWThF 11
Spr (Lawrence) MTWThF 10
4 to 5 units, Sum (—) MTWThF 11

103a. Experimental Psychology: Higher Mental Processes—Prerequisites: 1 and 60.

4 units, Aut (Horowitz) MWF 9 and three hours by arrangement

103b. Experimental Psychology: Perception—Prerequisites: 1 and 60.

4 units, Aut (Hamilton) MWF 10 and three hours by arrangement

103c. Experimental Psychology: Animal Learning—Prerequisites: 1 and 60.

4 units, Win (Bower) MWF 3:15 and three hours by arrangement

103d. Experimental Psychology: Social Processes—Prerequisites: 1 and 60.

4 units, Spr (Wallace) MTWThF 11 and three hours by arrangement

104. Special Laboratory Projects — Prerequisites: 103a, 103b, 103c, or 103d, and consent of instructor.

3 to 6 units, each quarter (Staff) by arrangement

111. Developmental Psychology—Prerequisite: 1 or equivalent.

4 units, Aut (Ward) MWF 9

112. Development in Middle Childhood—(Enroll in Education 116.) Prerequisite: 111.

4 units, Win (P. Sears) MWF 9 and one 3-hour block by arrangement

113. Adolescent Development — Prerequisite: 1 or equivalent.

3 units, Sum (—) MTWThF 1:15

114. Exceptional Children — The study of children with deviant patterns of development; includes gifted, retarded, sensory defects, emotional problems. Prerequisite: 111.

3 units, Spr (Ward) MTWThF 1:15

117. Observation of Children—Enrollment limited to 16. Prerequisites: 111 or equivalent, and permission 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 permission of instructor.

3 to 5 units, Aut, Win, Spr (Dowley) T 2:15-4:05 and by arrangement

121. Social Psychology—Prerequisite: 1 or equivalent.

4 units, Aut (Carlsmith) MWF 11

122. Industrial Psychology—Prerequisite: 1 or equivalent.

3 units, Spr (Bavelas) MWF 10

124. Cognitive Processes and Social Interaction—Prerequisite: 1 or equivalent.

3 units, Spr (Hastorf) TTh 11:00-12:20

131. Abnormal Psychology—Psychopathology and behavior deviations. Concepts and
128. Personality—Prerequisite: 1 or equivalent.

4 units, Win (Sanford) MWF 10 and by arrangement

132. Personality—Prerequisite: 1 or equivalent.

4 units, Win (Sanford) MWF 10 and by arrangement

134. Dynamic Psychology—Emphasis on psychoanalytic theories and their derivatives. Prerequisites: 131 and senior or graduate standing.

4 units, Spr (Hilgard) MWF 11

141. History of Psychology—Prerequisites: three courses in psychology and junior standing.

3 units, Win (Hastorf) TTh 11:00-12:20

145. Psychological Foundations of Education—(Enroll in Education 215.) Prerequisite: 1 or equivalent.

4 units, Aut (Gage) MTWTh 9

Sum (—) MTWTh 8 and by arrangement

146. Language and Thought—Prerequisite: 1 or equivalent.

3 units, Aut (Ward) given 1967-68

148. Physiological Psychology—Prerequisites: 1 and a course in zoology or physiology.

3 units, Win (Pribram) MWF 9

151. Statistical Methodology—(Enroll in Statistics 161.) Prerequisite: 60 or equivalent.

3 units, Win (——) MWF

152. Analysis of Data—Prerequisite: 151 or permission of instructor.

3 units, Spr (Carlsmith) MWF 10

155. Human Abilities—(Same as Education 255.) The nature, development, and measurement of intellectual abilities. Prerequisites: 1, and 60 or Education 250b.

3 units (Cronbach) alternate years, given 1967–68

162. Quantitative Methods in Psychology I—Prerequisites: 1 and 60 or equivalent.

3 units, Aut (Bower) TTh 10

163. Quantitative Methods in Psychology II—Prerequisites: 1 and 60 or equivalent.

3 units, Win (Estes) TTh 10

181. Honors Seminar (Junior)—Limited to students in the Psychology Honors Program.

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

182. Honors Seminar (Senior)—Limited to students in the Psychology Honors Program.

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

188. Reading and Special Work—Independent study. Prerequisite: permission of instructor.

1 to 3 units, each quarter (Staff) by arrangement

190. Undergraduate Seminar in Intelligence and Mental Retardation—Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Aut (Landauer) by arrangement

191. Undergraduate Seminar in Behavior Change—Application of social learning principles to the modification of prosocial and deviant behavior. Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Spr (Bandura) M 2:15-4:05

193. Undergraduate Seminar in Social Psychology—Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Win (Freedman) by arrangement

194. Undergraduate Seminar in Developmental Psychology—Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Spr (Maccoby) by arrangement

195. Undergraduate Seminar in Personality—Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Win (Geiwitz) by arrangement

196. Undergraduate Seminar in Physiological Psychology—Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Win (Hamilton) by arrangement

197. Undergraduate Seminar in Learning—Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, Aut (Estes) by arrangement

See also Senior Colloquia.
SCHOOL OF HUMANITIES AND SCIENCES

COURSES PRIMARILY FOR GRADUATE STUDENTS

Undergraduate students may be admitted only by special permission.

207. Contemporary Viewpoints in Psychology—A survey of major issues in contemporary psychology with their historical backgrounds. Required of and limited to first-year graduate students in psychology.

2 to 3 units, Aut (Hilgard, Hastorf)
TTh 11:00–12:20

208. Advanced Physiological Psychology—Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, Spr (Hamilton)
by arrangement

209. Advanced Perception—Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, Aut (Festinger, Lawrence)
by arrangement

210. Advanced Learning—Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, Win (Lawrence)
by arrangement

211. Advanced Developmental Psychology—Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, Win (Maccoby)
by arrangement

212. Advanced Social Psychology—Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, Aut (Freedman)
by arrangement

213. Advanced Personality—Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, Spr (Geiwitz) by arrangement

220. Human Motivation—Limited to graduate students in psychology and related fields.

2 to 3 units, Win (Hilgard) TTh 11

221. Organizational Processes and Task Performance—Prerequisite: permission of instructor.

3 units, Win (Bavelas) W 1:15–4:05

222. Mathematical Theories of Perception—Prerequisite: permission of instructor.

3 units, Spr (Atkinson) by arrangement

224. Computer Simulation of Cognitive Processes—(Enroll in Computer Science 224.) Introduction into computer simulation techniques and information processing models of thought processes. The research area lies at an interface between psychology and computer science and the course is expressly designed for graduate students in both fields. Some knowledge of experimental and theoretical psychology, and computer programming, is advisable but not mandatory.

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

246. Methods in Developmental Research—Prerequisite: permission of instructors.

4 units, Spr (Sears, Maccoby, Dowley, Landauer, Ward) by arrangement

248. Introduction to Test Theory—(Enroll in Education 252.) Concepts of reliability and validity; mathematical models underlying commonly used procedures for test analysis. Test scales and norms. Prerequisite: 60 or Statistics 7, or equivalent.

3 to 4 units, Aut (Cronbach)
MW 2:15–4:05, alternate years, given 1967–68

249. Problems in Measurement—(Enroll in 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 personal decisions. Prerequisites: Education 250b and 252, or equivalent.

3 to 4 units, Aut (Cronbach)
MW 2:15–4:05, alternate years, given 1966–67

251. Psychopathology—Review and analysis of research literature and theory in the area of behavior deviation. Prerequisite: permission of instructor.

3 units, Aut (Wallace) T 2:15–5:05

252. Principles of Personality Assessment I—Theory and research on the prediction and classification of behavior. Prerequisite: permission of instructor.

3 units, Win (Mischel) Th 9–12

253. Principles of Personality Assessment II—Representative measurement methods for the assessment of personality. Prerequisites: 252 and permission of instructor.

3 units, Spr (Mischel) Th 9–12
254. Principles of Behavioral Modification I—Application of social-learning principles to the modification of deviant behavior. Prerequisites: graduate standing and permission of instructor.

3 units, Aut (Bandura) M 10-12

255. Principles of Behavioral Modification II—Continuation of 254. Prerequisites: graduate standing and permission of instructor.

3 units, Win (Bandura) M 10-12

256. Intensive Psychotherapy — A discussion of general principles of exploratory psychotherapy. Prerequisite: permission of instructor.

2 units, Spr (——) by arrangement

257a. Practicum in Assessment and Modification of Behavior I — Prerequisite: permission of instructor.

3 to 5 units, Aut (——) by arrangement

257b. Practicum in Assessment and Modification of Behavior II — Prerequisite: permission of instructor.

3 to 5 units, Win (——) by arrangement

257c. Practicum in Assessment and Modification of Behavior III—Prerequisite: permission of instructor.

3 to 5 units, Spr (——) by arrangement

258. Child Research Practicum—Prerequisites: 117 and permission of instructor.

3 to 4 units, Win (Dowley) TTh 1:15

259. Seminar in the Practice of Psychotherapy—Prerequisites: current practice of psychotherapy with one or more cases, and permission of instructor.

2 to 3 units, Spr (Bradway) by arrangement

260. Seminar in Neuropsychology — Prerequisite: permission of instructor.

2 to 3 units, Aut (Pribram) by arrangement

261. Seminar in Social Psychology—Prerequisite: permission of instructor.

2 to 3 units, Win (Carlsmith, Freedman) by arrangement

262. Seminar in Verbal Behavior—Prerequisite: permission of instructor.

2 to 3 units, Spr (Horowitz) given 1967-68

263. Seminar in Perception — Prerequisite: Permission of instructor.

2 to 3 units, Win (——) by arrangement

264. Seminar in Learning Theory—Prerequisite: permission of instructor.

2 to 3 units, Win (Bower) TTh 11

265a. Seminar in Mathematical Psychology I—Prerequisite: permission of instructor.

2 to 3 units, Aut (Estes) by arrangement

265b. Seminar in Mathematical Psychology II—Prerequisite: permission of instructor.

2 to 3 units, Win (Atkinson) by arrangement

265c. Seminar in Mathematical Psychology III—Prerequisite: permission of instructor.

2 to 3 units, Spr (Bower) by arrangement

266. Seminar in Developmental Psychology—Prerequisite: permission of instructor.

2 to 3 units, Aut (Hastorf) by arrangement

267. Seminar in Person Perception — Prerequisite: permission of instructor.

2 to 3 units, Spr (Landauer) by arrangement

268. Seminar in Physiological Psychology—Prerequisite: permission of instructor.

2 to 3 units, Spr (Landauer) by arrangement

269. Seminar in Personality—Prerequisite: permission of instructor.

2 to 3 units, Aut (Wallace) by arrangement

271a. Seminar in Theoretical Problems — Prerequisite: permission of instructor.

2 to 3 units, Win (Festinger) Th 3:15-5:05

271b. Seminar in Theoretical Problems — Prerequisite: permission of instructor.

2 to 3 units, Spr (Festinger) Th 3:15-5:05

272. Foundations of Mathematical Behavior Theory—(Same as Philosophy 243.) Prerequisite: permission of instructors.

2 to 3 units, Spr (Estes, Suppes) M 3:15-5:05

275. Research — Research of intermediate nature, whether or not to be used toward Master's thesis, may be undertaken with members of Department faculty.

(Staff) by arrangement

276. Internship in Psychology — As part of training for advanced degrees in clinical, child, industrial psychology, arrangements are made for residence service in hospitals, penal institutions, schools, business and industrial establishments.

5 to 15 units, each quarter (Staff) by arrangement
280. Doctoral Research—For dissertation. (Staff) by arrangement

303. Research Seminar in Hypnosis—Primarily for graduate students doing research within hypnosis and related areas. Prerequisite: permission of instructor.
1 to 3 units, Aut, Win, Spr (E. Hilgard, J. Hilgard, Cooper) F 3:15–4:30

304. Research Seminar in Neuropsychology—Prerequisite: permission of instructor.
1 to 3 units, Aut, Win, Spr (Pribram) Th 12–2

305. Research Seminar in Mathematical Psychology—Prerequisite: permission of instructor.
1 unit, Aut, Win, Spr (Atkinson, Bower, Estes) F 3:30–5:00

Counseling Techniques: The Interview—See Education 333a.
Counseling Techniques: Testing—See Education 333b.
Seminar in Educational Psychology—See Education 415.
The Biochemistry of Behavior—See Psychiatry 9.

SOCIAL SCIENCES (SPECIAL PROGRAM)

HONORS PROGRAM IN SOCIAL THOUGHT AND INSTITUTIONS

Committee in Charge: Charles A. Drekmeier (Chairman), Richard A. Brody, Robert McA. Brown, Margot Drekmeier, David Levin, Max Levin, Mark Mancall

STATEMENT OF PURPOSE

The Honors Program in Social Thought and Institutions is designed to meet the needs of students desiring special preparation in areas of research 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.

ADMISSION TO THE PROGRAM

Students wishing admission to the program should provide evidence of superior academic achievement (at least a 3.00 average). It is recommended that application be made in the last quarter of the sophomore year, and that either Philosophy 5 or 10 be completed before enrollment. 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 one of the departments participating in the program. 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) during his junior year—which is organized around a particular theme or concept each year. He will be asked to submit a thesis at the end of his senior year which should demonstrate his ability to synthesize and criticize materials drawn from several disciplines. A credit of from 5 to 15 units will be allowed for the thesis. 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.

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 will 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.

After the student's program of study has been approved by the administrative committee, he will be assigned an adviser by his department. Individual programs must also have the approval of the adviser. In most cases the committee will arrange for the appointment of a second adviser from a department appropriate to the student's interests to aid in the supervision of the projected study.
The following areas of concentration are listed as examples of programs the committee would consider acceptable. It by no means exhausts the possibilities for study within the program.

- Public opinion, propaganda, and collective behavior
- Studies in American ideas and institutions
- Problems of social planning
- Values and society
- Personality and social structure
- History of social thought
- Processes of decision making
- Totalitarian social systems

**SPECIAL COURSES OF INSTRUCTION**

1. **Interdisciplinary Seminar** — Designed to familiarize the student with philosophical and methodological problems of the social sciences.
   
   *3 units, Aut (Staff) by arrangement*

2. **Interdisciplinary Seminar** — Continuation of 101.
   
   *3 units, Win (Staff) by arrangement*

3. **Interdisciplinary Seminar** — Continuation of 102.
   
   *3 units, Spr (Staff) by arrangement*

4. **Senior Thesis and Directed Reading.**
   
   *1 to 5 units, each quarter (---) by arrangement*

**SOCILOGY**

Emeriti: Richard T. LaPiere, Charles N. Reynolds (Professors)

Executive Head: Morris Zelditch, Jr.


Associate Professors: Joseph Berger, Bernard P. Cohen, W. Richard Scott (on leave autumn quarter)

Assistant Professors: Bo Anderson, James C. Kimberly, Francis M. Sim

**PROGRAMS OF STUDY**

**Bachelor of Arts**

The Bachelor of Arts degree, with a major in Sociology, may be obtained in one of two ways:

1. **The Standard Major** — If the student elects this program, he must take 45 units of sociology, in addition to basic University requirements. Introduction to Sociology, Introduction to Sociological Research, and Introduction to Sociological Theory are required of all majors, and, in addition, two courses must be selected from the remaining five courses in the Fundamental Program. These requirements are designed to provide each major with a sound basis for further work in more specialized fields in sociology.

   To be recommended for the degree the student must maintain an average grade of C or higher in the major field. Normally, students who expect to graduate as Sociology majors must be registered with the Department two full quarters prior to graduation.

2. **The Honors Program** — This program is designed to meet the needs of those students who expect to pursue graduate work, or who have the interest and capacity for independent study and research. Students are admitted to the program only if they have maintained an average grade of B or better in all courses taken at Stanford.

   Honors students are not required to take a fixed number of units in sociology. Each student in the Honors Program will have a special adviser, but he may work with various staff members on individual projects during the junior and senior years. He will plan his program with the adviser to include Introduction to Sociological Research, a course in sociological theory, and a course in statistics. Honors students are exempt from prerequisites attached to courses at the discretion of the adviser, and may be admitted to graduate level courses. They are urged to take courses in related fields, such as anthropology, psychology, and philosophy.

   Intensive work in the Honors Program will begin in the junior year, when the student will participate in Honors seminars. These seminars will examine basic readings in sociology and current faculty research. In the spring, he will present as his Junior Thesis a research proposal with a review of the relevant literature. This research proposal will be the prelude to the required Senior Thesis. The student will be granted 2 units of credit for each quarter's partici-
pation in the junior year and 10 units for the satisfactory completion of original research in the senior year.

To remain in the Honors Program, the student must maintain an average grade of B or better in all sociology courses. In the last quarter of the senior year, Honors students must pass a Comprehensive Examination in Sociology.

MASTER OF ARTS

Although it is desirable to have had undergraduate preparation in sociology, under special circumstances the Department will admit candidates for advanced degrees without such preparation. The Master of Arts degree is granted as a step toward eventual fulfillment of requirements for the Doctor of Philosophy degree. Ordinarily, the Department prefers not to admit students who are candidates solely for the A.M. degree.

To be recommended for the degree, the candidate must complete forty-five units of approved work, no units will count which do not have a grade of C or higher, and the student must receive an average grade of B or better. At least 30 of the 45 units must be received in courses offered by the Department.

Twelve of the required 45 units may be obtained by completing a Master’s Thesis, or by participating in one of the formal research programs being conducted by a faculty member, or by replicating a previous research study. For the latter two alternatives, the candidate is required to present to the Department a written report of article length and professional quality. The candidate must satisfactorily complete one of the three alternatives.

DOCTOR OF PHILOSOPHY

The goal of training for the Ph.D. is the preparation of persons who may be expected to make significant contributions to the advancement of sociological knowledge. To be recommended to the University Committee on the Graduate Division for admission to candidacy for this degree, the student must satisfy the following requirements: (a) he must have a Master’s degree in sociology, or the equivalent thereof in course work; (b) he must demonstrate to appropriate examiners his knowledge of a language other than English, which language is to be approved by the Department. Normally, this requirement will be satisfied no later than during the second year of graduate study.

All sociology graduate students must develop a thorough grounding in both sociological theory and research methods to provide a solid foundation for later specialization. To accomplish this, six graduate courses are required: Theory Construction, Advanced Social Statistics, Research Design, all normally taken in the first year of graduate work; Logic of Social Research, normally taken in the second year; and Basic Problems in Sociological Theory and Problems in Sociological Measurement, taken in either the first or second year. In addition, for students entering with a deficiency in statistics, Statistics 7, Psychology 60, Statistics 50 or some equivalent must be taken in the first quarter after entering.

Each candidate must select three fields within sociology as his areas of special competence, in consultation with the Director of Graduate Studies. He must pass written examinations in these fields in order to be certified for the University oral examination. Examples of such fields are Small Groups, Organizational Behavior, Institutional Structure, and the Sociology of Medicine. Sociological Theory or Research Methods may be offered as a field only when the candidate has an exceptional grasp of materials in the area for competence in both fields is assumed for all graduate students. The written examinations will ordinarily be given only within the first seven weeks of autumn and spring quarters.

After passing the University oral examination, the candidate must satisfactorily complete a doctoral dissertation. Members of the faculty are available to assist the candidate at each stage of his research in fulfilling the dissertation requirement.

THE MASTER OF ARTS IN TEACHING DEGREE

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparations. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education.
TEACHING ASSISTANTSHIPS AND FELLOWSHIPS

The University has a number of fellowships and scholarships available. Information about these, as well as application blanks, may be secured by writing the Office of Admissions.

In addition, the Department has annual teaching assistantships, traineeships in medical sociology, research assistantships, traineeships in mental health, and National Defense Education Fellowships for the support of its graduate students.

COURSES PRIMARILY FOR UNDERGRADUATES

#1. Introduction to Sociology—Basic concepts; theories; emphasizes group aspects of human behavior.
5 units, Aut (Zelditch) MTWThF 11
Win (Zelditch) MTWThF 1:15
Spr (Scott) MTWThF 11
Sum (——) MTWThF 11

7. Introduction to Statistics.
5 units, Aut (——) MTWThF 10

50. American Society — Basic institutions and problems of contemporary American society.
3 units, Spr (——) MWF 3:15

FUNDAMENTAL PROGRAM

100. Introduction to Sociological Research—Aim of this course is to provide the consumer of social research with standards by which to evaluate the findings of sociological studies. 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) MW 11; labs. T or Th 2:15–5:05

102. Basic Social Institutions — Study of how basic institutions such as the stratification system, the polity, the family, the economy and political order affect one another in Western and non-Western societies.
5 units, Aut (Anderson) MWF 9

103. Introduction to Social Psychology — Review and discussion of current problems, theories, and research in social psychology; social perception, development of self-conceptions, socialization, attitude change.
5 units, Win (——) MWF 2:15

104. Interpersonal Behavior—An examination of research in such areas as power and prestige structures in small groups; communication networks and processes; deviance, conformity, and social control.
5 units, Spr (Berger) MWF 1:15

105. Organizational Behavior—An analysis of the structural characteristics of economic, political, educational and other organizations and their impact on individual participants. Prerequisite: 1 or consent of instructor.
5 units, Win (Scott) MTWThF 11

106. Introduction to Sociological Theory—Critical analysis of some basic notions and theories used in sociological analysis, like Heider’s balance theory, Homan’s theory of social behavior as an exchange process and structural-functional analysis.
5 units, Win (Anderson) MTWThF 10

108. Class, Status, and Power—Analysis of stratification in simple and complex groups and societies. General theories of stratification are analyzed and evaluated. Emphasis is placed on conditions affecting the stability of stratification.
5 units, Win (Kimberly) MWF 1:15

OTHER COURSES OPEN TO UNDERGRADUATES AND GRADUATES

110. Religious Institutions and Behavior—A sociological approach to organized religion, emphasizing the interaction between the church and its social setting.
5 units, given 1967–68

123. Political Institutions and Behavior—This course utilizes a framework of classic political and social theory to place in perspective empirical evidence on political processes in selected industrial societies.
5 units, Aut (——) MWF 10

129. Family Institutions and Behavior — Social structure of the family in Western and non-Western societies; family pathologies.
5 units, Spr (Zelditch) MWF 9
131. Advanced Social Psychology — An analysis of current research in social psychology including such topics as socialization, assimilation, interpersonal perception and social control. Prerequisite: 103 or consent of instructor.

5 units, Spr (——) MWF 10

137. Advanced Organizational Behavior—An examination of organization structures, of the social processes—specialization, authority, ranking, etc.—which modify them and of the levels at which such processes operate. Prerequisite: 105 or consent of instructor.

5 units, Spr (Sim) MWF 11

145. Survey Methods—Training in the use of the questionnaire and the interview schedule for the systematic collection of data. Prerequisite: 100 or consent of instructor.

5 units, given 1967–68

146. Field Methods—Training in the use of participant observation, informants' life histories, interview material, etc., for the study of sociological problems. Prerequisite: 100 or consent of instructor.

5 units, given 1967–68

147. Experiments in Social Interaction—Topics considered in this laboratory course include: formulation of an experimental problem, experimental design, problems of conducting and analyzing experiments. Discussion will be in the context of conducting an actual experiment. Prerequisite: 100 or consent of instructor.

5 units, given 1967–68

149. Advanced Social Statistics—Prerequisite: 7 or consent of instructor.

5 units, Win (Sim) MWF 9;
lab. F 2:15–4:05

150. Sociology of Mental Health.

5 units, given 1967–68

161. Advanced Interpersonal Behavior—A more intensive examination of topics covered in Sociology 104. Prerequisite: 104 or consent of instructor.

5 units, given 1967–68

162. Comparative Institutional Analysis—Cross-cultural approach to the study of institutions and social systems. Prerequisite: 102 or consent of instructor.

5 units, given 1967–68

165. Advanced Social Stratification—Analysis of stratification structures in complex social systems. Emphasis is placed on the formulation of theory relevant to problems of stability of stratification structures.

5 units, Spr (Kimberly) Th 2:15–5:05

175. The Evolution of Underdeveloped Societies — A discussion of social, economic and political development of emergent countries (e.g., Ghana, Nigeria, India).

5 units, given 1967–68

176. Sociological Aspects of Economic Development — Special emphasis is given to Latin America. Prerequisite: consent of instructor.

5 units, given 1967–68

180. Honors Seminar—Basic readings in sociology and current faculty research.

2 units, Aut (——) by arrangement

185. Honors Seminar—Basic readings in sociology and current faculty research.

2 units, Win (Staff) by arrangement

190. Individual Study.

(Staff) by arrangement


2 units, Spr (Staff) by arrangement

192. Senior Thesis.

3 to 10 units (Staff) by arrangement

COURSES PRIMARILY FOR GRADUATES

200a. Graduate Proseminar — Limited to first-year graduate students in sociology.

2 units, Aut (Zelditch) Th 12–2

200b. Graduate Proseminar — Continuation of 200a.

2 units, Win (Zelditch) Th 12–2

200c. Graduate Proseminar — Continuation of 200b.

2 units, Spr (Zelditch) Th 12–2

205. Problems in Organizational Analysis.

5 units, Aut (Sim) W 2:15–5:05

216. Theories of Interpersonal Processes.

5 units, Aut (Kimberly) M 2:15–5:05

217. Problems in Theoretical Analysis — Prerequisite: 253 and consent of instructor.

5 units, Win (Berger) Th 7–10 p.m.

248. Problems in Study of Educational Institutions.

5 units, Win (——) M 2:15–5:05
250. Basic Problems in Sociological Theory — Prerequisite: consent of instructor.
   5 units, Win (Anderson) W 7–10 p.m.

253. Theory Construction — Prerequisite: consent of instructor.
   5 units, Aut (Berger) Th 7–10 p.m.

255. Logic of Social Research — Logic of scientific research, methods commonly used for collection and analysis of social data. Prerequisites: 149 and 260.
   5 units, given 1967–68

   5 units, Aut (——–) T 2:15–5:05

260. Research Design—Prerequisite: 149.
   5 units, given 1967–68

267. Problems of Sociological Measurement—Prerequisite: 149.
   5 units, Spr (Cohen) W 2:15–5:05

   5 units, Win (Cohen) T 2:15–5:05

GRADUATE INDIVIDUAL STUDY

290. Graduate Individual Study.  
   (Staff) by arrangement

300. Graduate Research.  
   (Staff) by arrangement

309. Directed Graduate Research.  
   (Staff) by arrangement

   (Staff) by arrangement

SPEECH and DRAMA

Emeriti: James G. Emerson (Professor); Helene Blattner, Elisabeth Buckingham (Associate Professors)

Executive Head: Robert Loper

Professors: Wendell Cole, Robert Loper, Norman Philbrick, H. Donald Winbigler


Assistant Professors: Clara Bush, Arthur Hastings, Helen W. Schrader. Acting: Kenneth E. Mosier

Instructors: R. Elizabeth Cecchetti, Frederick Hunt, Frieda Politzer, Griffith Richards. Acting: Marianne E. Crowder

Lecturers: Gerald Hiken, Naomi Wrage

PROGRAMS OF STUDY

BACHELOR OF ARTS

The requirements for the degree of Bachelor of Arts with a major in Speech and Drama are planned to allow the student wide latitude in developing his special aptitudes. A minimum program is required of all students. Every major in Speech and Drama must take:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>90, 91, 92. Dramatic Literature</td>
<td>12</td>
</tr>
<tr>
<td>164a, 164b, 164c. Acting; Directing</td>
<td>12</td>
</tr>
<tr>
<td>170a, 170b, 170c. Visual Arts for Theater</td>
<td>9</td>
</tr>
<tr>
<td>173a. Theatrical Makeup</td>
<td>1</td>
</tr>
<tr>
<td>95. Theater Criticism</td>
<td>3</td>
</tr>
</tbody>
</table>

Total: 37 units

In addition to the courses listed above, each student must take 9 units to be chosen from:

- 190, 191, 192. Acting; Directing of Plays in Various Periods
- 60. Introduction to the Contemporary Theater
- 200. American Drama

or, with evidence of unusual qualifications and consent of instructor, from:

- 241a, 241b, 241c. Technical Production
- 251a, 251b, 251c. Lighting
- 261a, 261b, 261c. Acting I
- 271a, 271b, 271c. Costume I
- 281a, 281b, 281c. Scene Design I
- 291a, 291b, 291c. Directing I

All students must complete a minor program of not less than 16 units of advanced work chosen from courses offered in a department or departments other than Speech and Drama. The student must maintain a C average in all the course work of the major and minor departments. The minor program is chosen with the approval of the student’s faculty adviser. The student will have the opportunity to participate as a cast or crew member with the Stanford Repertory Theater company.

Special Major Program for the Honors Candidate in Humanities — Students who are planning to take the special Honors Program in Humanities may fulfill the requirements for the major in Speech and Drama by satisfactory completion of the following program:

- 164a, 164b, 164c. Acting and Directing
- 90, 91, 92. Dramatic Literature
- 200. American Drama
- Six units to be chosen from Speech and Drama 170a, 170b, 170c or Art History
- Electives in theater and drama totaling at least 6 units
GRADUATE PROGRAM IN HUMANITIES

The Department of Speech and Drama also participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in Speech and Drama and Humanities. For a description of that program and fellowships offered in connection with it, see the section “Humanities (Special Programs).”

TEACHING CREDENTIALS

The degree of Master of Arts in Teaching of Speech and Drama is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential 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 General 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 Speech and Drama for Departmental requirements.

ADVANCED DEGREES

Any student wishing to enter upon graduate work in the Department of Speech and Drama at Stanford University should apply to the Office of the Director of Admissions. Graduate students, when applying for admission, must furnish their scores on the Aptitude Test of the Graduate Records Examination. Applicants for the doctoral degree must also submit a sample of their best written scholarly work. All graduate students must be degree candidates.

For University regulations governing advanced degrees, see the section “Degrees” in this Bulletin.

MASTER OF FINE ARTS

An intensive program in theater arts has been inaugurated for the exceptionally gifted student who wishes to train for a professional career in the fields of acting, directing, costume, lighting, stage design, and technical production. A professional resident company, the Stanford Repertory Theater, is the producing organization of the Department of Speech and Drama. The visiting director, the staff, and the leading actors of this company will serve as teachers in the training program. The acting program is designed for two years; the curriculum for directors and designers is planned for three years. For students with a strong background in drama, the three-year curriculum could well be reduced to two years. Advanced standing would be based upon special examination. All students in the latter stages of the program will work in direct association with the professional company; limited work with the company is possible during the first year, but the emphasis will be upon intensive class and project work within the student program.

In addition to regular University requirements for admission, all applicants for the acting and directing programs will be interviewed; design applicants must submit a portfolio of their work. While overall scholastic ability will be a factor in admission, primary emphasis will be placed on evidence of superior potential in theater arts.

The M.F.A. is designed as a terminal degree, but if a candidate successfully completes his work for the M.F.A. and demonstrates strong interest and ability in teaching and research, he will be urged to continue to the Ph.D. degree.

For further details please write to the Executive Head, Department of Speech and Drama.

Note—Certain of the following course sequence requirements can be fulfilled by special examination.

COSTUME DESIGN MAJOR

Candidates for the M.F.A. degree in costume design are required to complete 101 units of course work beyond the Bachelor’s degree. The course requirements are as follows:

**First Year**

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>271a, 271b, 271c. Costume I</td>
</tr>
<tr>
<td>297, 298, 299. Theater History</td>
</tr>
<tr>
<td>170a, 170b, 170c. Visual Arts for the Theater</td>
</tr>
<tr>
<td>281a, 281b, 281c. Stage Design I</td>
</tr>
<tr>
<td>280. Crew</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>
**Second Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>272a, 272b, 272c. Costume II</td>
<td>9</td>
</tr>
<tr>
<td>291a. Directing I (one quarter)</td>
<td>3</td>
</tr>
<tr>
<td>251a, 251b, 251c. Lighting I</td>
<td>9</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>173a, 173b. Theatrical Makeup</td>
<td>2</td>
</tr>
<tr>
<td>Electives</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>35</td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>273a, 273b, 273c. Costume III</td>
<td>6</td>
</tr>
<tr>
<td>397. Seminar in Stage Arts</td>
<td>3</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>Electives (to include courses in Art and Architecture)</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>24</td>
</tr>
</tbody>
</table>

**SCENE DESIGN MAJOR**

Candidates for the M.F.A. degree in scene design are required to complete 99 units of course work beyond the Bachelor's degree. The course requirements are as follows:

**First Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>281a, 281b, 281c. Scene Design I</td>
<td>9</td>
</tr>
<tr>
<td>297, 298, 299. Theater History</td>
<td>12</td>
</tr>
<tr>
<td>241a, 241b, 241c. Technical Production I</td>
<td>9</td>
</tr>
<tr>
<td>170a, 170b, 170c. Visual Art for the Theater</td>
<td>9</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>271a, 271b, 271c. Costume I</td>
<td>9</td>
</tr>
<tr>
<td>291a. Directing I (one quarter)</td>
<td>3</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>Two of the following three courses must be taken:</td>
<td></td>
</tr>
<tr>
<td>252a, 252b, 252c. Lighting II</td>
<td>18</td>
</tr>
<tr>
<td>242a, 242b, 242c. Technical Production II</td>
<td></td>
</tr>
<tr>
<td>271a, 271b, 271c. Costume I</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>246a, 246b, 246c. Technical Production III</td>
<td>6</td>
</tr>
<tr>
<td>397. Seminar in Stage Arts</td>
<td>3</td>
</tr>
<tr>
<td>245a. Theater Management (one quarter)</td>
<td>3</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>9</td>
</tr>
<tr>
<td>One of the following three courses must be taken:</td>
<td></td>
</tr>
<tr>
<td>252a, 252b, 252c. Lighting II</td>
<td>9</td>
</tr>
<tr>
<td>242a, 242b, 242c. Technical Production II</td>
<td></td>
</tr>
<tr>
<td>271a, 271b, 271c. Costume I</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>33</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 108 units of course work beyond the Bachelor's degree. The course requirements are as follows:

**First Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>251a, 251b, 251c. Lighting I</td>
<td>9</td>
</tr>
<tr>
<td>297, 298, 299. Theater History</td>
<td>12</td>
</tr>
<tr>
<td>170a, 170b, 170c. Visual Art for the Theater</td>
<td>9</td>
</tr>
<tr>
<td>241a, 241b, 241c. Technical Production I</td>
<td>9</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>271a, 271b. Costume I (two quarters)</td>
<td>6</td>
</tr>
<tr>
<td>244a, 244b. Survey of Lighting and Technical Production</td>
<td>6</td>
</tr>
<tr>
<td>281a, 281b. Scene Design I (two quarters)</td>
<td>6</td>
</tr>
<tr>
<td>292. Directing II</td>
<td>6</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>300-series. Dramatic Literature (two quarters)</td>
<td>8</td>
</tr>
<tr>
<td>Two of the following four courses must be taken in spring quarter:</td>
<td></td>
</tr>
<tr>
<td>271c. Costume I</td>
<td>6</td>
</tr>
<tr>
<td>281c. Scene Design I</td>
<td></td>
</tr>
<tr>
<td>300-series. Dramatic Literature</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
</tr>
</tbody>
</table>


**Third Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>293a, 293b, 293c. Directing III</td>
<td>9</td>
</tr>
<tr>
<td>397. Seminar in Stage Arts</td>
<td>3</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>39</strong></td>
</tr>
</tbody>
</table>

(Note—If the "directing" candidate is interested in going on to the Ph.D. degree, his electives should specifically be 360a, b, c, and 200 and 306. If these courses are taken, he will need only 12 additional courses (or, normally, 3 quarters' work) to complete the remaining residence requirements for the Ph.D.)

**ACTING MAJOR**

The candidate for the M.F.A. in acting is required to complete 80 units of course work.

<table>
<thead>
<tr>
<th>First Year</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>261a, 261b, 261c. Acting I</td>
<td>9</td>
</tr>
<tr>
<td>271a. Costume I (one quarter)</td>
<td>3</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>263a, 263b, 263c. Voice and Movement</td>
<td>6</td>
</tr>
<tr>
<td>291a. Directing I</td>
<td>3</td>
</tr>
<tr>
<td>264. Rehearsal and Performance (Stanford Repertory Theater)</td>
<td>6</td>
</tr>
<tr>
<td>294a, 294b. Projects with M.F.A. Directors</td>
<td>6</td>
</tr>
<tr>
<td>173a, 173b. Theatrical Makeup</td>
<td>2</td>
</tr>
<tr>
<td>Electives (winter and spring quarters) to be chosen from courses outside of Speech and Drama</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Second Year</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>262a, 262b, 262c. Acting II</td>
<td>9</td>
</tr>
<tr>
<td>297, 298, 299. Theater History</td>
<td>12</td>
</tr>
<tr>
<td>260. Crew</td>
<td>3</td>
</tr>
<tr>
<td>263a, 263b, 263c. Voice and Movement</td>
<td>6</td>
</tr>
<tr>
<td>264. Rehearsal and Performance (Stanford Repertory Theater)</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>

**DOCTOR OF PHILOSOPHY**

Candidates are normally expected to complete 108 units of course work beyond the Bachelor's degree. The course program is planned to occupy nine quarters of graduate resident work. The degree of Master of Arts is eliminated; no interim degree is awarded by the Department of Speech and Drama for Ph.D. candidates.

**Language Requirements** — Examinations in French and German must be passed by the candidate during his first year of residence. Other languages may be substituted upon request to the Graduate Study Committee of the Department. After passing the language examinations, the candidate is required to take a literature course in one of the language departments at Stanford, or in another university approved by the Department, in which course reading assignments and class lectures and discussions are conducted in the original language of the literature studied.

**Specialization** — During the first year of residence, the candidate, in consultation with his adviser, submits a plan of study consisting of four fields of specialization. One of the four fields is designated as the candidate's major field of specialization and it is expected that his dissertation subject will be chosen from this field, so that much preparatory research and study for the dissertation will have been completed before completion of the course work requirements.

One field of specialization is to be chosen from each of the following groups:

1. Comparative drama in one literary period. (Examples: Medieval Drama, Renaissance Drama, European Drama in the Eighteenth Century, Modern Drama from 1870 to 1914, etc.)
2. One major playwright.
3. One national drama. (To be chosen from English, American, French, Italian, Spanish, German, Scandinavian, Classical.)
4. One dramatic genre, or dramatic criticism. (Examples: Tragicomedy, Farce, Comedy of Manners, Melodrama, etc.)

Only two areas of study in a candidate's program are permitted to overlap significantly. (Examples: French Drama and Molière; or, European Drama of the Nineteenth Century and Melodrama.) At least one area of study must be before 1700.

The candidate for the Ph.D. degree is required to take all courses in the survey of dramatic literature sequence (301-306). Other course requirements are the course sequence in research and criticism (360a, b, c). Another 9 units are to be chosen from the following courses: 261a, 244a, 271a, 281a. A complete sequence may be taken in any one of these courses to satisfy the requirement. Additional electives totaling at least 12 units must be taken from courses offered in Speech and Drama or by outside departments.

**Examinations** — Upon completion of the first year of residence, the candidate must pass a short preliminary written examination admitting him to candidacy. When
course work is completed, the candidate takes an examination in his four fields of specialization. The candidate's doctoral dissertation must be submitted and approved in final form after the successful completion of the comprehensive examination. The candidate must then pass a University oral examination on his dissertation and his major field of specialization.

FELLOWSHIPS

The Department of Speech and Drama awards a number of fellowships to graduate students in both the M.F.A. and Ph.D. programs. These grants range in amounts from about $1,500 to $3,000. 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 usually awarded to the student who has completed a portion of his work in the program.

SPEECH CORRECTION, HEARING, AND SPEECH SCIENCES

For programs and courses in Speech Correction, Hearing, and the Speech Sciences, please refer to the Division of Speech Pathology and Audiology listed in the section “Allied Medical Sciences” in this Bulletin.

Attention of Speech and Drama majors is especially directed to the following courses which may be of interest: Speech Pathology and Audiology 110 (Principles of Phonetics), and Speech Pathology and Audiology 232 (Principles of Voice Training).

SUMMER SESSION

A special brochure is available, with full details of courses given in the summer by the Department of Speech and Drama.

COURSES

SPECIAL PROGRAM FOR FOREIGN STUDENTS

The courses below represent the basic offerings in Foreign Student English. Each quarter, additional sections of these courses are scheduled at other hours and days as needed. The staff for Foreign Student English includes Bush, Cecchetti, Politzer, and Richards.

47. English Communication for Foreign Students I—Basic work in spoken English with emphasis on comprehension and intelligibility. Course also includes the use and comprehension of written English.
   6 units, Aut (Staff) MTWThF 9 and one hour by arrangement

48. English Communication for Foreign Students II—Intermediate work in spoken English with emphasis on comprehension and intelligibility. Prerequisite: 47 or consent of instructor.
   4 units, Aut, Win (Staff) MWF 4:15 and one hour by arrangement

49. English Communication for Foreign Students III—For students with some facility in spoken English. Emphasis on fluency, idiom, and current usage. Upon recommendation of the adviser, the course may be repeated for a total of 6 units. Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Staff) TTh 4:15 and one hour by arrangement

58. English Communication for Foreign Students Ha—Intermediate work on written English with emphasis on acceptable usage in the mechanics and form of expository writing. Prerequisite: 47 or consent of instructor.
   2 units, Aut, Win (Staff) TTh 11

59. English Communication for Foreign Students IIIia—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Upon recommendation of the adviser, the course may be repeated for a total of 6 units. Prerequisite: consent of instructor.
   1 to 3 units, Aut, Win, Spr (Staff) MWF 11

GENERAL

1. Characteristics of Spoken Language — Analysis of articulatory and vocal usage as they relate to spoken language. Practicum emphasizing these factors as they facilitate oral communication.
   3 units, Win, Spr (Bush, Richards) MWF 10

#30. Oral Interpretation—Basic course in understanding the organization of the logical and emotional content of literature with
emphasis on its communication to the listener.

3 units, Aut, Win, Spr (Staff) MWF 9 or 11

PUBLIC ADDRESS AND SMALL GROUP COMMUNICATION

Courses offered in this division provide instruction in communication processes in which men assert their ideas to effect social action through public address or participation in small groups.

#20. Public Speaking — Includes preparation and presentation of original speeches, and analysis and written criticism of significant public addresses.

3 units, Aut, Win, Spr (—, Hastings, Mosier, Wragge) MTW 10, 11, 1:15; TWTh 9, 10, 11, 1:15

100. Independent Study.

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

120a. Exposition — Focuses on the individual as he experiences the process of communication in an interacting group.

3 units, Aut, Win, Spr (Schrader, Staff) MWF 11 or 1:15

#120b. Argumentation — Reasoning processes and logical proof in analysis and persuasion.

3 units, Aut, Win, Spr (Hastings) MWF 10

120c. Discussion — Focuses on group phenomena which facilitate or inhibit free communication in the solving of problems in an interacting group.

3 units, Win, Spr (Schrader) MWF 10

130. Persuasion Theory — Philosophical, psychological, and rhetorical principles of persuasion.

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

132. Group Communication — Processes of communication in leadership, conflict, and social pressures of small groups. Prerequisite: 120a or 120c.

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

134. Language and Communication — Analysis of symbolic processes.

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

140. Social Protest — Men and their communication roles in American social controversies.

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

Business and Professional Speaking — See Business 386, Graduate School of Business Bulletin.

Aut, Spr (—)

Intercollegiate Debate — A program of debate and speaking activities open to all students. Activity credit offered for participation.

(Mosier)

THEATER AND DRAMA

Undergraduate

#60. Introduction to the Contemporary Theater — Survey of the arts of the theater, lectures and discussion of readings in contemporary drama.

3 units, Win (—) MWF 9

#90. Development of Drama (Classical and Medieval) — Survey of masterpieces of Western drama from origins in Greece to the Renaissance. Emphasis on the social and theatrical environments of each play's performance.

4 units, Aut (Sharp) MW 2:15-4:05

#91. Development of Drama (Renaissance and Baroque) — Survey of the art of drama from the Renaissance to Ibsen.

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

92. Development of Drama (Modern) — Ibsen, subsequent dramatists, English and Continental. Lectures, discussions, critical papers.

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

95. Theater Criticism — Readings in contemporary techniques. Papers based on performances attended in the area.

3 units, Spr (—) TTh 2:15-3:40

160. Theater Practice — Credit for participation by undergraduates in productions in acting or stagecraft. May be repeated for total of 9 units. Prerequisite: consent of instructor.

1 to 3 units, any quarter (Staff) by arrangement

164. Fundamentals of Acting and Directing — Not open to freshmen. Sophomores with consent of instructor.

164a. Principles of Acting — Actor's resources and methods, basic body movement.

4 units, Aut (Hiken, Crowder) WF 10-12; lab. T or Th 1:15
4 units, Win (Loper, Hiken, Crowder)
WF 10–12; lab. T or Th 1:15

164c. Directing—Techniques of analysis, blocking and composition. Acting projects.
4 units, Spr (Loper, Hiken, Crowder)
WF 10–12; lab. T or Th 1:15

170a,b,c. Visual Art for the Theater—Survey of painting, sculpture, as it affects theater style. Required of majors and M.F.A. students.
3 units, Aut, Win, Spr (——)
MWF 1:00–1:50

173a, 173b. Theatrical Makeup—Laboratory course in the art of stage makeup. 173a required of all undergraduate drama majors; complete sequence required of all M.F.A. acting, directing and costume majors.
173a. 1 unit, Aut (Russell) S 11–1
173b. 1 unit, Win (Russell) S 11–1

190. Senior Seminar—Acting and Directing selected Classic and Renaissance plays.
3 units, Aut (Sharp) MWF 11

191. Senior Seminar—Acting and Directing selected Restoration and Eighteenth Century plays.
3 units, Win (Sharp) MWF 11

192. Senior Seminar—Acting and Directing selected Romantic or Modern plays.
3 units, Spr (——) MWF 11

193. Special Research—Individual reading in dramatic literature.
1 to 4 units, any quarter (Staff)
by arrangement

194. Special Projects — Individual projects in theater arts.
1 to 4 units, any quarter (Staff)
by arrangement

200. American Drama.
3 units, Spr (Cole) MWF 11

GRADUATE COURSES FOR M.F.A.
Open by permission to unusually qualified undergraduate 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, 241b, 241c. Technical Production I—Introduction to technical production and scenographic techniques.
241a. 3 units, Aut (Hunt) MW 11–1 and F 11
241b. 3 units, Win (Hunt) MW 11–1 and F 11
241c. 3 units, Spr (Hunt) MW 11–1 and F 11

242a. 3 units, Aut (Hunt) TTh 10
242b. 3 units, Win (Hunt) TTh 10
242c. 3 units, Spr (Hunt) TTh 10

243a, 243b, 243c. Theater Engineering — A study of the use of electrical and mechanical devices for theater equipment, theater planning, and facilitated theatrical production.
243a. 3 units, Aut (Landry) MWF 9, given 1967–68
243b. 3 units, Win (Landry) MWF 9, given 1967–68
243c. 3 units, Spr (Landry) MWF 9, given 1967–68

244a, 244b. Survey of Lighting and Technical Production—Required of M.F.A. directing majors.
244a. 3 units, Aut (Hunt) MW 9
244b. 3 units, Win (Hunt) MW 9

245a. 245b, 245c. Theater Management — Theater organization, production organization, box office procedures, publicity, and business procedures.
245a. 3 units, Aut (Staff) TTh 9, given 1967–68
245b. 3 units, Win (Staff) TTh 9, given 1967–68
245c. 3 units, Spr (Staff) TTh 9, given 1967–68

246a, 246b, 246c. Technical Production III—Research and thesis.
246a. 2 units, Aut (Staff) T 12, given 1967–68
246b. 2 units, Win (Staff) T 12, given 1967–68
246c. 2 units, Spr (Staff) T 12, given 1967–68

251a, 251b, 251c. Lighting I—Introduction to stage lighting.
251a. 3 units, Aut (Landry) TTh 12
251b. 3 units, Win (Landry) TTh 12  
251c. 3 units, Spr (Landry) TTh 12  
252a, 252b, 252c. Lighting II — Advanced stage lighting.  
  252a. 3 units, Aut (Landry) M 12 and F 11–1  
  252b. 3 units, Win (Landry) M 12 and F 11–1  
  252c. 3 units, Spr (Landry) M 12 and F 11–1  
253a, 253b, 253c. Lighting III.  
  253a. 2 units, Aut (Landry) one hour by arrangement, given 1967–68  
  253b. 2 units, Win (Landry) one hour by arrangement, given 1967–68  
  253c. 2 units, Spr (Landry) one hour by arrangement, given 1967–68  
  2 units, any quarter (Staff) by arrangement  
271a, 271b, 271c. Costume I—Introduction to costume history, design and construction.  
  271a. 3 units, Aut (——) T 9 and Th 9–11  
  271b. 3 units, Win (——) T 9 and Th 9–11  
  271c. 3 units, Spr (——) T 9 and Th 9–11  
272a, 272b, 272c. Costume II — Projects in costume design.  
  272a. 3 units, Aut (——) T 10  
  272b. 3 units, Win (——) T 10  
  272c. 3 units, Spr (——) T 10  
  273a. 2 units, Aut (——) T 11  
  273b. 2 units, Win (——) T 11  
  273c. 2 units, Spr (——) T 11  
281a, 281b, 281c. Scene Design I — Principles of design and practice.  
  281a. 3 units, Aut (Hay) T 11 and Th 11–1  
  281b. 3 units, Win (Hay) T 11 and Th 11–1  
  281c. 3 units, Spr (Hay) T 11 and Th 11–1  
  291a. 3 units, Aut (——) MWF 10; lab. by arrangement  
  291b. 6 units, Win (——) MWF 10; lab. by arrangement  
  291c. 6 units, Spr (——) MWF 10; lab. by arrangement  
292. Directing II—Preparation for production.  
   6 units, Spr (Staff) by arrangement  
293a, 293b, 293c. Directing III—Thesis production.  
  293a. 3 units, Aut (Staff) by arrangement  
  293b. 3 units, Win (Staff) by arrangement  
  293c. 3 units, Spr (Staff) by arrangement  
294a, 294b. Acting projects with M.F.A. directors.  
  294a. 3 units, Win (Staff) MWF 10; lab. by arrangement (Directing I)  
  294b. 3 units, Spr (Staff) by arrangement (Directing II)  
297. Theater History (Classical)—Reading and discussion of representative plays and staging methods.  
   4 units, Aut (Cole) MWF 9  
298. Theater History (Baroque)—Reading
and discussion of representative plays and staging methods.

4 units, Win (Cole) MWF 9

299. Theater History (Modern) — Reading and discussion of representative plays and staging methods.

4 units, Spr (Cole) MWF 9

PH.D. COURSES

301. Seminar in Classical Drama (Greek and Roman).

4 units, Aut (——) MW 12:00–1:30, given 1967–68

302. Seminar in Medieval Drama.

4 units, Win (——) MW 12:00–1:30 given 1967–68

303. Seminar in Renaissance Drama (1550–1640).

4 units, Spr (——) MW 12:00–1:30, given 1967–68

304. Seminar in Baroque Drama (1660–1775).

4 units, Aut (——) MW 12:00–1:30

305. Seminar in Romantic Drama (1780–1880).

4 units, Win (——) MW 12:00–1:30

306. Seminar in Modern Drama (1880 to present).

4 units, Spr (——) MW 12:00–1:30


4 units, Aut (——) MW 2:15–4:05

306b. Contemporary Critical Techniques.

4 units, Win (——) MW 2:15–4:05

306c. Research and Bibliography.

4 units, Spr (——) MW 2:15–4:05

300. Special Research in Drama and Theater History.

1 to 4 units, all quarters (Staff) by arrangement

307. Seminar in Stage Arts.

3 units, Spr (Staff) MWF 10, given 1967–68

400. Dissertation Research.

All quarters (Staff) by arrangement

401. Special Research in Classical Drama (Greek and Roman).

1 to 4 units, Aut (——) by arrangement, given 1967–68

402. Special Research in Medieval Drama.

1 to 4 units, Win (——) by arrangement, given 1967–68

403. Special Research in Renaissance Drama (1550–1640).

1 to 4 units, Spr (——) by arrangement, given 1967–68

404. Special Research in Baroque Drama (1660–1775).

1 to 4 units, Aut (——) by arrangement

405. Special Research in Romantic Drama (1780–1880).

1 to 4 units, Win (——) by arrangement

406. Special Research in Modern Drama (1880 to present).

1 to 4 units, Spr (——) by arrangement

STATISTICS

Emeritus: Quinn McNemar

Executive Head: Lincoln E. Moses


Professor of Business and Industrial Statistics: Harvey M. Wagner

Associate Professor: Rupert G. Miller

Assistant Professors: Bradley Efron, Paul Switzer

OFFERINGS AND FACILITIES

The Department's purposes 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.

General students with an interest in the principles of statistical inference and the theory of making decisions in the face of uncertainty should take Statistics 50. 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, 217a, and 217b is a basic one-year course in probability theory.

Students interested in computing and data processing have access to the Stanford Computation Center, which contains an IBM 7090 and a Burroughs 5000.

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, Economics, Psychology, Electrical Engineering, Industrial Engineering, and the Graduate School of Business.

**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. Mathematics through Mathematics 45 or equivalent, and Mathematics 113.
3. Statistics 116, 119, 120 (or the Honors sections of these courses), 138, and 3 additional courses chosen from offerings in the Statistics Department (24 units). Students can receive credit toward fulfilling this requirement for, at most, 1 of the following 3 courses: Statistics 7, 50, 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, mathematics in behavioral science, industrial statistics, or data processing and operations research. Each student will normally fulfill the following requirements for the Master of Science degree:

1. Statistics 116, 219, 220 (or the Honors sections of these courses), 217a, 217b.
2. Mathematics 113; and Computer Science 136 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, industrial statistics, or data processing and operations research.

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 206, 207, 208, and 209 offered within the Department, as well as authorized courses from other departments.

The program in industrial statistics is directed toward students with graduate training in engineering or science. Such students will usually take 110, 161, 216, and 252 within the Department, as well as authorized courses from other departments.

Students interested in operations research and data processing will normally be interested in the application of quantitative techniques to business and industrial technology. They may take 252, 253, 254, 256, 257, and 258 within the Department, as well as authorized courses from other departments.

**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, 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, Large Sample Theory, Multivariate Analysis, Non-parametric Inference, and Time Series.

3. Two written examinations in statistics—one at the end of the first year, the other at the end of the second year of graduate study. These will be based entirely on course work taken by the student.

Doctor of Philosophy Minor — The general requirements for the minor in statistics are a reasonable knowledge of the principal branches of the theory of statistics and professional competence in those branches of statistical theory commonly applied in the major. Ordinarily a student will be required to take Statistics 116, 219, 220, 217a, and 217b. In addition, five other courses will be chosen from offerings in the Statistics Department or from authorized courses in other departments. A written examination to establish proficiency will be required and must be taken before the University oral examination. This examination for the minor will be given once in the spring quarter.

Fellowships and Assistantships

A variety of fellowships and assistantships are available. Generally they cover the student’s tuition and pay a stipend of $2,025 for the academic year (or if the student has dependent children, $2,250). 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.

COURSES

7. Introduction to Statistics—(Same as Economics 7 and Sociology 7.) Especially designed for students in economics, sociology, and other social sciences.

5 units, Aut (—) MTWThF 10


3 units, Aut (—) MWF 2:15
Spr (—) MWF 2:15

#50. Elementary Statistics — An introduction to statistics for the general student, with emphasis on concepts of decision making in the face of uncertainty.

5 units, Aut (—) MTWThF 11
Win (—) MTWThF 2:15
Spr (—) MTWThF 11

#62. Mathematics for Social Scientists — Special version of Mathematics 42 primarily for students majoring in a behavioral science. Prerequisite: Mathematics 41 or 11.

5 units, Win (—) MTWThF 2:15

#63. Mathematics for Social Scientists—Continuation of 62. Special version of Mathematics 43 primarily for students majoring in a behavioral science.

5 units, Spr (—) MTWThF 2:15

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, Aut (Madow) MWF 11

107. Introduction to Statistics—For graduate students. Lectures same as Statistics 7.

4 units, Aut (—) MTWThF 10

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 (——) TTh 10 and MW 4:15
Win (——) MTWF 9
Spr (——) MTWF 10
Sum (——)

116. Theory of Probability — This course covers the material of Statistics 27 in more detail and with more emphasis on mathematical technique. Students are expected to have a good working knowledge of calculus, including infinite series and double integrals. The course is designed to provide an adequate background for all courses whose prerequisite is probability theory. Prerequisite: Mathematics 44 or equivalent.

4 units, Aut (——) MTWF 9
Win (——) MTWF 11
Spr (——) MTWF 9
Sum (——)

116E. Theory of Probability — A course similar to 116 for engineering students. Prerequisite: Mathematics 45.

3 units, Aut (——) MWF 11


4 units, Aut (——) MTWF 10

119. Elementary Statistical Inference — Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. Prerequisite: 116 or 27.

4 units, Win (——) MWF 9

119H. Elementary Statistical Inference — Honors version of 119. Prerequisites: Grade of A in 116 or B in 116H; Mathematics 45.

4 units, Win (——) MWF 10

120. Statistical Inference — Point estimation; interval estimation; tests of hypothesis; linear hypothesis; distribution free methods; sequential analysis. Prerequisite: 119.

4 units, Spr (——) 9

120H. Statistical Inference — Honors version of 120.

4 units, Spr (——) MWF 10

136. Introduction to the Theory of Games — Two person-zero sum games; strategy; minimax solutions; infinite games. Prerequisite: 27 or equivalent.

3 units, Aut (——) MWF 3:15

137. Special Mathematical Topics Related to Probability and Statistics — Subject matter varies from year to year; topics may be drawn from convexity, geometrical probability, generating functions, Tchebychev inequalities, etc. Prerequisite: 116. May be repeated for credit.

3 units, Win (——) MWF 9

138. Special Topics in Statistics — Subject matter varies from year to year; topics may be any of Biological assay, Sequential analysis, Non-parametric methods, Analysis of variance, Design of experiments, Regression, Multi-variate statistical methods, Decision theory. Prerequisite: 120. May be repeated for credit.

3 units, Win (——) MWF 9

150. Elementary Statistics — For graduate students. Lectures same as Statistics 50.

4 units, Aut (——) MTWThF 11

152. Introduction to Operations Research I — (Enroll in I.E. 152.) Introduction to deterministic models in operations research. Linear, non-linear, and dynamic programming. Network analysis, inventory theory, simplex method, transportation problem, dual theorem, convex programming, integer programming, structure of deterministic dynamic programming problems, minimax theorem. Matrix notation will be introduced. Not open to graduate students. See 252. Prerequisite: Differential Calculus.

3 units, Win (Wagner) MW 4:15–5:30


3 units, Spr (Wagner) MWF 9

161, 162. Theory and Application of Statistics (Non-Mathematical) — This course is intended for the student who has had a single elementary statistics course. Tests of sig-
nificance and estimation, with emphasis on
the application and rationale of the most
common methods. Chi-square, Least
squares, Regression, Correlation, Non-para-
metric methods, Analysis of variance, Ele-
mentary design of experiments. Prerequisites: 7, 50, or 110, or Psychology 60 or
equivalent.

161. 3 units, Win (——) MWF
162. 3 units, Spr (——) MWF

199. Independent Study—For undergradu-
ates. (Staff)

204. Sampling from Human Populations—
Theory of simple and complex sample sur-
vey designs. Limiting distributions. Estimate
theory for finite populations. The sampling of
experiments. Prerequisites: Completion of or concurrent registration in 120.

3 units, Spr (Madaw) given 1967–68

206. Mathematical Models in Behavioral
Sciences: Measurement and Utility Theory—
(Enroll in Philosophy 206.) After a general
introduction to the theory of models in the
empirical sciences, the course will concen-
trate 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 cri-
tera. Prerequisite: Statistics 63 or Math-
ematics 43 or equivalent.

3 units, Aut (Suppes) TTh 2:15
and one hour by arrangement

207. Mathematical Models in Behavioral
Sciences: Learning Theory—(Enroll in Phi-
losophy 207.) Stimulus sampling and linear
models for learning will receive the main
emphasis. Modification of the basic models
to deal with concept formation and percept-
tual problems will be discussed. Prerequi-
site: Statistics 63 or Mathematics 63 or
equivalent.

3 units, Win (Suppes) TTh 3:15
and one hour by arrangement

208. Mathematical Models in Behavioral
Sciences: Psychometrics — Examination of
mathematical models in factor analysis,
mental testing, latent structure analysis, scal-
ing theory, and related topics.

3 units, Aut, given 1967–68

209. Mathematical Models in Behavioral
Sciences: Sociometrics — Examination of
mathematical models in social and psycho-
logical processes; equilibrium states, Pois-
son processes, and related topics.

3 units, Win, given 1967–68

216. Statistical Techniques for Industrial
Problems—Review of principles of lot-by-
lot acceptance inspection; variables inspec-
tion; recent results in use of economic costs
and Bayesian statistical methods; general
principles of sequential sampling plans;
sampling plans for continuous production;
life testing. Prerequisite: 120 or equivalent.

3 units, Spr, given 1967–68

217a. Introduction to Stochastic Processes
—The theory and application of stochastic
processes as models for empirical phenom-
ena, with special emphasis on the following
processes: Wiener, Poisson, stationary, nor-
mal, counting, renewal, Markov, birth and
death. Prerequisite: 116.

3 units, Win (——) MWF

217b. Introduction to Stochastic Processes
—Continuation of 217a.

3 units, Spr (——) MWF

219. Elementary Statistical Inference—For
graduate students. Lectures same as Statis-
tics 119.

3 units, Win (——) MWF

219H. Elementary Statistical Inference—
Honors version of 219.

3 units, Win (——) MWF

220. Statistical Inference — For graduate
students. Lectures same as Statistics 120.

3 units, Spr (——) MWF

220H. Statistical Inference — Honors ver-
ssion of 220.

3 units, Spr (——) MWF

221. Analysis of Variance—Theory of gen-
eral linear hypotheses; important special
cases of analysis of variance; case of unequal
class frequencies. Prerequisite: 120 and
some knowledge of matrix algebra, or con-
sent of the instructor.

3 units, Aut (——) MWF

222. Analysis of Variance II—Special topics
under Model I; consequences of relaxing as-
sumptions; randomization basis of infer-
ce; components of variance; applications.
Prerequisite: 221.

3 units, Win (——) MWF

230a. Advanced Probability—Fundamental
concepts, limit law theorems, weak and
strong laws of large numbers, convergence theorems, martingales, second order processes, processes with independent increments. (Same as Mathematics 230a.) Prerequisite: Mathematics 205a.

3 units, Win (——) 10


3 units, Spr (——) 10

236a. Mathematical Statistics—A survey of classical and modern statistics from an advanced mathematical point of view. Probability, games and decision theory, estimation, testing hypothesis, 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.

3 units, Aut (——) MWF 9


3 units, Win (——) MWF 9

236c. Mathematical Statistics — Continuation of 236b.

3 units, Spr (——) MWF 9

239d. Stochastic Optimization—(Enroll in Engineering Mechanics 239d.) Markovian realization of random processes. Construction of optimal predictors and filters. Applications to stochastic control and information theory. Prerequisite: Engineering Mechanics 239c. For graduate students in statistics with a knowledge of matrix theory and probability theory. 239a and 239b are not prerequisites for this course.

3 units, Aut (Kalman) alternate years, given 1967–68

242a. Introduction to Time Series Analysis—Model fitting and prediction theory, correlation analysis, spectral analysis, and regression analysis of univariate and multivariate time series. Applications to communication theory (extraction and detection of signals in noise), statistical control theory, and economic time series. Prerequisites: 217a, 219, and Computer Science 136.

3 units, Aut, given 1967–68

242b. Introduction to Time Series Analysis—Continuation of 242a.

3 units, Win, given 1967–68


3 units, Aut (Veinott) TTh 11:00–12:15


3 units, Win (——) MWF 11

254. Seminar in Operations Research—(Enroll in I.E. 254). Case studies and papers appearing in the operations research literature. Student teams work in local industry on problems in operations research. Special topics, including some presentations by guest specialists. Prerequisites: At least two courses in operations research.

3 units, Spr (Lieberman) MW 4:15–5:30

255a. Linear Programming—(Enroll in Business 465a.) This course will survey linear programming, emphasizing standard model formulation, fundamental theorems, variations of the simplex method and parametric programming. Students will solve a linear programming problem on computer. Prerequisite: familiarity with matrix algebra.

4 units, Aut (——)


4 units, Win (——)

256. Inventory and Production Control—General discussion of inventory models; costs; analysis of the one-stage model; the sequential inventory problem; time lags; operating characteristics; statistical considerations. Prerequisite: 217b (may be taken concurrently).

3 units, Spr (Lieberman) MWF 3:15
257. Data Processing in Operations Research—(Enroll in I.E. 257.) Seminar in selected topics in the application of electronic computers to operations research activities. Emphasis on the use of simulation techniques. Prerequisites: I.E. 141 and at least two courses in Operations Research.

3 units, Win (Winters) MW 4:15–5:30

258. Queueing Theory—(Enroll in I.E. 258.) A survey of queueing theory and its application. Birth–death process. Other useful models where the inter-arrival or the service-time distributions, or both, are non-exponential. Special service disciplines. Statistical estimation of model parameters. Prerequisites: 217a, b, or 116 and I.E. 352, or equivalent.

3 units, Spr (Hillier) TTh 4:15–5:30

260a. Workshop in Biostatistics — Techniques useful in biological applications including bioassay, quantal response, epidemiology. Informal training in medical science by medical school faculty. Open to second-year graduate students in Statistics.

2 to 5 units, Aut (Miller, Moses)

Th 1:15–3:05 and by arrangement

260b. Workshop in Biostatistics—Continuation of 260a.

2 to 5 units, Win (Miller, Moses) Th 1:15–3:05 and by arrangement

260c. Workshop in Biostatistics—Continuation of 260b.

2 to 5 units, Spr (Miller, Moses)

Th 1:15–3:05 and by arrangement


3 units (Staff)

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 permission of the instructor).

324a. 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.

3 units, given 1967–68

324b. Multivariate Analysis—Continuation of 324a.

3 units, Spr, given 1967–68

326. Sequential Analysis — The Wald sequential probability ratio test, operating characteristics and applications; Bayes sequential decision problems; asymptotic shapes; sequential design of experiments; special topics. Prerequisites: 217a and 220.

3 units, given 1967–68

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.

3 units, given 1967–68


3 units, Aut ( —— )

332b. Large Sample Theory—Continuation of 332a.

3 units, Win ( —— )

336a. Decision Theory and Statistical Inference—Minimax theorem, admissibility and complete class theorem, formulation of statistical decision problems, sufficient statistics, testing hypotheses, estimation, compar-
ison of experiments, and sequential problems. Prerequisites: 236a, b, c.
  3 units, given 1967-68

336b. Decision Theory and Statistical Inference—Continuation of 336a.
  3 units, given 1967-68

343a. Foundations of Time Series Analysis—Hilbert space and function space methods of studying the probabilistic structure and statistical theory of time series. Prerequisites: 230b.
  3 units

343b. Foundations of Time Series Analysis—Continuation of 343a.
  3 units

345. Special Topics in Time Series Analysis—Discussion of current theoretical and empirical research on time series analysis.
  3 units, Spr

381a. Special Topics in Decision Theory—Subject matter will be drawn largely from the literature on empirical Bayes decision procedures and compound decision problems.
  3 units, Win (Johns)

381b. Special Topics in Decision Theory—Continuation of 381a.
  3 units, Spr (Johns)

384. Special Topics in Multivariate Analysis: Matrix Analysis and Inequalities—Consideration will be given to those topics in matrix theory and inequalities which are generally omitted from courses in matrix theory. Applications in statistics will be stressed. Prerequisites: Mathematics 113 and 114. Recommended: Statistics 220.
  3 units, Aut

386a. Seminar in Sequential Analysis.
  3 units, Win

386b. Seminar in Sequential Analysis—Continuation of 386a.
  3 units, Spr

392. Special Topics in Stochastic Processes.
  3 units

399. Research—Research work as distinguished from independent study of nonresearch character listed in Statistics 199 and 299.
  Any quarter (Staff) by arrangement
Dean: Bayless Manning  
Professor: John H. Merryman  
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 degree in law (LL.B.) constitutes an adequate preparation for the practice of law in any English-speaking jurisdiction. Graduate work leading to the degrees of Master of Laws and Doctor of Law is also offered. (For full Law School Curriculum and Faculty see the School of Law Bulletin.) Classes in the Law School will commence on September 7, 1966, and terminate on January 24, 1967, for the Autumn Term. The Spring Term classes commence on January 30, 1967, and terminate on June 5, 1967.

**COURSES**

**GRADUATE**

The following courses are open to qualified graduate students of other departments of the University upon permission of the instructor:

233. *Introduction to the Civil Law System*—This introductory course will be conducted in English and will be based on materials in English. It is the basic comparative law offering, its function being to introduce the student to the civil law system. Among the matters discussed will be the history of Roman law in Europe following the fall of the Roman Empire; the movement for codification and reform in the Eighteenth and Nineteenth centuries and the nature and impact of the Code Napoleon; the structure of the legal process in Italy and the roles played by legislature, executive, court, public authority and the legal profession; civil procedure, evidence and the trial of civil actions in Italian courts; the Italian Civil Code, and the movement toward unification of private law in Western Europe.

3 term units, Aut term (Merryman)

234. *Selected Problems in Comparative Law*—Seminar on selected problems. Sessions will be conducted in English, but the outside reading and research will require a reading knowledge of Italian, French, German or Spanish (or, in appropriate cases and by special arrangement, some other language). Emphasis will be placed on reading, research, and the preparation of a paper.

3 term units, Spr term (Merryman)

283. *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, Aut term (Torzsay-Biber)

**NONPROFESSIONAL**

The following nonprofessional course, 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. *Law in Society*—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. Cases and other materials are employed to focus attention upon three related topics: (1) the processes of legal decision making; (2) the change of legal doctrine in response to altered societal conditions and problems; (3) the influence of the law upon other social institutions and the course of social change.

4 quarter units. Quarters and Instructor to be announced.
Dean: Robert J. Glaser

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, and 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 application of that knowledge to problems of illness and health. The following section outlines the plan of work toward the M.D. degree which is described in more detail in the separate School of Medicine Bulletin.

THE STANFORD PLAN OF MEDICAL EDUCATION

The Stanford Plan of Medical Education is a five-year program which emphasizes medical education as an integral part of University education. The medical sciences are presented not only as they relate to medical knowledge and the treatment of patients, but also in the context of developing human knowledge. The unity of the medical sciences is stressed, rather than their diversity. Other major concerns are the role of medicine in society and the parts played by the patient and physician as members of society. The program is based on the belief that medical education is graduate education and that firsthand experience with the scientific method is essential. Therefore the Stanford Plan encourages learning in terms of attitude toward, and approach to, problems in medicine rather than in terms of acquiring techniques or accumulating data at the expense of interpretation. Each student is given maximum opportunity to develop his own interests as they complement the basic knowledge included in the work required of all students.

A student entering this program will find a thorough grounding in the humanities valuable, in addition to a basic understanding of the natural sciences. In addition, he will benefit from knowledge of both a modern foreign language and of mathematics through the calculus because these subjects contribute to the breadth of his liberal education and to his ability to take the fullest advantage of his medical education. The Medical Faculty believes it would be unduly restrictive to require these courses as a condition for admission, but urges any student contemplating a career in medicine to consider their usefulness seriously.

The striking feature of the program is the provision of time equivalent to one academic year which the student may devote to work anywhere in the University. This time, designated "University time" for convenience of identification, is distributed through the first three years of the program in such a manner that its combination with the free time in the medical course results in half of each day being free for study or other activity outside the required medical course work. Students entering the program with a baccalaureate degree may use the University time in formal course work in any department of the University (including those of the School of Medicine), in work toward an advanced degree, in research in any University department, or in programs of independent study tailored to individual interests and abilities. Those students who enter after three college years must use whatever portion of University time as may be necessary to fulfill requirements for a Bachelor's degree, after which the options open to those with degrees become available.
Student interest in research is encouraged. To this end there is ample free time within the medical course (in addition to the University time) and special physical facilities have been designed for student use. Fellowship support is available for matriculated students who wish to undertake such activities either in the summer or during free time.

For further details, see the separate School of Medicine Bulletin. Certain departments of the School of Medicine list work in this Bulletin because of its interest to students working for other degrees.

ALLIED MEDICAL SCIENCES

SCHOOL OF NURSING

The School of Nursing offers a five-academic-year program leading to a Bachelor of Science degree and certification as a Public Health Nurse. The nursing major commences in the junior year. See the separate School of Nursing Bulletin for details.

DIVISION OF PHYSICAL THERAPY

Director: Lucille Daniels
Associate Professors: Lucille Daniels. Clinical: Herbert Browne, Helen Hardenbergh
Instructors: Helen Blood, Barbara Kent, Frances Lupi. Clinical: Donna J. Jensen

OFFERINGS AND FACILITIES

The following programs in physical therapy are offered:

1. A four-year course leading to the Bachelor of Arts degree.
2. A four-quarter, 12-month course for students with the Bachelor's degree and adequate background in the basic sciences.
3. The Master of Arts degree.

Program 1, plus an additional quarter of clinical training, and Program 2 conform to the standards of the Council on Medical Education and Hospitals of the American Medical Association and the American Physical Therapy Association. Both programs prepare students for the examination for registration in California and other states.

All prerequisite courses and the basic science courses that are a part of the physical therapy curriculum are given in the respective departments on the campus. Courses in medical science and physical therapy theory and technique are held in the Edwards Building of the Medical Center which houses lecture, laboratory and research rooms, a library, and clinics.

Following initial directed clinical experience in the University's integrated rehabilitation program, students are assigned to affiliated hospitals and treatment centers in the Bay area to assure a well-rounded background of clinical work.

ADMISSION

Graduate students applying for the program leading to the certificate in physical therapy or to the Master of Arts degree are admitted autumn quarter. Admission dates for undergraduates and general information for all students will be found in the Information Bulletin of the University.

SCHOLARSHIPS, TRAINEESHIPS, LOAN FUNDS

General University scholarships and fellowships are available and are listed in the booklet, Student Aid Funds; Awards and Prizes. In addition, a number of special scholarships for physical therapy students are offered by such organizations as the National Society for Crippled Children and Adults and the Elks National Foundation. Local chapters of these organizations and others in many parts of the country also offer assistance to students.

The Marian Williams Memorial Scholarship is awarded through the Division of Physical Therapy; the Mary McMillan scholarships are under the auspices of the American Physical Therapy Association.

The United States Government offers traineeships for both undergraduate and graduate students through the Vocational Rehabilitation Administration and trainee-
ships for graduate students from the Public Health Service. The California State Department of Mental Hygiene offers assistance to undergraduate and graduate students.

The Information Bulletin lists the long-term and short-term loan policies of the University and the details of the National Defense Student Loan Program. Information about scholarships, commissions, and fellowships may be obtained from the office of the Division.

COMMISSIONS IN THE ARMED SERVICES

The United States Air Force offers commissions to senior and graduate women enrolling in the basic curriculum. The United States Navy offers commissions to both women and men for this program. The salary paid during the year of study is equivalent to a $4,000 scholarship.

PROGRAMS OF STUDY

BACHELOR OF ARTS

The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor’s degree:

First- and second-year undergraduate program — Courses in biological science equivalent to one course each quarter for three quarters are required. General biology, botany, zoology, comparative vertebrate anatomy or embryology, and general or plant physiology may be used to fulfill this requirement (all courses must include laboratory work).

Courses in physical science equivalent to one course each quarter for three quarters are required; basic courses in chemistry and mathematics must be included. A course in physics is recommended (chemistry and physics courses must include laboratory work).

General Psychology and Introduction to Physical Therapy should be taken during the first two years.

Students should confer with a physical therapy adviser as early as possible to determine the best course sequence.

Third- and fourth-year undergraduate program — Physiology (see adviser for course selection), Anatomy 114, Practical Anatomy.

Physical Therapy 150 to 195, and at least one third- or fourth-year course in psychology are required. Education 155, Elementary Analysis of Body Movement, and additional courses in psychology should be included in this program.

TWELVE-MONTH COURSE

Students applying for this course should present a Bachelor’s degree. They should have completed the biological science, physical science, and psychology courses listed under the first- and second-year undergraduate program and courses in human anatomy, human physiology and psychology.

Courses in this program include Physiology, Anatomy 114, and Physical Therapy 150–200.

MASTER OF ARTS

Candidates should present a Bachelor’s degree in physical therapy, or a Bachelor’s degree and a credential of completion for a course in physical therapy approved by the Council on Medical Education of the American Medical Association and the American Physical Therapy Association.

Experience in the field is a prerequisite and the program will be planned with each individual on the basis of former training and present interest. A thesis satisfactory to the faculty adviser and the University Committee on the Graduate Division is required. Candidates must complete a minimum of 45 units of credit (including units for thesis).

MINOR FOR PH.D.

A qualified physical therapist may select, with the approval of the adviser, units from the courses numbered above 200.

BASIC COURSES

50. Introduction to Physical Therapy — General survey of history of the field, common physical disabilities, and current treatment procedures; observation of treatment.

2 units, Win (Daniels) T 3:15–5:05

150. Elements of Pathology — Basic medical terminology; the causes, process, and effects of disease; repair of tissues following injury.

2 to 3 units, Aut (Hardenbergh) T 8–10
162. Physical Agents I — Analysis of the principles underlying the use of electrotherapy, massage, and hydrotherapy; practice of essential techniques.
   2 to 3 units, Aut (Staff) MW 10–12 and open labs. by arrangement

163. Physical Agents II — Continuation of 162.
   4 to 5 units, Win (Staff) lec. M 11–12 and F 1:15–2:05, lab. WF 8–10 and open labs. by arrangement

170. Clinical Medicine I — Basic lectures in orthopedics, medicine, and surgery.
   4 units, Win (Browne, Special Lecturers) M 8–10, T 2:15–4:05

172. Clinical Medicine II — Basic lectures in medicine, neurology and pediatrics.
   2 units, Spr (Special Lecturers) Th 1:15–3:05

182. Kinesiology and Therapeutic Exercise I — Biomechanics and neuroanatomy related to body motion; organization and development of movement; theory and practice of neuromuscular reeducation; tests and measurements.
   4 units, Aut (Forward, Kent, Semans) M 10–12, WF 8–10 and open labs. by arrangement

183. Kinesiology and Therapeutic Exercise II — Continuation of 182.
   4 units, Win (Kent, Semans) lec. M 10–12, W 1:15–3:05, F 2:05–4:05 and open labs. by arrangement

   2 units, Spr (Kent, Semans) TTh 9–12

   2 units, Sum (Daniels, Graham) S 9–11

193. Psychology of the Handicapped — Special problems of handicapped individuals related to reactions to illness and disability, patient-therapist relationships; emphasis on total rehabilitation of the patient.
   2 units, Spr (Grossman) by arrangement

195. Directed Clinical Experience in Physical Therapy — Students are assigned part-time to hospitals, rehabilitation centers, and crippled children's schools in the local area.
   1 to 4 units, any quarter (Blood, Kent) by arrangement

200. Directed Clinical Experience in Physical Therapy — Students are assigned to treatment facilities at Stanford and in the Bay area for full-time work with patients.
   3 to 8 units, any quarter (Blood, Kent) by arrangement

ADVANCED COURSES

Courses offered in the Division of Physical Therapy and in related areas of basic science, psychology, education, and speech pathology allow flexibility in individual programs for candidates with interests in administration, teaching, or research. A minimum of 30 units must be selected from the following:

220. Analysis of Human Movement I — Biomechanics and neuroanatomy related to body motion; regional approach to anatomy and kinesiology, review of prospected material; consideration of common disabilities and analysis of related therapeutic exercise procedures. Organization and development of sequential movement as behavior in relation to learning, perception and motivation.
   5 units, Aut (Staff) MWF 10–12

221. Analysis of Human Movement II — Continuation of 220.
   5 units, Win (Staff) T 1:15–3:05 and WF 10–12

   3 units, Spr (Semans) MW 10–12

224. Analysis of Neuromuscular Disorders in Cerebral Palsy.
   4 units, Sum (Semans, Forward) by arrangement

230. Clinical Tests — Presentation, discussion of principles and techniques of testing procedures, including electromyography and dynamometry; newer developments in the field and in related clinical areas.
   5 units, Spr (Forward) MWF 10–12
232. Curriculum Development and Instruction — Objectives, organization, content, techniques in teaching courses in physical therapy.

3 units, Win (Daniels) M 1:15–3:05 and W 1:15–2:05


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

234. Seminar in Administration—Administrative problems in hospitals, clinics, schools of physical therapy; interprofessional relationships in comprehensive patient care.

3 units, Aut (Daniels) T 1:15–3:05 and Th 2:15–3:05


3 units, Spr (Blood) TTh 10–12

240. Continuing Case Conferences in Rehabilitation—Observation of the care of patients with extensive disability and the use of the case conference technique for the integration of services; case studies and reports.

1 to 2 units, any quarter (Staff) T 1:15–3:05

244. Directed Clinical Experience in Special Areas of the Field—For therapists wishing to strengthen their background in special areas by short-term periods in facilities such as thoracic surgery, amputation, and cerebral palsy centers.

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

246. Individual Work.

1 to 8 units, any quarter (Staff) by arrangement

280. Seminar in Research and Thesis Problems—Basic principles of research with emphasis on material applied to physical therapy. Biostatistics.

3 units, Aut (Forward) MF 1:15–2:05 and W 1:15–3:05


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

295. Research.

(Staff) by arrangement

DIVISION OF SPEECH PATHOLOGY AND AUDIOLOGY

Emeritus: Virgil A. Anderson (Professor)
Director: Hayes A. Newby
Professors: Jon Eisenson, Hayes A. Newby, Earl D. Schubert
Associate Professors: Richard F. Dixon, Dorothy A. Huntington, Joel Stark
Assistant Professors: Clara N. Bush, James H. Dewson III. Clinical: Lyman S. Barrett
Instructors: Gordon L. Duck, Robert H. Gottsleben, V. Monica Pestroy, Virginia Puich, Ellen Seefeldt. Clinical: Donald R. Calvert

OFFERINGS AND FACILITIES

Training programs in the Division of Speech Pathology and Audiology are designed to prepare students for professional careers, for teaching at various academic levels, and for research in the fields of speech pathology, audiology, and speech and hearing sciences. The rapid expansion of these fields in recent years has created many opportunities for properly trained individuals to work in hospital clinics, rehabilitation centers, in industry, and in various local, state, and federal agencies dealing with the handicapped. In addition, the curriculum provides preparation for careers in public school speech and hearing work and for private practice.

The program of the Division is so organized, however, as to make ample provision for electives outside the major and minor, affording the student opportunity to gain a liberal education along with his professional preparation. It is hoped that a number of the courses will also prove useful as electives to majors and minors from other departments.

The Division is fortunate in having its own library, containing a highly selected core of books and journals, not only in the immediate fields of speech and hearing but also in the related areas of psychology, special education, the physical sciences, and certain aspects of medicine as well. A well-equipped speech and hearing clinic pro-
vides ample opportunity for the student to supplement course work with practical experience with a wide range of speech and hearing disorders, in the setting of a general rehabilitation program. Modern research facilities enhance the student's training, not only in the speech and hearing sciences, but in speech pathology and audiology as well.

Three major areas of concentration are provided: speech pathology, audiology, and speech and hearing sciences. Although a student may specialize in any one of the three, he is expected to have some background in the other two as well. Undergraduate programs provide specializations for the degree only in speech pathology and/or audiology.

The courses in the Division are numbered according to the following scheme:

0 to 9 on any level (0 to 9, 100 to 109, 200 to 209, etc.) are general
10 to 39, Speech Sciences
40 to 59, Speech Correction
60 to 79, Combined Speech and Hearing
80 to 99, Audiology (hearing)

The only courses in the Division that provide graduate credit for the A.M. or Ph.D. degrees are those numbered 200 or above.

PROGRAMS OF STUDY

BACHELOR OF ARTS

The following requirements are in addition to the University's basic requirements for the Bachelor's degree:

1. As a minimum program, the satisfactory completion, with an average grade of C or better, of the following courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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<tbody>
<tr>
<td>110</td>
<td>Principles of Phonetics</td>
<td>4</td>
</tr>
<tr>
<td>130</td>
<td>Introduction to Speech Science</td>
<td>4</td>
</tr>
<tr>
<td>141</td>
<td>Speech Correction</td>
<td>5</td>
</tr>
<tr>
<td>180</td>
<td>Introduction to Audiology</td>
<td>4</td>
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<tr>
<td>220</td>
<td>The Psychology of Speech</td>
<td>4</td>
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<tr>
<td>233</td>
<td>Principles of Voice Training</td>
<td>3</td>
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<td>281</td>
<td>Hearing Measurements and</td>
<td>4</td>
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<td>Interpretation</td>
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<td>Electives</td>
<td>8</td>
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<tr>
<td>Speech and Drama 20. Public Speaking:</td>
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<td></td>
<td>Practice and Criticism</td>
<td>3</td>
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<tr>
<td>Speech and Drama 1. Characteristics of Spoken Language</td>
<td>3</td>
<td></td>
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<tr>
<td>or Speech and Drama 30. Oral Interpretation</td>
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<tr>
<td>Completion of either of the following programs:</td>
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<tr>
<td>a) 223. Speech and Language Development</td>
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<td>241. Advanced Speech Correction</td>
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2. The satisfactory completion, with an average grade of C or better, of a minor program of not less than 20 units of advanced work in a department or in departments closely allied with the student's program in speech and hearing. The minor program will be planned in consultation with the student's adviser.

MASTER OF ARTS

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin. Details of the Master's program in the Division of Speech Pathology and Audiology are presented in the following paragraphs:

All candidates for the Master's degree are expected to take 300 (Introduction to Graduate Study) and 360 (Medical Backgrounds of Speech and Hearing Disorders).

The minimum number of graduate units required by this Division for the Master's degree is 45. The typical candidate requires six quarters of academic work in order to complete all requirements for the A.M. degree. Students with superior prior preparation may complete their work in four quarters; others may require at least eight quarters. Within limits, each program is planned individually to fit the needs, interests, and previous background of the student. This program may include course work offered in other departments of the University. Four units may be devoted to a thesis. The thesis is optional. Candidates who expect to pursue a doctoral program and others who show research promise will be encouraged by their advisers to elect to write a thesis.

Examinations—Early in his first quarter of residence the candidate will take a diagnostic examination covering various subjects. These include speech pathology, audiology, speech science, phonetics, and the psychology of speech. These examinations are truly diagnostic; they are not recorded as "passing" or "failing," but are used as a basis for advising the student and planning his program.
Near the end of his final quarter of course work the student must pass a written examination covering the three areas: speech pathology, audiology, and speech and hearing sciences. The relative emphasis devoted to each of these three areas in the examination will vary according to the particular specialization of the student. Students who have not completed the degree within three years from the date of filing for candidacy must reapply.

**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 student may specialize in any one of the three fields—speech pathology, audiology, or speech and hearing sciences. Normally he is expected to acquire a substantial background in the other two as well.

The doctoral program cannot be laid out in advance in terms of specific courses routinely required, but it is planned individually with the needs and interests of the candidate in mind. The general University requirements for the doctorate are followed as they apply to residence, application for candidacy, etc. A reading knowledge of one foreign language is required.

All doctoral candidates must complete the following courses: 300 (Introduction to Graduate Study), 308 (Research Methods), and 400 (Doctoral Research) which is the formal course registration for the Dissertation. Fifteen units of 400 must be included in the candidate's program. The candidate is expected to attend a special doctoral dissertation seminar during each quarter of his residence or until his dissertation has been completed. (See course 400 for days and hours.) Candidates for the doctorate may include a formal minor as a part of their total 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.

**Examinations** — The doctoral candidate takes the same diagnostic examinations as described earlier for the Master's degree. Not later than the beginning of the quarter in which the candidate expects to take his University oral examination, he must pass written examinations administered by the Division. Content areas for these examinations are determined by the candidate's advisory committee. Upon the candidate's successful completion of these examinations, the staff administers an oral examination as a basis for admission to the University oral examination.

**Postdoctoral**

A limited number of postdoctoral fellows will be accepted each year in speech pathology, audiology, and speech and hearing sciences. For further information, write to the Director.

**Teaching Credentials**

Anyone interested in earning a credential that would authorize the holder to work in the public schools of California as a speech therapist and hearing specialist should consult the credential adviser in the Division.

**SPEECH AND HEARING CLINIC**

Throughout the year, including the summer quarter, a Speech and Hearing Clinic is maintained by the Division for the purpose of diagnosing and treating speech and hearing disorders. The primary purpose of the Clinic is to provide students in training actual experience with a variety of speech and hearing disorders under the supervision of the staff. A secondary purpose is to serve the Medical Center, the University, and the community as a diagnostic and rehabilitative agency for individuals who have problems of speech or hearing. Clinical services are available to both children and adults, either individually or with a group. University students may receive the service without charge by registering for Speech Pathology and Audiology 1. Adult stuttering and lipreading groups meet weekly. Information concerning any of the services of the Clinic can be obtained by calling the Clinic reception desk—321-1200, Local 5416.

**Scholarships and Assistantships**

The University has a number of scholarships and fellowships available. In addition, the Phi Chapter of Kappa Alpha Theta Fund and the J. D. Zellerbach Fund provide scholarships specifically for graduate students in Speech Pathology and Audiology.
Application for these special scholarships should be made directly to the Director of the Division of Speech Pathology and Audiology.

Some teaching, research, and clinical assistantships are available to students who have sufficient background of training and experience. Some of these involve employment in near-by medical and research facilities and hence offer valuable experience in addition to the financial remuneration. In addition, traineeships from the Vocational Rehabilitation Administration and fellowships from the Children's Bureau and the Office of Education are available for graduate students with the proper qualifications. A limited number of postdoctoral fellowships in audiology are available from the National Institute of Neurological Diseases and Blindness. Application for these traineeships and fellowships should be made directly to the Division of Speech Pathology and Audiology.

**COURSES**

1. **Speech Clinic**—Remedial work in speech disorders, hearing problems. Open to all students in need of corrective treatment.
   
   No credit, any quarter (Staff) by arrangement

60. **Introduction to Speech Therapy and Hearing**—Elective, to acquaint undergraduate students with subject matter, vocational opportunities, in fields of speech therapy and hearing. Lectures, demonstrations, films.

   2 units, Win (Puich, Staff) Th 3:15–5:05

101. **Independent Study**—Individual study under direction in fields or subjects of special interest. Credit limited to 6 units.

   1 to 3 units, any quarter (Staff) by arrangement

110. **Principles of Phonetics**—English phonetics as applied to articulation, standards of pronunciation, teaching of speech, speech correction.

   4 units, Aut (Seefeldt) MTWF 1:15

112. **Introduction to Phonetic Theory**—Descriptive and historical phonetics as applied to English. Prerequisite: some acquaintance with phonetic transcription.

   2 units, Aut (Bush) TTh 1:15

130. **Introduction to Speech Science**—Anatomy and physiology of voice and speech, with application to theories of voice production and vocal therapy.

   4 units, Win (Bush) MTWF 2:15

141. **Speech Correction**—Classification, diagnosis, treatment of speech disorders. Supervised observation in Speech Clinic.

   5 units, Win (——) MTWThF 10 and one hour by arrangement

180. **Introduction to Audiology**—Survey of field of clinical audiology. Introduction to hearing disorders and problems of measurement.

   4 units, Aut (Dixon) MTWF 8

**ADVANCED UNDERGRADUATE AND GRADUATE COURSES**

220. **The Psychology of Speech**—Origin, development of speech, semantics; relation of speech to thought, emotion, personality.

   4 units, Aut (Eisenson) MTWF 9

222. **Models for Communication**—A discussion of the various organizational structures imposed on language for the purpose of analyzing, controlling, or refining communication. Systematic patterns ranging from simple grammar to information theory are scrutinized and evaluated.

   3 units, Sum (Schubert) MTWF 10

223. **Speech and Language Development**—Psycho-social, intellectual, and linguistic correlates.

   3 units, Spr (Stark) MWF 8

230. **Advanced Speech Science**—Acoustic characteristics of voice and speech.

   3 units, Spr (Huntington) MWF 1:15

232. **Principles of Voice Training**—Theories, methods of training speaking voice as applied to both normal, abnormal voice. Problems in teaching of diction. Prerequisites: some background in voice and a course in phonetics.

   3 units, Sum (——) MTWF 1:15

241. **Advanced Speech Correction**—Emphasis on more serious types of speech disorders. Unless otherwise arranged, the student is expected to register for one or more units of 270 concurrently with this course.

   4 units, Spr (——) MTWF 10
250. Stuttering.  
3 units, Win (Eisenson) MWF 9  
Sum (——) MTWF 1:15

252. Aphasia — Historical survey, pathology; methods of testing, diagnosis, therapy.  
3 units, Spr (Eisenson) MWF 9

253. Aphasia in Children — Language disorders and related problems. Prerequisite: permission of instructor.  
3 units, Win (Stark) MWF 1:15  
3 units, Sum (Eisenson) MTWF 9

254. Speech Problems in Cerebral Palsy.  
3 units, Sum (Puich) MTWF 2:15

264. Clinical Testing and Diagnosis—Theory, practice in use of tests, other diagnostic techniques that can be applied to speech correction.  
4 units, Aut (Duck) MWF 10 and
one hour by arrangement  
Sum (Duck) MTWF 11 and
one hour by arrangement

270. Clinical Practice in Speech and Hearing—Prerequisite: 141 or equivalent, or permission of instructor.  
1 to 4 units, any quarter (Duck, Staff)  
Th 11 and by arrangement

271. Clinical Practice in Audiology — Prerequisite: permission of instructor.  
1 to 4 units, any quarter (Dixon, Staff)  
by arrangement

281. Hearing Measurements and Interpretation — Theory, practice in administering hearing tests. Prerequisite: 180 or equivalent. The student is expected to register for 1 unit of 270 concurrently with this course.  
4 units, Aut (Newby) MWF 8 and
one hour by arrangement  
Win (Dixon) MWF 8 and
one hour by arrangement

284. Advanced Clinical Audiology—Differential diagnostic procedures. Prerequisite: 281 or equivalent.  
4 units, Spr (Dixon) MTWF 8

286. Industrial Audiology — Determining industrial hazards to hearing; medico-legal problems of noise-induced hearing loss; control measures. Prerequisite: 281 or permission of instructor.  
2 units, Spr (Newby) TTh 9

289. Aural Rehabilitation—Speech reading, auditory training, and speech training for the acoustically handicapped.  
4 units, Spr (Seefeldt), MTWF 11

290. Language Training for the Deaf Child — Unless otherwise arranged the student is expected to register for 1 unit of 270 concurrently with this course. Prerequisite: permission of instructor.  
4 units, Spr (Puich) MTWF 10

291. Hearing Aids and Residual Hearing—Amplification as a rehabilitative measure. Counseling and training the hearing-aid user. Prerequisite: permission of instructor.  
3 units, Sum (Dixon) MTWF 8

292. The Auditory Process — A systematic survey of our current knowledge of the operation of the auditory system. Emphasis is placed on acquiring a knowledge of the acoustic signal, and on an understanding of the methods of measuring a sensory process.  
4 units, Win (Schubert) MTWF 10

300. Introduction to Graduate Study—Required of all candidates for graduate degrees.  
2 units, Aut (Huntington) MF 2:15

301. Research — Independent study for graduate students.  
1 to 3 units, any quarter (Staff) by arrangement

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

308. Research Methods — Required of all Ph.D. candidates. Prerequisite: some training in statistics.  
3 units, Win (Huntington) MWF 11

310. Experimental Phonetics I — Study of experimental work in physiological characteristics of speech. Lectures, demonstrations, laboratory.  
4 units, Aut (Huntington) Th 9–11 and
two hours by arrangement

4 units, Win (Huntington) Th 9–11 and
two hours by arrangement

312. Experimental Phonetics III—Study of
experimental work in speech perception. Lectures, demonstrations, laboratory.

4 units, Spr (Huntington) Th 9–11 and two hours by arrangement

330. Seminar in Speech Sciences—Material will vary from year to year; hence, may be repeated for credit.

4 units, Spr (Bush) MW 3:15–5:05

340. Seminar in Speech Pathology—Material will vary from year to year; hence, may be repeated for credit.

4 units, Aut (——) MW 3:15–5:05
Win (——) MF 3:15–5:05
Spr (——) MW 3:15–5:05
3 units, Sum (Stark) MW 3:15–5:05

360. Medical Backgrounds of Speech and Hearing Disorders—Anatomical, physiological, and neurological bases for organic disorders of speech and hearing. Taught by members of the Medical School Staff.

4 units, Win (Newby, Medical Staff) MF 11 and W 4:15–6:05

366. Acoustic Instrumentation I—Basic principles of electronic circuits. Description and application of instrumentation commonly used in speech and hearing sciences. Prerequisite: permission of instructor.

3 units, Aut (——) M 7–10 p.m.

367. Acoustic Instrumentation II—Continuation of 366.

3 units, Win (——) M 7–10 p.m.

370. Clinical Internship—In-service clinical practice and observation in selected speech and hearing centers. Prerequisite: permission of instructor.

2 to 12 units, any quarter (——, Staff) by arrangement

380. Seminar in Audiology—Material will vary from year to year; hence, may be repeated for credit.

4 units, Win (Newby) MF 3:15–5:05
3 units, Sum (Newby) MW 3:15–5:05

381. Seminar in Experimental Audiology—Material will vary from year to year; hence, may be repeated for credit.

4 units, Aut (Dewson) MW 3:15–5:05


4 units, Aut (Schubert) MTWF 11

393. Experimental Audiology II: The Peripheral Mechanism—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. Prerequisite: permission of instructor.

4 units, Win (Dewson) MTWTh 1:15

394. Experimental Audiology III: Central Auditory Mechanisms—Anatomy and physiology of the central auditory system. Demonstration of the electro-physiological research procedures. Prerequisite: permission of instructor.

4 units, Spr (Dewson) MWF 10 and one hour by arrangement

400. Doctoral Research.
1 to 15 units, any quarter (Staff) T 4:15

ANATOMY

Emeriti: Charles H. Danforth, William W. Greulich, Hadley Kirkman (Professors)

Executive Head: To be announced

Professors: Donald J. Gray, Robert S. Turner

Associate Professors: Robert L. Hunter, Donald L. Stilwell, Jr.

Assistant Professors: Doris J. Burda, A. Kent Christensen, Henry J. Ralston III


Lecturer: 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 num-
ber 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. 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

112. Embryology—Lectures on normal and abnormal human development. For medical, graduate, and senior undergraduate students. Enrollment by permission of instructor.

3 units, Spr (Burda) TThF 4:15-5:05

114. Practical Anatomy—Brief survey of human body by dissection, study of anatomical preparations. Lectures, demonstrations. For students of nursing, physiotherapy, hygiene, physical education or others similarly qualified. Cannot be substituted for any part of Anatomy 121.

5 units, Aut (———) TThF 1:15-4:05

121. Dissection of the Human Body—Lectures, demonstrations. A few nonmedical students may be admitted by special arrangement.

3 units, Win (Gray, Peckham, Burda)

Th 1:15-4:05 and S 8:00-11:50

5 units, Spr (Stilwell, Turner, Peckham)

W 2:15-5:05 and TThF 1:15-4:05

122. Normal Histology and Microscopic Anatomy—Elementary structure, activities of the animal cell; histology; development of tissues, their combination into the organs of vertebrates, with special reference to man.

2 units, Aut (Hunter, Christensen, Burda) S 8:00-10:50

2 units, Spr (Hunter, Christensen)

M 2:15-5:05, F 11:00-11:50, and S 8:00-9:50

145. 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 staff.

Any quarter (Staff) by arrangement

201. Topographical Anatomy—Laboratory study of fetal, infantile, adult cadavers; dissected and specially injected preparations, student reports relevant to this material. Prerequisite: 121 and 122.

2 to 5 units, any quarter (Gray) by arrangement

203. Research—By individual arrangement, approved by Department faculty.

Any quarter (Staff) by arrangement

204. Dissection of the Fetus—General introduction to fetal anatomy, or review and intensive study of selected regions. Enrollment limited. Ordinarily, prerequisites: 121 and a course in embryology.

Any quarter (Gray) by arrangement

209. Cell Biology—Lectures on the structure and functions of cells as revealed by electron microscopy and other modern techniques. Prerequisites: some background in histology and permission of instructor.

3 units, Aut (Christensen) TThF 4:15-5:05

211. Chemical Basis of Morphology — A series of lectures and laboratory procedures emphasizing and providing experience in histochemical techniques in combination with starch gel and acrylamide gel electrophoretic methods as tools for the study of the chemical substances that compose cells and tissues.

3 units, Win (Hunter) TThF 4:15-5:05, alternate years, given 1966-67

221. Dissection of the Human Body.

3 units, Aut (Gray, Peckham,———) M 8:00-11:50 and S 9:00-11:50

3 units, Win (Gray, Peckham, Ralston) M 8:00-11:50 and F 8:00-10:50

2 units, Spr (Gray, Peckham, Ralston) S 9:00-11:50
222. Normal Histology and Microscopic Anatomy.
2 units, Aut (Hunter, Christensen, Burda)
F 9:00-11:50

323. Neuroanatomy — Structure of central nervous system of man, dissections, prepared slides, dissections of central nervous systems of other mammals. Prerequisite: 122. Enrollment of nonmedical students by permission of instructor.
5 units, Aut (Turner, Stilwell, Ralston)
MWF 9:00-11:50

BIOCHEMISTRY

Executive Head: Arthur Kornberg
Professors: Robert L. Baldwin, Paul Berg, Arthur Kornberg
Associate Professors: David S. Hogness, A. Dale Kaiser, I. Robert Lehman
Assistant Professors: George R. Stark, Lurbert Stryer

PROGRAMS OF STUDY

The Department offers a first-year course in modern biochemistry which is required of medical students and open to qualified graduate students and senior undergraduates. Also a series of advanced courses are 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, but not the Master's degree. Remission of fees and a personal stipend are available to those students accepted. For further information, applicants should write to Dr. G. R. Stark. 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, and biochemical functions; and in the biochemistry of viral infection.

COURSES

101, 102. Biochemistry Lectures — These deal with basic biochemistry, and with special biochemical aspects of the various life processes. Required of medical students in Year 1, and open to graduate and advanced undergraduate students.
101. 4 units, Aut (Staff) MTWTh 11
102. 4 units, Win (Staff) MTWTh 11

102a. Biochemistry Laboratory—Required of medical students in Year 1, and open to graduate and advanced undergraduate students.
4 units, Win (Staff) MW 1:00-4:50
and T 1:00-3:50

103. 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 through interaction with other molecules, synthesis of nucleic acids and proteins, helix-coil transitions in nucleic acids. Prerequisite: three quarters of organic chemistry; 101, 102 also recommended. Consent of the instructor required both for auditors and students enrolling for credit.
3 units, Spr (Staff) MWTh 10

201. Research and Special Advanced Work.
By arrangement

By arrangement

2 units, Aut (Kaiser)
212. Special Topics in Biochemistry.  
2 units (Lehman) given 1967–68

213. Biosynthesis of Proteins.  
2 units (Hogness) given 1967–68

2 units (Baldwin) given 1968–69

215. Regulation of Macromolecular Synthesis—The course will consist of lecture-discussions of current advances in the regulation of macromolecular synthesis in micro- and higher organisms. Prerequisites: 101, 102.  
2 units, Win (Berg)

217. Physical Chemistry of Proteins.  
2 units (Stryer) given 1968–69

218. Chemistry of Proteins.  
2 units (Stark) given 1968–69

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GENETICS

Executive Head: Joshua Lederberg*  
Professor: Joshua Lederberg  
Associate Professors: Walter F. Bodmer, Leonard A. Herzenberg, Eric M. Shooter  
Assistant Professor: A. T. Ganesan  
Senior Research Associate: Elliott C. Levinthal  
Research Physicist: Sidney Liebes, Jr.


PROGRAMS OF STUDY

In addition to the courses required for the medical students, the Department of Genetics offers advanced courses for undergraduate students; programs of study and research training leading to a Ph.D. in Genetics; and research training to holders of the Ph.D. or M.D. Financial support for predoctoral and postdoctoral trainees is available, including full tuition and personal stipend at current national levels.

The Department of Genetics is particularly interested in applicants for the Ph.D. degree who have proved their outstanding qualifications in chemistry, physics, and mathematics or computation, and have since become interested in fundamental aspects of biology. It is equally interested in students with an undergraduate program in biology who have a strong background in chemistry, physics or mathematics. The Department administers a Ph.D. program of unusual flexibility, especially for students of exceptional capability and with well defined goals, whom it can accommodate regardless of previous formal training in biology. By cooperation with other departments we can promote the attainment of high professional competence in a source field together with the necessary standing in biological theory and technique. Well qualified students are invited to apply to the Departmental executive for further information on these opportunities.

The principal areas for which research training is available at the present time are the function of DNA in bacteria, genetics of antibodies, immunogenetics and somatic cell genetics, the genetic control of human leukocyte antigens, biochemical neurogenesis, the investigation of extraterrestrial life, genetic demography, and population genetics.

The Lt. Joseph P. Kennedy Jr. Laboratories for Molecular Medicine 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. An Instrumentation Research Laboratory, under NASA support, also offers special opportunities in the use of advanced instrumentation, with special emphasis on real-time computer-linked devices. Research in any of the areas indicated can be applied toward the Ph.D. degree in genetics or in other degree programs by individual arrangement.

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 listing of the Department of Biological Sciences.

COURSES

101. Man as Organism—Special undergraduate course (Undergraduates should enroll in Undergraduate Special 101). Impact of new biological knowledge on further evolu-
tion of the human species, the design of human beings. Topics discussed include eugenics, euphonies (control of development), mechanistic foundations of behavior, transplanted and artificial organs, duration of life, symbiosis of men and machines.

1 unit, Aut (Lederberg) TTh 11

103. Physics and Technology of Analytical Instruments—A review of the Physical principles underlying analytical instruments encountered in medical research and applications of these principles to instrumental components and design.

2 units, Aut (Levinthal, Liebes) TTh 4:15

199. Supervised Study.

200. Individual Research.

201. Medical Genetics—Topics in general genetics and their application to human biology and pathology. Nonmedical students who wish to enroll in this course must obtain special permission from the Department of Genetics.

2 units, Win (Staff) ThF 8

202. Medical Genetics — Continuation of 201.

2 units, Spr (Staff) TW 8

249. Cytogenetics—(Enroll in Biological Sciences 249.) Principles and modern methods of analysis of major cellular components. The structure and design of chromosomes from bacteriophages to higher organisms. The influence of chromosomal changes in development and evolution. Prerequisites: Biology 4 and 5 or 10, 11 and 12, knowledge of genetics, and consent of instructor.

3 units, Aut (Ganesan) MWF 10

302. Genetics Seminar.

(Staff) alternate F 4:15


2 units, Win (Herzenberg) T 4:15, alternate years, given 1967–68

307. Genetics and Development — Genetic control of development and differentiation, gene-cytoplasm relationships and cytoplasmic inheritance. Prerequisite: consent of instructor.

2 units, Win (Bodmer) T 7:45 p.m., alternate years, given 1966–67

308. Mathematical Genetics — (Enroll in Mathematics 279a, b.) Mathematical models in population genetics, ecology, population growth, and epidemiology. The first part of the course will deal mainly with deterministic models in population genetics. Prerequisite: consent of instructors.

3 units, Aut, Win (Bodmer, Karlin, McGregor) by arrangement, alternate years, given 1967–68

GYNECOLOGY and OBSTETRICS

Executive Head: Charles E. McLennan
Professor: Charles E. McLennan
Associate Professors: Robert C. Goodlin, Eugene C. Sandberg
Assistant Professors: Allen H. Gates, Emmet J. Lamb
Research Associate: Margaret T. McLennan

PROGRAMS OF STUDY

While the principal instruction in the Department is for students in medicine, candidates for the degree Master of Arts in Medical Sciences may major in Physiology of Reproduction. Candidates will be expected to have completed 45 quarter units, at least 15 units of which shall be from the following courses (or their equivalents): Anatomy 122, 145, 204, 222; Biochemistry 101, 102; Biology 103, 105, 142; Physiology 251; Statistics 50; and 30 units of research in reproduction (Gynecology-Obstetrics 400). Each candidate will be expected to pass an oral examination covering the fundamentals of mammalian reproduction, and submit an acceptable thesis. In addition the University requirements regarding the Master's degree, as given in the section “Degrees” of this Bulletin, must be fulfilled.

COURSES

400. Research in Reproduction—Advanced course for graduate students registered in the School of Medicine, or for students working toward the degree of Master of Arts in Medical Sciences, or toward the Ph.D. under the Graduate Division Special Pro-
grams. Detailed study of particular topics in reproduction planned for the individual student by the appropriate staff member, supervised laboratory experiments. Prerequisites: Biology 12 and 116 or their equivalent.

(Staff) by arrangement

401. Physiology of Reproduction—Open to medical students, upper division students majoring in biology, and graduate students. Limited to 8 students per quarter. Project research in the laboratory. One or two students and a preceptor select and complete a particular project each quarter, or may continue project in subsequent quarters. One 2-hour laboratory period and seminar.

2 units (Staff) by arrangement

MEDICAL MICROBIOLOGY

Emeriti: Edwin W. Schultz (Professor); Helen S. Thayer (Instructor)
Executive Head: Sidney Raffel
Professors: Charles E. Clifton, Sidney Raffel, Carlton E. Schwerdt, Bruce A. D. Stocker
Associate Professor: Robert J. Roantree
Assistant Professor: Leon T. Rosenberg

PROGRAMS OF STUDY

The Department of Medical Microbiology offers, in addition to the courses required of students of medicine, a group of courses for students who wish to specialize in various aspects of medical microbiology. An undergraduate program leading to the degree of Bachelor of Arts in Medical Microbiology is offered to seniors who have completed all of the essential premedical sciences (Biological Sciences, 15 quarter units; Chemistry, 24 quarter units; Physics, 12 quarter units), as well as Quantitative Analysis (Chemistry 110, 111). The following courses in the Department are normally covered during the senior year: Medical Microbiology 101, 225, 231, 238, 240, 315; in addition, Biochemistry 101 and 102 are required. Students who fall below an average grade of C in Departmental subjects completed will become ineligible for more advanced courses.

ADVANCED DEGREES

MASTER OF ARTS

Preference in selection of students for available places is given to candidates for the Ph.D. degree. Candidates for the degree of Master of Arts will be expected to have completed the premedical requirements (see above) and Quantitative Analysis (Chemistry 110, 111), and to complete the following courses: Medical Microbiology 101, 225, 231, 238, 240, 315, and Biochemistry 101, 102. (Biochemistry 102a may be taken depending upon individual interests.) At least 15 units of research work bearing on the thesis subject must be completed. A grade average of B in Departmental courses is required for admission to thesis work. Each candidate is expected to pass an oral examination of two hours' duration covering the fundamentals of medical microbiology, immunology, and virology at the end of the first year of work. A reading knowledge of French or German is required.

DOCTOR OF PHILOSOPHY

Candidates for the degree of Doctor of Philosophy must meet the same preliminary requirements as listed for the Master's degree and will follow such courses as are approved by the major professor and the Department faculty, subject to general University regulations covering this degree. The following courses should be included in the first year or two of graduate work, if the equivalents were not included in the undergraduate program: Biology 124, 129, 248; Biochemistry 101 and 102; completion of the foreign language requirement (one language). The following courses are recommended depending upon the field of major interest of the candidate: Anatomy 112, 122 (or Biology 103); Biochemistry 102a; Basic Medical Sciences 102 or Chemistry 171, 173, 175; Mathematics 10, 11, 21, 22, 23; General Human Pathology (autumn, winter, and spring quarters, Wednesday 9–12); and Psychology 60 or Statistics 50.

A grade average of B in Departmental and related subjects is required for admission to research work. In addition to this, the student is expected to pass an oral examination covering the fundamentals of general and medical microbiology, immunology and virology toward the end of his
first year of graduate work. Students who enter the Department with advanced standing in microbiology from other institutions are expected to take the final examination in Course 225, and in such other courses as may be stipulated, at the earliest time these examinations are regularly scheduled. In addition, such students are also required to pass the oral examination during their first year of residence.

**Courses**

101. General Bacteriology—Survey of fundamental aspects of bacteriology. Prerequisites: Biology 4, 5, and Chemistry 1, 2, 3.

5 units, Aut (Clifton, Staff), MWF 1:15; lab. MWF 2:15-4:05

121. Basic Medical Microbiology—An introduction to the principles of immunology, primarily for first-year medical students.

2 units, Spr (Staff) T 1:15-4:05 and W 1:15

225. Medical Microbiology—A course of lectures and laboratory exercises covering the fundamentals of pathogenic bacteriology, with particular reference to the bacteria and viruses of importance in infectious diseases of man. The course includes a discussion of the essential aspects of immunology and serology, of practical laboratory diagnosis, and of preventive measures. Prerequisites: required premedical sciences and 101, and 221 or 231.

5 units, Spr (Staff) M 8-12 and ThF 9-12

231. Immunology and Serology—Lectures, demonstrations covering infection, immunity, antigen-antibody reactions. Prerequisites: 101 or 225, Biology 103, and Biochemistry 101.

3 units, Win (Raffel, Roantree, Rosenberg) MW 1:15 and F 2:15

231a. Immunology and Serology Laboratory.

3 units, Win (Raffel, Roantree, Rosenberg) MW 2:15-5:05 and F 3:15-5:05

238. Bacterial Physiology—Lectures on physical and chemical aspects of bacterial growth, behavior. Prerequisites: 101 and Biochemistry 101.

5 units, Spr (Clifton) MTWThF 1:15

240. Virology—Lectures, demonstrations on general nature of plant, animal viruses, their relationships with their hosts. Prerequisites: 101 and 231, and Biochemistry 101.

3 units, Win (Schwerdt) TThF 1:15

240a. Virology Laboratory.

2 units, Win (Schwerdt) TTh 2:15-5:05

250. Advanced and Special Work—Students who have completed necessary basic courses with satisfactory grade average may be admitted by instructor to advanced work on informal basis in: (a) general bacteriology, including bacterial physiology; (b) medical bacteriology; (c) immunology and serology; or (d) virology. Grade average of B in bacteriological subjects required for admission to research or thesis work.

5 to 10 units, any quarter (Clifton, Raffel, Roantree, Rosenberg, Schwerdt, Stocker) by arrangement

300. Research—Students who have satisfactorily completed necessary foundation courses may elect research work in: (a) general bacteriology, including bacterial physiology; (b) pathogenic bacteriology; (c) immunology and serology; or (d) virology. Grade average of B in bacteriological subjects required for admission to research or thesis work.

5 to 10 units, any quarter (Clifton, Raffel, Roantree, Rosenberg, Schwerdt, Stocker) by arrangement

315. Seminar—Reports, discussions on selected topics. Required of all graduate students.

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

316. Literature Reviews—Review of literature on special topics to be assigned by instructor.

3 to 5 units, any quarter (Clifton, Raffel, Roantree, Rosenberg, Schwerdt, Stocker) by arrangement

333. Current Topics in Immunology—An intensive review of the current literature in one or a few selected areas of interest chosen from among the following: specificity, immunogenicity, genetic variants of serum proteins, tissue specific antigens. Prerequisite: permission of the instructor.

2 units, Win (Raffel, Roantree, Rosenberg) by arrangement
PATHOLOGY

Executive Head: To be announced
Professors: David Glick, Lelland J. Rather, Lucien J. Rubinstein
Associate Professor: Bruno Gerstl
Assistant Professors: Jon C. Kosek, Robert C. Rosan, Alexander M. Saunders, Lloyd Silverman
Instructors: Luis F. Fajardo, Lysia S. Forno.
Acting: Robert E. Smith

PROGRAM OF STUDY

The teaching of the Department is limited largely to the instruction of medical students, and is outlined in the School of Medicine Bulletin. The course listed below is open to nonmedical students.

Course

210. Histo- and Cytochemical Techniques — Diverse experimental techniques employed in histo- and cytochemical investigation will be considered with particular emphasis on quantitative aspects. Principles, methods, areas of application, and limitations will be included.

1 unit, Win (Glick, Staff) M 12:15

PHARMACOLOGY

Emeritus: Leon Kolb (Clinical Associate Professor)
Executive Head: Avram Goldstein
Professors: Robert H. Dreisbach, Avram Goldstein, Tag E. Mansour
Associate Professors: Lewis Aronow, Sumner M. Kalman, Keith F. Killam, Jr., Robert T. Schimke
Assistant Professors: Anthony J. Hance, Ernest F. Zimmerman

PROGRAMS OF STUDY

The principal instruction offered by the Department of Pharmacology is for students in medicine. However, the required courses for medical students (Pharmacology 101, 201, 301) and elective courses are also open to qualified graduate students not registered in medicine. Programs leading to the degree of Doctor of Philosophy must be worked out by each student with the Department faculty. Candidates for the degree of Master of Arts are not accepted. Research opportunities are available for qualified students and for postdoctoral fellows. Prospective candidates for an advanced degree should consult the University's general requirements described in the section "Degrees" in this Bulletin, and obtain further information from the Department. Consult Time Schedule for additional elective courses.

COURSES

REQUIRED COURSES


1 unit, Win (Staff) F 11
2 units, Spr (Staff) TTh 11

201. Pharmacology—Lectures and demonstrations. Drugs acting on renal, endocrine, reproductive, and other systems; general pharmacology; toxicology; chemotherapy of infectious disease.

2 units, Aut (Staff) TW 8
2 units, Win (Staff) TW 8
2 units, Spr (Staff) ThF 8

301. Pharmacology — Lectures and laboratory exercises. Problems of drug evaluation.

3 units, Win (Staff) M 8–12 and T 11

Neurological Sciences — Neuropsychology and psychopharmacology are taught in the winter and spring quarters in the interdepartmental course Neurological Sciences, described in the School of Medicine Bulletin.

ELECTIVE COURSES

203. Cellular Regulatory Mechanisms in Carbohydrate Metabolism — A course of lectures and discussions on the different regulatory processes which keep the carbohydrate catabolic reactions in the cell in pace with its energy requirement; the effect of different hormones on the carbohydrate metabolism at the cellular and subcellular level. Prerequisite: Biochemistry 101 (first quarter) or equivalent.

1 unit, Win (Mansour) T 4:15
204. Recent Advances in Molecular Pharmacology — Assigned readings and discussion of selected topics in the recent literature. Students should be conversant with modern biochemistry and genetics, and should have taken (or be taking) courses in physiology and general pharmacology.

1 unit, Spr (Goldstein) W 4:15, given 1967–68

205. Drug Metabolism — Lectures and discussions on the metabolic conversions of foreign compounds in the mammalian organism, including factors such as species, age, and genetic variability.

1 unit, Win (Aronow) T 4:15, given 1967–68

207. The Anti-Cancer Drugs — (Same as Radiology 207.) A joint course offered by the Departments of Pharmacology, Radiology, and Medicine. The biochemical basis of action of the anti-cancer drugs will be developed in detail, and current research trends (including clinical aspects) will be discussed by invited lecturers. Open to medical staff, and advanced medical and graduate students.

2 units, Spr (Staff) W 7:30–9:30 p.m.


1 unit, Spr (Killam) T 4:15

213. The Use of Drugs in Population Control — Lectures and seminar discussion about population growth and its control through the use of pharmacological agents.

2 units, Aut (Kalman) T 4:15–6:05

214. Regulation of Calcium Transfer in Biological Systems.

1 unit, Aut (Dreisbach) T 4:15, given 1968–69

215. Antibiotics — Discussion of the mechanism of action, with special emphasis on antibiotics which have been used to elucidate specific biochemical pathways.

1 unit, Aut (Zimmerman) T 4:15, given 1967–68

250. 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

252. Research Methods in Pharmacology — Training in laboratory techniques applicable to pharmacological research. Primarily for graduate students in pharmacology.

Any quarter (Staff) by arrangement

259. Research Seminar — A weekly conference for discussion of current research in pharmacology.

1 unit, any quarter (Staff) by arrangement

300. Research — With the approval of the Department qualified students may elect research work in any area of pharmacology.

Any quarter (Staff) by arrangement

PHYSIOLOGY

Emeritus: James P. Baumberger (Professor)

Acting Executive Head: F. Eugene Yates

Professors: Jefferson M. Crismon, Ronald Grant, Leo A. Sapirstein (Physiology in Radiology)

Associate Professors: George A. Feigen, F. Eugene Yates

Assistant Professors: Julian M. Davidson, David F. Lindsay, Geronimo Terres, Jr.

Lecturer: 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 graduate students. In addition, the department offers two advanced laboratory courses restricted to Ph.D. candidates in physiology.

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: Biochemistry 101 and 102 (without laboratory), Physical Chemistry (Chemistry 171 and 173, or Physiology 102), and Physiology courses 150, 151, 250, 251, 350, 351, 310, and 311. In addition, students will take any three of these Physiology courses: 300, 301, 302, 303, 305, 306, 307, 308, and 309. Other courses in computer science, mathematics, statistics, chemistry, physics, biology, or engineering may be arranged by agreement between the student and his faculty supervisor, but they are not required.

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 or teaching assistantships are occasionally available to graduate students who have completed substantial work toward the Ph.D. degree in physiology. Tuition aid may be awarded to students holding research assistantships, and to a few first-year students.

Support for qualified students in years two through four may be applied for from the National Science Foundation and the U.S. Public Health Service.

COURSES

102. Biophysical Chemistry — (Same as Basic Medical Sciences 102 in the School of Medicine curriculum.) Lectures in chemical thermodynamics, phase equilibria, kinetics, transport phenomena, and the physical chemistry of macromolecules.

4 units, Aut (Yates, Terres, Interdepartmental Staff) Th 2-4 and F S 11

150. Muscle Nerve — Lecture course on muscle contraction and membrane excitability.

1 unit, Win (Grant) F 1


3 units, Spr (Crismon, Sapirstein)
M 11, M 1, and W 11

207. Research — Original laboratory research planned for individual students by the appropriate staff member and carried out under his guidance. Maximum 14 units in any one quarter. Open to graduate students only.

Any quarter (Staff) by arrangement

250. Control of Fluid Environment — Lectures, laboratories, and demonstrations in respiration, circulation, renal function, and acid-base balance.

5 units, Aut (Staff) W Th 8-12, S 8

251. Endocrinology and Gastrointestinal Function — Lectures on gastrointestinal function and the endocrine regulation of metabolic pathways.

3 units, Win (Davidson, Yates, Staff)
Th 9-12 and S 8

300. Central Nervous System and Behavior — Lecture and discussion course dealing with selected topics related to the brain and the role of the brain in the control of behavior. Topics will be selected on the basis of their interest to the group, and their perti-
nence to present-day neurophysiology and behavioral neurophysiology. Prerequisites: Physiology 350, 351, and Anatomy 323, or permission of instructor.

2 units, Spr (Lindsky) Th 7:30–9:30 p.m., biennially, given 1967–68

301. Peripheral Circulation—Lectures and demonstrations on regulation of the peripheral circulation with emphasis on special features of the circulation in man. Prerequisites: Physiology 150 and 151, or equivalent.

3 units, Aut (Crismon) W 4–6 and F 4, triennially, given 1966–67


3 units, Aut (Thompson) W 4–6 and F 4, biennially, given 1967–68

303. Physiological Control Systems—A lecture course for biologists on the systems analysis approach to selected physiological systems under negative feedback control. Examples for detailed analysis include regulation of arterial pressure, alveolar ventilation, adrenocortical function and pupillary area. The course includes a discussion of time bases ("biological clocks"). Use of the analog computer in the study of physiological processes is demonstrated. Prerequisites: Physiology 150, 151, 250, 302, and one year of calculus.

3 units, Win (Yates) W 4–6 and F 4, biennially, given 1967–68

304. Immunophysiology Laboratory — A laboratory course in quantitative immunophysiology emphasizing basic immunological phenomena such as isolation and preparation of purified antigens and antibodies, quantitative analysis of specific precipitates, immunoelctrophoresis, immune hemolysis, isotopic labeling, identification of reactants by gel diffusion; quantitative tissue anaphylaxis. Limited to 15 students. Prerequisite: Biology 105 or consent of instructor.

4 units, Aut (Feigen, Terres) M 4:15; lab. Th 9:00–4:05

305. Circulation—Recent developments in cardiovascular physiology. Special emphasis will be placed on problems of regional blood flow measurement, analysis of disappearance curves of injected materials, and transcapillary transfers. No formal laboratory will be offered, but interested students will have the opportunity to participate in experiments on these and related subjects in the Palo Alto–Stanford Hospital. Prerequisites: Physiology 150, 151, 250, 251, and calculus.

2–5 units, Aut (Sapirstein) T 7:30–9:30 p.m., triennially, given 1966–67


2 units, Spr (Feigen) T 7:30–9:30 p.m., triennially, given 1967–68

307. Neurophysiology — Consideration in depth of selected aspects of central nervous system physiology. New concepts as well as new research data will be examined. Topics to be discussed will be announced in the previous quarter and students will be expected to have read much of the relevant literature before class begins. Prerequisites: completion of Physiology 350 and 351.

2 units, Win (Grant) T 7:30–9:30 p.m., triennially, given 1967–68

308. Neuroendocrinology — 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 adenohypophyseal function; behavioral aspects of neuroendocrinology will also be treated. Prerequisites: Physiology 251, 350, 351, and Anatomy 323, or permission of instructor.

2 units, Spr (Davidson) T 7:30–9:30 p.m., biennially, given 1966–67

309. Respiration — A lecture course designed to cover recent advances in mammalian respiration. Emphasis will be placed on the structure and function of hemoglobin, control of respiration, and environmental adaptation. Prerequisite: Physiology 250.

2 units, Spr (Terres) Th 7:30–9:30 p.m., triennially, given 1966–67
310. **General Physiology** — A quantitative, experimental approach to problems in thermodynamics, kinetics, transport, and bioelectric phenomena. Restricted to Ph.D. candidates in physiology.

2 units, Win (Feigen, Terres) TTh 2-5

311. **Advanced Mammalian Physiology** — Experimental investigation of interactions of organ systems; adaptation. The course introduces the student to modern techniques of surgery, instrumentation, analog modeling of systems, and data reduction in various fields of physiology. Prerequisite: Physiology 310.

4 units, Aut (Crismon, Grant, Staff) ThF 1-6, given 1967-68

350. **Neurological Sciences** — Lectures and demonstrations. (Same as Medicine 300 in the School of Medicine curriculum.)

3 units, Aut (Grant, Lindsley, Interdepartmental Staff) S 8-11

351. **Neurological Sciences** — Continuation of 350, with laboratory.

6 units, Win (Grant, Lindsley, Interdepartmental Staff) WS 8-12
BIOPHYSICS PROGRAM

Advisory Committee
Chairman: Mitchel Weissbluth

Professors: Robert L. Baldwin (Biochemistry), Hubert Heffner (Electrical Engineering, Applied Physics, Associate Provost for Research), Donald Kennedy (Biology), Joshua Lederberg (Genetics, Biology), Harden M. McConnell (Chemistry), Joseph M. Pettit (Electrical Engineering; Dean, School of Engineering), Leonard I. Schiff (Physics)

Associate Professor: Marsden S. Blois, Jr. (Dermatology)

Affiliated Faculty
Associate Professors: Philip C. Hanawalt (Biology), Kendric C. Smith (Radiology)
Assistant Professor: Mitchel Weissbluth (Radiology, Director of Biophysics Laboratory)

Lecturers and Research Biophysicists:
Earl E. Jacobs, Howard H. Pattee
Research Associate: John E. Maling

OFFERINGS AND FACILITIES

The Biophysics Program offers instruction and research opportunities leading to the degree of Doctor of Philosophy in Biophysics. Students admitted to the Program may perform their graduate research in the Biophysics Laboratory or, through special arrangements, in other University departments.

The Laboratory has its own library and research facilities for staff and students. Opportunities for research are currently available in the fields of electron paramagnetic resonance spectroscopy, X-ray microdiffraction, partial cell irradiation, cellular control mechanisms, physical chemistry of bacterial DNA during the growth cycle, molecular photobiology, abiotic molecular evolution, thermoluminescence, Mossbauer resonance, photosynthesis, mitochondrial electron transport and oxidative phosphorylations, magnetic and optical properties of metallo-proteins, theoretical biophysics.

PROGRAM OF STUDY

The program is designed for graduate students only, and leads to the degree of Doctor of Philosophy in Biophysics. The requirements for the degree are as follows:

1. Training in physics equivalent to that of an undergraduate physics major at Stanford. Students with a comparable background will automatically satisfy this requirement; others will need to take only those courses in which deficiencies exist.

2. A graduate minor in one field selected from biology, chemistry, or physics. The requirements for the minor, as specified by the respective departments, are as follows:

   a) Minors in physics must take either Physics 210, 211, and 212 or Physics 130, 131, and 132, with the appropriate prerequisites. All physics minors must pass the comprehensive examination given to physics majors, but need take this examination only when they feel prepared for it.

   b) Minors in chemistry must complete, with a grade point average of 3.00 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, 233, 235, or 272.

   c) Minors in biology must complete the Departmental course requirements for the Ph.D. degree with a 3.00 average, or must pass the Departmental qualifying examination.

Students may petition for permission to substitute other fields of specialization (e.g., mathematics, electrical engineering) to satisfy the requirements of the minor.

3. Completion of the following courses with a grade point average of 3.00 or better:

   a) Chemistry 171, 173, 175.
   b) Biochemistry 101, 102, 102a.
   c) Biology 113a, 114.
e) Four units of any other life science courses which include laboratory work.

4. Reading ability in one language selected from French, German, or Russian.

5. After fulfilling the above requirement, each student must pass a comprehensive examination based primarily on course material. He may then apply for Ph.D. candidacy.

6. Each student is required to pass the University oral examination which is to be taken only after the student has substantially completed his research.

7. The satisfactory completion of research and acceptance of the resulting dissertation conclude the requirements.

COURSES

200. Molecular Biophysics — A survey of physical approaches to biological problems at the molecular level. Lectures include discussion of intra- and intermolecular forces and their relation to biological structure, physical methods for characterizing macromolecules, the interaction of electromagnetic radiation with biological molecules, isotopic tracer techniques, and classical physics of cellular processes. Assigned readings and problems. Prerequisites: Biology 10, Chemistry 121, and Physics 57, or permission of instructor.

3 units, Aut (Hanawalt) TTh 10, T 7:15 p.m.

220, 221. Energy, Entropy, and Information — A rigorous analysis of the energy, entropy, and information transformations accomplished by living organisms. The lectures will include a generalized theoretical development of the fundamental principles of energy, entropy, and information transformations in open systems and their application to the detailed reactions of cell metabolism and to the origin and evolution of complex chemical systems and life. Prerequisite: permission of instructor.

220. 3 units, Win (Jacobs) by arrangement
221. 3 units, Spr (Jacobs) by arrangement

230, 231, 232. Advanced Molecular Biophysics — Properties of biological molecules from the standpoint of quantum mechanics. Molecular orbitals, ligand fields, group theory, interpretation of spectra, magnetic properties, electron spin resonance, interaction with radiation, mechanisms of energy and charge transfer. Prerequisite: Physics 132 (may be taken concurrently).

230. 2 units, Aut (Weissbluth) MW 1:15
231. 2 units, Win (Weissbluth) MW 1:15
232. 2 units, Spr (Weissbluth) MW 1:15


3 units, Spr (Pattee) MWF 1:15


1 unit, Spr (Pattee) by arrangement

250. Molecular Photobiology — Lecture topics include photochemistry of molecules of biological interest, effects of ultraviolet light on simple biological systems, photoreactivation, photodynamic action, etc.

2 units, Spr (Hanawalt, Smith) W 11–1

252. Radiation Biology — (Enroll in Radiology 14.) Radiological physics, target theory and other mechanisms of biologic action, radiochemistry and radiation biochemistry, cellular radiobiology, general and special radiation pathology, acute lethal and immunological effects of whole-body exposure, genetic effects of radiation, relative biological effectiveness (RBE) as a function of linear energy transfer (LET), recovery kinetics, radiation carcinogenesis and other late effects, and applications of radiobiology to clinical radiotherapy.

2 units, Win (Kaplan) T 1–3

255. Biophysical Measurements — A course covering the underlying theory, experimental procedures, and methods of interpretation of modern biophysical instruments and techniques. The staff will arrange instruction on two or three of the following topics
each year: electron paramagnetic resonance, infrared spectroscopy, electrochemical measurements, chromatography, optical microscopy, microdensitometry, spectrofluorimetry, radioactive tracer methods, ultracentrifugation, ultraviolet spectroscopy, and computer techniques.

Any quarter (Pattee, Staff) by arrangement


2 units, Win (Pattee) by arrangement

300. Research.

Any quarter (Staff) by arrangement

310. Literature of Biophysics — Intensive study of literature of any special topic in biophysics. Preparation of a report.

Any quarter (Staff) by arrangement

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**COMPUTATION CENTER**

*Director:* Edward A. Feigenbaum  
*Associate Director for Campus Service Facility:* Roderic M. Fredrickson  
*Associate Director for the Linear Accelerator Facility:* Robert T. Braden  
*Associate Director for the Medical Facility:* Gio Wiederhold  
*Associate Director for Business Affairs:* Robert J. Langle  
*Research Associates:* Robert T. Braden, Kenneth M. Colby, Roger Hockney, Harwood Kolsky  
*Affiliated Faculty:*  
  *Professors:* George E. Forsythe, John G. Herriot, William Miller  
  *Associate Professors:* Edward A. Feigenbaum, Gene Golub, Peter Winters  
  *Assistant Professor:* Niklaus Wirth

The Stanford Computation Center was established in 1953 to provide high-speed electronic digital computing facilities for research work at the University. Its present mission is to provide University-wide service for both education and research at its main campus facility. In addition, it is responsible for systems and operations management of the ACME Medical Research facility at the Medical School, and the large facility for high energy physics calculations located at the Linear Accelerator site. The campus facility is available to University staff members in connection with research work and to students in connection with Stanford courses.

The Computation Center is housed in Pine Hall and Polya Hall in the Jordan Science Quadrangle. Equipment operated by the Computation Center at its general campus service facility in Pine Hall includes: an IBM 7090 with drums, discs, and tapes, supported by an IBM 1401 and a CDC 8090 (peripheral computers); a Burroughs B5500 with disc and tapes; a Digital Equipment PDP-1, operated in time-shared mode using 12 teletypewriters, and 12 high-performance Philco READ cathode ray tube display units with keyboards. The PDP-1 is connected to the 7090 for break-in service. Half of the PDP-1 time-shared consoles provide the technological base for an advanced research laboratory for computer aided instruction. The laboratory is part of Pine Hall.

Computing languages used at Stanford include a variety of dialects of ALGOL, as well as LISP, FORTRAN, COBOL, and others.

It is the aim of the Computation Center to render every assistance in use of the facilities. Advice and counsel in programming and computer problem-solving are generally available from staff members. It is nevertheless expected that all users will do their own programming and adapt any available programs to the solution of their own problems.

**INSTRUCTION**

At various times throughout the year, the Computation Center offers short courses in the use of the major programming languages
current at Stanford. In addition, where special requirements exist for computer education in various areas, the Computation Center is prepared to offer a course to meet these requirements.

1. Introduction to a Problem-Oriented Language—ALGOL, FORTRAN, PL/1, LISP, etc. This course is offered several times a year for those persons desirous of solving their own problems at the Computation Center.

No credit, any quarter (Staff) by arrangement; usually meets 2 hours per day for one week, as announced, with two weeks of informal supervised programming laboratory. Contact the Computation Center to register for this. Do not register officially with the Registrar.

Other introductory courses:
Introduction to Programming Languages—see Computer Science 5, 6, 126, 136, 238.

FOOD RESEARCH INSTITUTE

Emeriti: Merrill K. Bennett, Karl Brandt, Joseph S. Davis, S. Daniel Neumark, E. Louise Peffer, Vernon D. Wickizer, Holbrook Working (Professors)

Director: William O. Jones

Professors: Helen C. Farnsworth, Roger W. Gray, Bruce F. Johnston, William O. Jones

Assistant Professor: Victor C. Uchendu


Associate Statistician: Rosamond H. Peirce

Librarian: Charles C. Milford.

OFFERINGS AND FACILITIES

The Food Research Institute endeavors to familiarize graduate students with both the methods and results of its long research into problems of food supply, distribution, and consumption. A number of specialized courses of instruction, some of them unique in character, are offered. In addition to the courses given in the Food Research Institute, students enrolled there are required to enroll in approved courses in other departments, and Ph.D. candidates are required to complete an approved program in the Department of Economics.

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 special programs in other social sciences.

The graduate program is designed especially for students who plan careers in research into the economics of food and agriculture, whether in universities, governments, or private business. Students presenting evidence of high ability together with appropriate training, such as a Bachelor's degree or better, in economics or agricultural economics, may be accepted for graduate study in the Institute, leading to the degrees of Master of Arts and Doctor of Philosophy.

The Institute's specialized library contains some 50,000 items, including up-to-date series of rare periodicals from over fifty countries, and is open for reference to students and others.

The Institute publishes a journal, Food Research Institute Studies, three times a year, which serves primarily as an outlet for staff research in progress.

MASTER OF ARTS

The requirement for the Master's degree is the satisfactory completion of an approved program of study amounting to not less than 45 units of credit.

DOCTOR OF PHILOSOPHY

Doctoral candidates are required to offer a minor in economics, statistics, or an approved equivalent.

A candidate must demonstrate a reading knowledge of two approved languages, other than English, or he must demonstrate a reading knowledge of one language and offer an approved 15-unit program in mathematics, statistics, or other area in lieu of the second foreign language.
FELLOWSHIPS AND SCHOLARSHIPS

The Food Research Institute has available a limited number of fellowships and scholarships for qualified students. University fellowships, in addition, are open to all students. Applications for all fellowships and scholarships should be made to the Admissions Office, Stanford University.

COURSES

103. Economics of Food Consumption — (May be taken as 203 by graduate students.) Food supplies and requirements in a developing economy; the major food groups, international contrasts and trends in food-consumption patterns; interrelations of food, population, and economic progress.

5 units, Aut (Johnston) MTWThF 11

105. Commodity Futures Markets and Prices—(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. The level of use of a market in relation to its usefulness to traders and the kind of hedging that is practicable. Others functions and uses of the markets. The forecasting of commodity prices. Consideration of some of the reasons for using or not using futures markets, and some alternatives to hedging.

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

130. International Commodity Trade — (May be taken as 230 by graduate students.) Economics of world commodity trade. Issues and problems with special reference to trade between developing areas and the advanced countries. Terms of trade measurement and analysis.

5 units (Staff) by arrangement

134. Economics of American Agriculture — (May be taken as 234 by graduate students.) The structure and organization of American Agriculture. Economic analysis and policy problems.

5 units (Staff) by arrangement

160. Economic Development of Tropical Africa—Traditional organization of production and distribution, economic achievements under European rule, economic problems of political independence. Food and agricultural economies, internal and external trade, levels and standards of living, national accounts, development plans, and capital formation.

5 units, Win (Jones) MTWThF 11

COURSES PRIMARILY FOR GRADUATE STUDENTS

203. Economics of Food Consumption — See 103.

5 units, Aut (Johnston) MTWThF 11

205. Commodity Futures Markets and Prices—See 105.

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


3 units, Spr (Jamison) T 4:15-6:05

230. International Commodity Trade—See 130.

234. Economics of American Agriculture—See 134.

250. Methods of Analyzing Commodity Problems — Sources and selection of basic data on commodity production, trade, stocks, utilization, and prices; rough tests of completeness and of comparability over time; methods of rough adjustment of commodity series; construction and use of “food balance sheets”; selected examples of economic problem solving, with special reference to primary food commodities. Prerequisites: Economics 1 and Statistics 7 or equivalent of both.

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

260. Seminar: Contemporary African Problems—Reports and discussion of current research into economic problems of tropical Africa in the 1960’s. Seniors admitted with permission of instructor.

3 units, Spr (Jones) T 4:15-6:05

303. Seminar: Food Supply and Agriculture in Relation to Economic Growth—Primarily for second-year graduate students in the Food Research Institute. Prerequisite: Food Research 203 or permission of instructor.

3 units, Win (Johnston) by arrangement
305. Seminar: The Economic Theory of Futures Trading—Consideration of conflicting theories of futures trading, the functions and performance of futures markets, and the evidence to support the theories.

3 units, Win (Gray) by arrangement

350. Seminar: International Commodity Problems and Politics — Prerequisite: permission of instructor.

2 units, Spr (Farnsworth) by arrangement

371, 372, 373, 374. Directed Reading and Research.

371. 3 units, Aut (Staff) by arrangement
372. 3 units, Win (Staff) by arrangement
373. 3 units, Spr (Staff) by arrangement
374. 3 units, Sum (Staff) by arrangement

401, 402, 403, 404. Advanced Directed Reading and Research.

401. 3 units, Aut (Staff) by arrangement
402. 3 units, Win (Staff) by arrangement
403. 3 units, Spr (Staff) by arrangement
404. 3 units, Sum (Staff) by arrangement

GRADUATE DIVISION SPECIAL PROGRAMS

Dean of the Graduate Division: Virgil K. Whitaker
Associate Dean: Robert M. Rosenzweig

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 well-qualified graduate student who has already been admitted to a department or school of the University and enrolled therein.

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 professor qualified to give him guidance. The professor, if he believes the program desirable, will gather a special committee consisting of at least three other members of the Academic Council who represent the student’s various fields of interest. Included in the advisory 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 the Graduate Division:

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 the Graduate Division, the special committee will supervise the candidate’s work and sign the forms ordinarily transmitted by major departments. The chairman of the special 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 Fellows. 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

340. The Human Potentiality — An inquiry directed to the question what is the nature of man's highest potentiality and how does he move in the direction of its realization. Points of view taken from the fields of the biological and social sciences, dynamic psychology, parapsychology, literature and philosophy, and various religious teachings will be compared and evaluated in group discussion. Enrollment limited to 15.

2 units, Aut, Win, Spr (Harman) MW 4:15-6:05

The following courses, though given within the departments listed, may be taken by any interested graduate students:

**COMPUTER SCIENCE**
126. Computing for Nonscientists.
136. Introduction to Algorithmic Processes.

**EDUCATION**
200. History of Education.
206a. Comparative Education.
206b. Comparative Education.
220. Introduction to Public School Administration.
299. Children's Literature.
308. Introduction to American Higher Education.
315. Cultural Transmission.
325. School Planning.

**ENGLISH**
204. Advanced Exposition.
208. Introduction to Modern Linguistics.
270. Contemporary American Fiction.
278. Popular Ballad and Folksong.
303. Seminar in Tragedy.

**FOOD RESEARCH INSTITUTE**

**GEOLOGY**
287. Minerals, Politics, and Economics.

**INDUSTRIAL ENGINEERING**
229. Engineering Economy.

**INTERNATIONAL STUDIES**

The Committee on International Studies coordinates resources for regional and comparative studies at Stanford, and inquiries about opportunities in the international field may be addressed to the CIS, Room 205, Building 10A, Stanford University, Stanford, California 94305. Virtually all area-related courses are offered by individual schools and departments and are listed thereunder in this *Bulletin*. A special program leading to the A.M. in Latin American Studies is described under that heading.

Interdisciplinary faculty committees on African Studies, East Asian Studies, and Latin American Studies coordinate and enrich University resources for the study of their respective regions. Members of these committees stand ready to counsel students who wish to emphasize one of these regions in their graduate or undergraduate programs to complement a departmental specialization. In some instances, special fellowship support is available. Inquiries about area-related opportunities may be addressed to the relevant committee c/o CIS.

No Ph.D. is offered in area studies, but a qualified doctoral candidate will be assisted in designing a cross-disciplinary program focused on the region of his interest. The Graduate Division Special Ph.D. Program outlined at the beginning of this section enables a student to pursue a doctoral program in the area of his special interest, if that interest cannot be accommodated within a regular departmental Ph.D. program.
HOOVER INSTITUTION
on WAR, REVOLUTION, and PEACE

Emeriti: Harold H. Fisher, Ralph H. Lutz (Chairmen); Joseph S. Davis, Edgar E. Robinson, Graham H. Stuart (Councilors)

Director: W. Glenn Campbell

Assistant Director and Professor: Witold S. Sworakowski

Executive Assistant to the Director: Alan H. Belmont

International Political Studies Program Director: Stefan T. Possony

African Studies Program Director: Peter Duignan

Senior Staff Members: Milorad M. Drachkovitch, Roger A. Freeman

Senior Research Fellow: Karl Brandt

Research Fellows: Theodore Draper, Ladis K. D. Kristof, Bertram D. Wolfe


Head, Publications Department: Karol Mai- chel

Editor: Carole Norton

Curators: Clarence C. Clendenen (Military Collection), Dennis J. Doolin (East Asia Collection), Peter Duignan (Africa Collection), R. W. Lyman (Honorary Curator, British Labor Collection), John T. Ma (East Asia Collection), Karol Mai- chel (East European Collection), Philip T. McLean (Special Collections), Boris I. Nicolaevsky (Nicolaevsky Collection), Agnes F. Peterson (Western European Collection), George S. Rentz (Middle East Collection). Deputy Curators: Anna M. Bourguina (Nicolaevsky Collection), Lewis H. Gann (Africa Collection), Tamotsu Takase (East Asia Collection)

Archivist, Herbert Hoover Archives: Rita R. Campbell

Librarian, Western Language Collections: Kenneth M. Glazier

Assistant Librarian for Technical Services: Joseph W. Bingaman

Since its founding by Herbert Hoover in 1919 as a special collection dealing with the causes and consequences of World War I, the Institution has become a national and international center of documentation and research on problems of political, economic, and social change in the twentieth century.

The world-wide coverage of the Institution's collections gives them special value in this period when so many problems are international in scope. While each of the major area collections (Western Europe, Eastern Europe, East Asia, Africa, and the Middle East) 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 the major upheavals of the contemporary world.

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.

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 research 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 research, that is, with studying problems where the findings can make important contributions to national policy. Since 1919 over 100 volumes have been published by the Institution and several major new projects are under way; for example, a history of the Communist International, studies of Communist activity in Africa, and monographs on Communist China as an economic power.

In addition to its own research staff, the Institution has been used continually by
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.

In these ways, by acquisitions, by research, by publications, and by fellowships, the Institution carries out its functions of collecting the living documents of international affairs, organizing and making them available for use, fostering their utilization, and encouraging and aiding the spread of knowledge.

The Institution also offers a limited instructional program.

**SEMINARS**

141. Eastern Europe Since 1945 — Analysis of events in the “Soviet sphere” since the collapse of Nazi domination; patterns of Communist conquest, domination of the area; comparative study of most important political, social, and economic problems of the area. Prerequisites: two background courses in modern European history or international relations. Seniors and graduate students by permission.

5 units, Aut (Sworakowski)


5 units, any quarter (Gann or Duignan)

261. Historical Background to Modern Africa—After a brief survey of the period of precontact and early European contact, emphasis is given to the European penetration, conquest, and administration of Africa.

4 units, Win (Gann)

299. Directed Reading and/or Special Research in Hoover Institution Fields — Advanced individual work by arrangement.

Any quarter (Staff or authorized faculty member)

**LECTURES**


4 units, any quarter (Gann or Duignan)

131. The History of Southern Africa from the Dutch Occupation to the Present—Political, economic, and social factors; includes South Africa, Rhodesia, Zambia, Malawi, and Mozambique.

4 units, any quarter (Gann or Duignan)

For other courses offered by Hoover Institution staff members, see also History, Political Science, and Senior Colloquia.

**COMMITTEE on HYDROLOGY**

Committee in Charge: Stanley N. Davis (Chairman), Norman H. Crawford, Joseph B. Franzini, Paul Kruger, Ray K. Linsley, Perry McCarty

**PROGRAMS OF STUDY**

The Committee on Hydrology which includes faculty from the Departments of Civil Engineering and Geology administers a program of graduate studies leading to degrees of M.S. in Hydrology and Ph.D. in Hydrology. This program is available to students having the Bachelor’s degree in Civil Engineering, Geology, Agronomy, Forestry, 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, and introduction to geology and preferably elementary fluid mechanics.

**MASTER OF SCIENCE**

The M.S. program will consist of the following courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 260</td>
<td>Advanced Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 261</td>
<td>Advanced Hydrology</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 263</td>
<td>Sedimentation Problems</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 276</td>
<td>Water Quality in Water Resources</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Development</td>
<td></td>
</tr>
<tr>
<td>Geol. 285</td>
<td>Hydrogeology</td>
<td>5</td>
</tr>
</tbody>
</table>
Geol. 286. Development of Ground-water Resources 3

Total 24

In addition, the M.S. program will include 10 units of restricted electives from the following list and 11 units of free electives.

<table>
<thead>
<tr>
<th>Course No</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 171</td>
<td>Environmental Radioactivity</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 206</td>
<td>Advanced Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 209</td>
<td>Hydraulics of Open Channels</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 262</td>
<td>Advanced Hydraulic Engineering</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 265</td>
<td>Flow in Permeable Media</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 272</td>
<td>Water Resources Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 274</td>
<td>Water Resources Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 277</td>
<td>Nuclear Civil Engineering</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 278</td>
<td>Radioactivation Analysis</td>
<td>2</td>
</tr>
<tr>
<td>Geol. 106</td>
<td>Physical Oceanography</td>
<td>4</td>
</tr>
<tr>
<td>Geol. 133</td>
<td>Principles of Geomorphology</td>
<td>4</td>
</tr>
<tr>
<td>Geol. 171</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 209</td>
<td>Physics of Underground Fluids</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 361</td>
<td>Permafrost</td>
<td>2</td>
</tr>
<tr>
<td>C.S. 136</td>
<td>Introduction to Algorithmic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 150a, b, c.</td>
<td>Formation Evaluation</td>
<td>8</td>
</tr>
</tbody>
</table>

Doctor of Philosophy

Ph.D. programs will be determined by discussion with the Committee on Hydrology but will normally include all the required and most of the suggested electives of the M.S. program plus additional course work totaling at least 90 units. To become a Ph.D. candidate the student must demonstrate proficiency in one foreign language, pass a qualifying examination specified by the Committee and have a grade point average in graduate work of at least 3.00. 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 serious students should expect 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.

INTER-UNIVERSITY CENTER for JAPANESE STUDIES in TOKYO

ADMINISTERED BY STANFORD UNIVERSITY

The Inter-University Center for Japanese Studies in Tokyo, Japan, is a cooperative enterprise of ten major academic institutions in the United States and Canada with Stanford University as the administrative agency. The purpose of the Center is to provide qualified graduate and undergraduate students with intensive audio-lingual Japanese language instruction, as well as to further the students' familiarity with Japanese texts and materials preparatory or leading to research in given disciplinary or professional fields. The location of the Center in Tokyo provides maximum opportunities for students to gain fluency in both the written and spoken language in a Japanese-speaking and Japanese cultural environment. Language study is carried on in small classes or in individual tutorial sessions by Japanese instructors. Advanced students are 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 and oral examination in the Japanese language distributed to applicants by the administering institution.

For further information please write to:
Graduate Overseas and Special Programs
Room 207, Building 10A
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, under the sponsorship of nine 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 and oral examination in the Chinese language.

For further information please address your inquiries to:

Graduate Overseas and Special Programs
Room 207, Building 10A
Stanford University
Stanford, California 94305

LIBRARIES

Emeriti: Elizabeth Hadden, Minna Stillman (Associate Librarians); Alice Charlton (Chief Catalog Librarian); Jeannette M. Hitchcock (Chief of Division of Special Collections); Margaret Wells (Education Librarian); Grace E. Stillson (Assistant Chief Catalog Librarian); Ruth Scibird (Curator of the Stanford Collection)

University Libraries
Director: Rutherford D. Rogers
Associate Directors: Elmer M. Grieder, David G. Weber
Assistant Director: Warren B. Kuhn
Administrative Services: David Walker

Division Chiefs: Julius P. Barclay (Special Collections); Joseph A. Belloli (Humanities and Social Sciences); Jennette E. Hitchcock (Catalog); Jeanne B. North (Government Documents); Richard D. Johnson (Undergraduate Library Project); Jack Plotkin (Circulation); Jack Pooler (Science); Allen B. Veaner (Acquisition)

Undergraduate Librarian: Warren B. Kuhn
University Archivist: Ralph W. Hansen

Curators — Resources Development Program: Pamela Dempsey (Latin America); Gabor Erdelyi (Germanic Languages); Paul J. Kann (Romance Languages); Peter Kudrik (Slavic Languages)

Curator—Frederick E. Brasch Collection on Sir Isaac Newton and the History of Scientific Thought: Frederick E. Brasch

Curators — Honorary: George T. Keating (Music Bibliography); Irving Whitttemore Robbins, Jr. (Rare Books and Manuscripts); Elmer E. Robinson (Americana); Albert Sperisen (Typography)

Food Research Library
Librarian: Charles Milford

Hoover Institution—See listing elsewhere in this catalog.

Jackson Library of Business
Director: Marion M. Smith

Reference Librarian: David A. Kuhner
Catalog Librarian: Elizabeth R. Carter
Librarian, International Center for the Advancement of Management Education: David Allen
Lane Medical Library
Chief Librarian: Clara S. Manson
Reference Librarian: A. V. Hoen; Catalog Librarian: Virginia Foss

Law Library
Law Librarian: J. Myron Jacobstein
Acquisition Librarian: Howard W. Sugarman; Head Catalog Librarian: Rosalee Long; Reference Librarian: George Torzsay-Biber

Linear Accelerator Center Library
Chief Librarian: George Owens
Acquisitions: Louise Addis; Cataloging and Reference: Robert C. Gex

FACILITIES

All faculty, staff, and registered students of the University are entitled to use the University Libraries. Information is available in the booklet Your Libraries at Stanford University or in special leaflets about general borrowing regulations, book stack access, interlibrary loans, photocopies, microtext reading machines, etc. Persons wishing an introduction to the library are urged to see the Chief, Humanities and Social Sciences Division.

Information regarding special borrowing privileges for individuals not connected with the University may be obtained at the Service Desk in the Circulation Division 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 $25.00 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; 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 Circulation Service Desk attendant or their own school librarians for information. Industrial firms wishing to use the Libraries should consult the Director of the Technical Information Service for information regarding subscriptions.

The Libraries of the University altogether contain about 2,500,000 volumes, 900,000 manuscripts, 103,000 sheet maps, 245,000 microtext sheets, and considerable other material. A principal part of the Libraries' collections is concentrated in the stack of the Main Library, which houses about 750,000 volumes on its seven levels. 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.

UNDERGRADUATE LIBRARY

The Undergraduate Library, with an initial collection of about 40,000 volumes and housing language laboratories, an Audio Library, a Forum Room and seminar rooms, is scheduled for opening in the fall of 1966.

Hours generally follow those of the Main Library during school sessions, though extended study will be possible from early evening throughout the night in one or more seminar rooms. A more detailed listing of hours and other services can be found in Your Libraries at Stanford University or in the new leaflet which will introduce the Undergraduate Library.

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. (It includes those volumes formerly housed in the Reserve Book Room and the Western Civilization Library.) 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.

The book collection is arranged by the Library of Congress classification scheme on open shelves. Individual portions of the classification are grouped by academic subject in pavilions and other reading areas on the second, third and fourth floors. Seating for 1,500 students on these floors is furnished through individual carrels, at larger tables, and by lounge chairs arranged among the alcoves formed by bookshelves. Outdoor reading terraces and an art print study area are features of the fourth floor. A snack
OTHER DEPARTMENTS, INSTITUTES, AND PROGRAMS

lounge including several coin-return lockers is located in the northwest portion of the first floor.

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 seven 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 8:00 a.m. to 11:00 p.m. On Saturday the hours are 8:00 a.m. to 5:00 p.m., and on Sunday from 1:00 p.m. to 11:00 p.m. Hours of opening for other rooms and other libraries on the campus are listed in Your Libraries at Stanford University. The Main Library provides quarters for the following:

The Humanities and Social Sciences rooms, the center for reference service in the Main Library, contain reference and subject collections totaling about 34,000 volumes and current issues of more than 1,400 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 Division of Special Collections, the main reading room of which is the Albert M. Bender Room, services the Library’s rare and valuable books and manuscripts, and administers a number of specialized research collections. Among the most important of these are: the Antoine Borel Collection, manuscript material on California political history; the Frederick E. Brasch Collection on Sir Isaac Newton and the History of Scientific Thought covering a full history of several branches of the physical sciences centering around the life and thought of Newton; the Bernard DeVoto Papers covering his career in literature, history, and politics; 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 Hopkins Transportation Library, dealing with the economic problems of transportation; 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 Timoshenko Collection on engineering mechanics; and the Morgan A. and Aline D. Gunst Memorial Library, composed of examples of fine printing and books on the history and the making of the printed book.

SPECIAL LIBRARIES IN THE HUMANITIES AND SOCIAL SCIENCES

The Cubberley Library of Education, with three reading rooms on the second floor of the School of Education building, houses about 150,000 books, periodicals, and pamphlets in the field of education. In the south reading room is the curriculum library, a collection of approximately 20,000 elementary and secondary school textbooks, curriculum guides, and graphic materials. 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: Art Graduate Seminar, Asian Languages, Briggs Memorial (English), Classics, Communication, Graduate Program in Humanities, Jones Collection in Creative Writing, Memorial Church,
Modern European Languages, 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 six major groups of departmental libraries—Biology, Chemistry, Engineering, Geology, Mathematics-Statistics, and Physics.

The Frederic M. Falconer Biology Library, located on the first floor of Jordan Hall, houses general publications in botany and zoology as well as specialized materials in the experimental fields of biology. Branches are the Systematic Biology Library which includes systematics, natural history and entomology, and specializes in distributional studies of the flora of western North America; and the Hopkins Marine Station Library at Pacific Grove which provides a working collection in marine biology.

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 most of the library materials in the field of engineering. Its specialized branches include the Guggenheim Aeronautics Library, the Radioscience Laboratory Library, the Ryan Nuclear Technology Library, the Solid State Library, and the Engineering-Economic Planning Library.

The Branner Geological Library, located in Room 333 of the Outer Quadrangle, houses collections on geology, mineralogy, paleontology, geophysics, mining and metallurgy, as well as geological maps and the U.S. Geological Survey topographical sheets. Specialized branch libraries include the Conchology Library, the Geophysics Library, the Micropaleontology Library, the Mineralogy Library, and the Permafrost Library.

The Mathematics-Statistics Library is located in Room 414 of the Sloan Mathematics Center. Its branch is the Computer Science Library, Room 170, Polya Hall.

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 Jackson Library of Business, 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. Other Stanford graduate students may use the library upon identification, but undergraduate students are requested to contact the person in charge of the library to make special arrangements for use of material from the collection. The library contains over 95,000 cataloged 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 1,800 trade, financial, labor, and general business periodicals. In addition, it subscribes to many of the leading labor, financial, marketing, and business research services. Branch libraries serve the International Center for Advanced Management Education and the Stanford-Sloan Program.

**FOOD RESEARCH INSTITUTE**

The Food Research Institute Library, located in Room 32, Inner Quadrangle, has over 45,000 items intended primarily for the use of the staff of the Institute but also available to other qualified readers.

**LAW**

The Law School Library contains about 130,000 volumes. In addition to extensive holdings in Anglo-American law, there are important special collections of French, German, Italian, Indian, British Commonwealth, and early State laws. The International Legal Studies Collection of international law and organization and of foreign and comparative law is of increasing importance.

The Law Library is primarily intended for use by students, faculty, and research staff of the Law School. Other faculty, staff, and students are welcome to use the Law Library when in need of legal materials.
MEDICINE

The Lane Medical Library, located at Room 100 in the Lane Building of the Medical Center, contains about 200,000 volumes and currently receives about 2,200 journals. The Barkan Library of Ophthalmology and Otolaryngology and the Medical History Collection are notable special collections. Specialized branches include the Anatomy Library and the Medical Microbiology Library.

COURSE

1. Use of the Library—Introduction to the Library; emphasis on major types of material and use of catalogs, bibliographies, indexes, abstracts, other aids to study. Primarily for freshmen and sophomores.

1 unit, Aut, Win, Spr (Kuhn) T 11

See also Senior Colloquia.

STANFORD LINEAR ACCELERATOR CENTER

The Stanford Linear Accelerator Center Library (SLAC) is located in Room 308, Central Laboratory Building on Sand Hill Road. The collection is primarily for use by the staff of the Center.

OPERATIONS RESEARCH PROGRAM

Committee in Charge:
Chairman: Gerald J. Lieberman

Professors: Kenneth J. Arrow (Economics and Statistics), George B. Dantzig (Computer Science), Ronald A. Howard (Engineering-Economic Systems), Gerald J. Lieberman (Industrial Engineering and Statistics), Alan S. Manne (Graduate School of Business), Harvey M. Wagner (Graduate School of Business)

Associate Professors: Charles P. Bonini, Peter R. Winters (Graduate School of Business), Fred Hillier, Arthur F. Veinott, Jr. (Industrial Engineering)

Assistant Professor: Robert B. Wilson
(Graduate School of Business)

Affiliated Faculty: Alex Bavelas, Henry B. Eyring, John Haldi, Yuji Iijiri, Robert K. Jaedicke, William F. Massy, Alexander A. Robichek (Graduate School of Business); Edward A. Feigenbaum (Computer Science); Douglass J. Wilde (Chemical Engineering); John W. Fondahl (Civil Engineering); Gene F. Franklin, Rudolf E. Kalman, William K. Linvill, Bernard Widrow (Electrical Engineering); M. V. Johns, Jr., Herbert Solomon (Statistics)

Offerings and Facilities

The program in Operations Research was established in 1962 in recognition of the importance of quantitative analysis in industry, government, and the military. The function of the Committee is to promote advanced teaching and research, emphasizing the interdisciplinary nature of the subject. The affiliated faculty is drawn from the Departments of Computer Science, Economics, Electrical Engineering, Industrial Engineering, Mathematics, and Statistics, and from the Graduate School of Business.

Programs of Study

A program leading to the degree of Doctor of Philosophy in Operations Research is offered. The curriculum recognizes the need for advanced training in quantitative methods as well as specialization in one or more subject areas including Business, Economics, Engineering, Mathematics, Psychology, and Statistics. Required courses will be drawn from these departments. In addition, the student must fulfill the University's basic requirements for the doctorate (residence, dissertation, examination, etc.), which are discussed in the section "Degrees" in this Bulletin. Graduate Record Examination scores are required for admission. Typical course requirements are listed below. The programs of individual students may be adjusted to satisfy previous course work deficiencies or the special interest of the student.

Students may also undertake a Master's program or a Doctor of Philosophy program...
emphasizing Operations Research in the Departments of Industrial Engineering, Statistics, and the Graduate School of Business. Interested students should consult the corresponding sections in Courses and Degrees and the Graduate School of Business Bulletin.

Course Requirements for the Ph.D. Degree in Operations Research

Prerequisites

| Stat. 116. Theory of Probability | 4 units |
| Stat. 119. Elementary Statistical Inference | 4 units |
| Stat. 120. Statistical Inference | 4 units |
| Math. 44. Advanced Calculus I | 3 units |
| Math. 45. Advanced Calculus II | 3 units |
| Math. 46. Advanced Calculus III | 3 units |
| Econ. Microeconomics, equivalent of any one of the following: Econ. 202. Price and Allocation Theory I Prerequisite: Statistics 220 (may be taken concurrently) | 3 units |
| Bus. 401. Microeconomics | |
| E.E.S. 210. Introduction to Price Theory and Resource Allocation | 3 units |
| C.S. 136. Introduction to Algorithmic Processes, or equivalent | 3 units |

Requirements

| Math. 113. Linear Algebra and Matrix Theory | 3 units |
| Math. 115. Fundamental Concepts of Analysis | 3 units |
| Math. 116. Fundamental Concepts of Analysis | 3 units |
| Stat. 217a. Introduction to Stochastic Processes | 3 units |
| Stat. 217b. Introduction to Stochastic Processes | 3 units |
| Op.Res. 221. Models in Reliability | 3 units |
| Op.Res. 256. Inventory and Production Control | 3 units |
| Op.Res. 257. Data Processing in Operations Research (or an advanced computer science course) | 3 units |
| Op.Res. 258. Queuing Theory | 3 units |
| Electives in courses having an operations research label or from courses of similar level and content from the offerings of other departments | 15 units |
| Integrated courses in one or more related subject fields | 30 units |

Total units of requirements 86

Fellowships and Assistantships

A limited number of fellowships and research assistantships in the Committee are available. Fellowships and research assistantships carry stipends of $2,000 to $3,600 for the academic year of three quarters (nine months). Application for University fellowships should be made to the Office of Admissions by January 15. Applications for research assistantships should be made to the Chairman, Committee on Operations Research.

Courses


3 units, Spr (Veinott) MWF 2:15


3 units, Win (——) MWF 11

254. Seminar in Operations Research—(Enroll in I.E. 254.) Case studies and papers appearing in the operations research literature. Student teams work in local industry on problems in operations research. Special topics, including some presentations by guest specialists. Prerequisites: at least two courses in operations research.

3 units, Spr (Lieberman) MW 4:15-5:30

256. Inventory and Production Control — (Enroll in Statistics 256.) General discussion of inventory models; costs; analysis of the one-stage model; the sequential inventory problem; time lags; operating characteristics; statistical considerations. Prerequisite: Statistics 217b. (May be taken concurrently.)

3 units, Spr (Lieberman) MW 4:15-5:30

257. Data Processing in Operations Research—(Enroll in I.E. 257.) Seminar in selected topics in the application of electronic computers to operations research activities. Emphasis on the use of simulation techniques. Prerequisites: I.E. 141 and at least two courses in operations research. (May be taken concurrently.)

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

258. Queueing Theory—(Enroll in I.E. 258.) A survey of queueing theory and its appli-
tion. Birth-death process. Other useful models where the inter-arrival or the service-time distributions, or both, are non-exponential. Special service disciplines. Statistical estimation of model parameters. Prerequisites: I.E. 252, Statistics 217a, b, or basic knowledge of Markov processes.

3 units, Spr (Hillier) TTh 4:15–5:30


3 units, Win (Staff)


3 units, Aut (Veinott) TTh 11:00–12:15

370. Large Scale Systems in Mathematical Programming — (Enroll in Computer Science 370.) 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-production and distribution models; and those that arise as a solution procedure for nonlinear, 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: Business 465b, or equivalent.

3 units, Spr (Dantzig) by arrangement

371. Seminar in Linear Programming—Advanced topics. Prerequisite: 370.

3 units, given 1967–68

372. Seminar in Network Theory — Advanced topics. Prerequisite: 253.

3 units, given 1967–68

373. Seminar in Combinatorial Analysis and Integer Programming—Advanced topics. Prerequisite: 370.

3 units, given 1967–68

374. Seminar in Reliability—Advanced topics. Prerequisite: 221.

3 units, given 1967–68

375. Seminar in Dynamic Programming — (Enroll in Computer Science 375.) Advanced topics. The subject for 1966–67 will be optimal economic growth. Prerequisite: 351 or consent of instructor.

3 units, Spr (Arrow) by arrangement

376. Seminar in Inventory — (Enroll in Computer Science 376.) Advanced topics. Prerequisite: 256.

3 units, Win (Veinott) by arrangement

465a. Linear Programming—(Enroll in Business 465a.) This course will survey linear programming, emphasizing standard model formulation, fundamental theorems, variations of the simplex method and parametric programming. Students will solve a linear programming problem on computer. Prerequisites: Mathematics 113 and 115.

4 units, Aut (Dantzig) TTh 1:15–3:05


4 units, Win (Dantzig) TTh 1:15–3:05

469a,b,c. Management Science Workshop — (Enroll in Business 469a, b, c.) Selected topics in management science drawn from current literature. Prerequisite: consent of instructor.

4 units, Aut, Win, Spr (——, ———) by arrangement
PHYSICAL EDUCATION for MEN

Emeriti: Allen Elward, Henry W. Maloney, Edward M. Twiggs, Harry M. Wolter (Directors); C. Myron Sprague (Associate Director); Elwyn Bugge, Ernest P. Hunt (Associate Professors)

Executive Head and Director of Physical Education and Athletics: Charles A. Taylor

Assistant Director of Athletics: Robert G. Young

Directors: Howard Dallmar (Basketball), William P. Fehring (Baseball and Football), Charles E. Finger (Golf), James Gaughran (Aquatics), John Gilmore (Gymnastics), Joseph Higgins (Intramurals), Payton Jordan (Track), Peter Kmetovic (Rugby), William Leland (Wrestling), Raymond E. Lunny, Jr. (Boxing), Fred J. Priddle (Soccer), John Ralston (Football), Robert Renker (Tennis)

Assistant Directors: Jerome Barland (Track), Clyde F. Devine (Diving), Robert Gambold (Football), Rodney Rust (Football), James Smith (Aquatics), William T. Turner (Basketball), Richard A. Vermeil (Football), Michael White (Football), J. Ray Young (Baseball)

Professor: John E. Nixon (Director of Professional Education)

Associate Professor: Wesley K. Ruff (Coordinator of Physical Education and Intramurals)

OFFERINGS AND FACILITIES

Athletics

In keeping with our cultural heritage and American university tradition, Stanford offers its 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 Athletic Association of Western Universities, and other such organizations, Stanford meets teams of outstanding universities throughout America in a number of sports every year. The Indians usually schedule 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, boxing, wrestling, gymnastics, rugby, soccer, water polo, and cross country. Other sports which have regular schedules include, among others, crew and rifleshooting.

Physical Education and Intramurals

The Physical Education Program is designed to accommodate the interests and needs expressed by our students. Students may elect the 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 man is an integrated, indivisible organism in need of both physical and intellectual stimulation, Stanford provides a vigorous and well-rounded program of physical education and intramural athletics. The necessity of physical fitness in a peacetime as well as a wartime United States is absolutely essential and the physical education program is geared to this purpose. 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, wrestling, basketball, softball, tennis, swimming, boxing, gymnastics, 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. Women's activities are conducted by the
Department of Physical Education for Women. Activity courses, such as equitation, folk and square dancing, riflery, bowling, 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**—Men 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**—Men desiring to teach physical education classes and coach athletic teams at the secondary and junior college levels should minor in physical education beginning in either the sophomore or junior year in a program which continues through 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 90,000 and enclosing a standard American football field encircled by a quarter-mile track with a 220-yard straightaway.

**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 specialized facility for track and field, and its quarter-mile track also has a 220-yard straightaway.

**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.

Two other turfed fields for football and rugby, an enclosed football practice turf, a polo field, an intramural sports field, and freshman and junior varsity baseball diamonds.

Three varsity tennis courts, hard-surfaced, with stands for spectators, and fourteen practice tennis courts.

**Encina Gymnasium**, including a basketball floor, three bleacher-flanked swimming pools, offices, rooms for gymnastics, combatives, and other indoor sports.

**The Pavilion**, 2700-seat structure housing the basketball floor used for varsity and freshman intercollegiate competition.

Facilities used jointly by men and women include the riding stables and an 18-hole championship golf course on the campus.

**The Department of Athletics**, adjoining the Gymnasium and the Pavilion, which contains offices of the director, his staff, and all coaches, and is also headquarters for the Military, Air, and Naval Science programs.

**Fees**

Fees are charged for enrollment in bowling, equitation, rifle marksmanship, and scuba skin diving.

**University Physical Education Requirement**

All undergraduate students except veterans, married students, and students over 24 years of age must participate in organized group activities as one of the requirements of the General Studies program, for a total of 6 non-credit units.

1. During each of the freshman and sophomore years at least one such unit of non-credit activity must be taken in a physical activity course, which may include varsity or freshman athletic teams, organized physical education classes, and other authorized physical activities listed in the Time Schedule.

2. The remaining 4 non-credit units may be fulfilled either in physical activity offerings, or in other types of group activities, as authorized by the General Studies Committee.
3. All six non-credit group activities may be taken in physical education.
4. Not more than two non-credit physical education courses may be taken in one quarter.
5. In addition to non-credit group activity courses, a student may elect not more than 12 units of physical education classes for academic credit toward graduation. He may not enroll in more than two such courses per quarter.
6. A student may enroll in one group activity non-credit and in one credit course, in physical education, concurrently in any one quarter.
7. Enrollment in ROTC will be accepted, quarter for quarter, in satisfaction of all or part of this 6-unit non-credit requirement.

COURSES

03. Freshman Seminars.
   1 unit, Aut, Win, Spr (Staff) by arrangement

04. Physical Education Participation Club.
   1 unit, Aut, Win, Spr (Staff) by arrangement

05. Physical Education Leadership.
   1 unit, Aut, Win, Spr (Staff) by arrangement

2. Modified Programs — Individually prescribed exercise programs adapted to fit special needs of students for whom usual class activities are not suitable. Admission on recommendation of Coordinator of Physical Education.
   1 unit, Aut, Win, Spr (Ruff) three periods a week

   1 unit, Aut, Win, Spr (Turner) MWF 11

11a. Basketball, Freshman.
   1 unit, Aut, Win, Spr (Turner) MTWThF 2:15

   1 unit, Aut, Win, Spr (Lunny) MWF 2:15 or 3:15

14a. Football, Freshman.
   1 unit, Aut (Vermeil) MTWThF 4:15

   1 unit, Aut, Win, Spr (Finger) MF or TTh 11 or 1:15, and nine holes additional

   1 unit, Aut, Win, Spr (Finger) MTWThF 3:15–5:30

   1 unit, Aut, Win, Spr (Gilmore) MWF 2:15

17. Volleyball.
   1 unit, Aut, Win, Spr (Staff) MWF 2:15

17b. Volleyball and Team Games.
   1 unit, Aut, Win, Spr (Staff) TTh 2:15

   1 unit, Aut, Win, Spr (Staff) MW or TTh 10, 11, 1:15 and 2:15

   1 unit, Aut, Win, Spr (Staff) MWF 11

   1 unit, Aut, Win (Gaughran) MTWThF 4:15

21. Tennis, Elementary.
   1 unit, Aut, Win, Spr (Staff) MWF 10, 11, 1:15, 2:15, or TTh 2:15

21a. Tennis, Freshman.
   1 unit, Aut, Win, Spr (Renker) MTWThF 3:15–5:05

22. Track, Elementary.
   1 unit, Aut, Win, Spr (Barland) TTh 10

22a. Track, Freshman.
   1 unit, Aut, Win, Spr (Jordan, Barland) MTWThF 3:15

23. Wrestling, Elementary.
   1 unit, Aut, Win (Staff) MWF 2:15

23a. Wrestling, Freshman.
   1 unit, Aut, Win (Leland) MTWThF 4:15

24. Diving, Elementary.
   1 unit, Aut, Spr (Staff) TTh 11

27. Crew, Elementary.
   1 unit, Aut, Win, Spr (Staff) MTWThF 4:15 and S 9

29. Water Polo.
   1 unit, Aut, Spr (Smith) TTh 2:15

   1 unit, Aut, Win, Spr (Young) MTWThF 3:15–5:30

   1 unit, Aut (Priddle) MTWThF 4:15
### OTHER DEPARTMENTS, INSTITUTES, AND PROGRAMS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Terms</th>
<th>Instructor(s)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>41.</td>
<td>Physical Conditioning</td>
<td>1</td>
<td>Aut, Win, Spr (Staff)</td>
<td>MWF 4:15</td>
<td></td>
</tr>
<tr>
<td>111a.</td>
<td>Basketball, Varsity</td>
<td>1</td>
<td>Aut, Win (Dallmar)</td>
<td>MTWThF 4:15–6:05</td>
<td></td>
</tr>
<tr>
<td>112.</td>
<td>Boxing, Advanced</td>
<td>1</td>
<td>Aut, Win, Spr (Lunny)</td>
<td>MTTh 4:15</td>
<td></td>
</tr>
<tr>
<td>113.</td>
<td>Judo</td>
<td>1</td>
<td>Aut, Win, Spr (Kitura)</td>
<td>TTh 11 or 12</td>
<td></td>
</tr>
<tr>
<td>114a.</td>
<td>Football, Varsity</td>
<td>1</td>
<td>Spr (Ralston)</td>
<td>MTWThF 3:15–5:30</td>
<td></td>
</tr>
<tr>
<td>115.</td>
<td>Golf, Advanced</td>
<td>1</td>
<td>Spr (Finger)</td>
<td>MTWThF and by arrangement</td>
<td></td>
</tr>
<tr>
<td>115a.</td>
<td>Golf, Varsity</td>
<td>1</td>
<td>Aut, Win, Spr (Finger)</td>
<td>MTWThF 3:15–5:30</td>
<td></td>
</tr>
<tr>
<td>116a.</td>
<td>Gymnastics, Varsity</td>
<td>1</td>
<td>Spr (Gilmore)</td>
<td>MWF 4:15</td>
<td></td>
</tr>
<tr>
<td>118.</td>
<td>Life Saving</td>
<td>1</td>
<td>(Gaughran)</td>
<td>TTh 2:15</td>
<td></td>
</tr>
<tr>
<td>119.</td>
<td>Swimming, Intermediate</td>
<td>1</td>
<td>Aut, Win, Spr (Smith)</td>
<td>MWF 2:15</td>
<td></td>
</tr>
<tr>
<td>120.</td>
<td>Swimming, Advanced</td>
<td>1</td>
<td>Aut, Win, Spr (Smith)</td>
<td>MWF 10</td>
<td></td>
</tr>
<tr>
<td>120a.</td>
<td>Swimming, Varsity</td>
<td>1</td>
<td>Spr (Gaughran)</td>
<td>MTWThF 4:15</td>
<td></td>
</tr>
<tr>
<td>121.</td>
<td>Tennis, Advanced</td>
<td>1</td>
<td>Spr (Renker)</td>
<td>MWF 2:15 and 3:15 or TTh 2:15 and 3:15</td>
<td></td>
</tr>
<tr>
<td>121a.</td>
<td>Tennis, Varsity</td>
<td>1</td>
<td>Spr (Jordan)</td>
<td>MTWThF 3:15</td>
<td></td>
</tr>
<tr>
<td>122a.</td>
<td>Track, Varsity</td>
<td>1</td>
<td>Spr (Jordan)</td>
<td>MTWThF 3:15</td>
<td></td>
</tr>
<tr>
<td>123.</td>
<td>Wrestling, Advanced</td>
<td>1</td>
<td>Win (Leland)</td>
<td>MTTh 4:15</td>
<td></td>
</tr>
<tr>
<td>123a.</td>
<td>Wrestling, Varsity</td>
<td>1</td>
<td>Win (Leland)</td>
<td>MTWThF 4:15–6:05</td>
<td></td>
</tr>
<tr>
<td>124.</td>
<td>Diving, Advanced</td>
<td>1</td>
<td>Spr (Staff)</td>
<td>TTh 11</td>
<td></td>
</tr>
<tr>
<td>124a.</td>
<td>Diving, Varsity</td>
<td>1</td>
<td>Spr (Devine)</td>
<td>MTWThF 4:15</td>
<td></td>
</tr>
<tr>
<td>127a.</td>
<td>Crew, Varsity</td>
<td>1</td>
<td>Spr (Staff)</td>
<td>MTWThF 4:15 and S 10</td>
<td></td>
</tr>
<tr>
<td>128.</td>
<td>Water Safety Instruction, Part I</td>
<td>1</td>
<td>Spr (Gaughran)</td>
<td>MTWThF 3:15</td>
<td></td>
</tr>
<tr>
<td>128b.</td>
<td>Water Safety Instruction, Part II</td>
<td>1</td>
<td>Spr (Gaughran, Staff)</td>
<td>MTWThF 3:15</td>
<td></td>
</tr>
<tr>
<td>129a.</td>
<td>Water Polo</td>
<td>1</td>
<td>Spr (Gaughran)</td>
<td>MTWThF 4:15</td>
<td></td>
</tr>
<tr>
<td>130.</td>
<td>Baseball, Junior Varsity</td>
<td>1</td>
<td>Spr (Turner)</td>
<td>MTWThF 3:15–5:05</td>
<td></td>
</tr>
<tr>
<td>130a.</td>
<td>Baseball, Varsity</td>
<td>1</td>
<td>Aut, Win, Spr (Fehring, Young)</td>
<td>MTWThF 3:15–5:05</td>
<td></td>
</tr>
<tr>
<td>139.</td>
<td>Soccer, Beginning</td>
<td>1</td>
<td>Spr (Priddle)</td>
<td>MWF 4:15</td>
<td></td>
</tr>
<tr>
<td>139a.</td>
<td>Soccer, Varsity</td>
<td>1</td>
<td>Spr (Priddle)</td>
<td>MTWThF 4:15</td>
<td></td>
</tr>
<tr>
<td>140.</td>
<td>Rugby, Beginning</td>
<td>1</td>
<td>Spr (Kmetovic)</td>
<td>MWThS 4:15</td>
<td></td>
</tr>
<tr>
<td>140a.</td>
<td>Rugby, Varsity</td>
<td>1</td>
<td>Spr (Kmetovic)</td>
<td>MWThS 4:15</td>
<td></td>
</tr>
<tr>
<td>142.</td>
<td>Skin Diving</td>
<td>1</td>
<td>Spr (Gaughran, Smith)</td>
<td>TTh 2:15</td>
<td></td>
</tr>
<tr>
<td>142b.</td>
<td>Scuba Diving</td>
<td>1</td>
<td>Spr (Gaughran, Smith)</td>
<td>TTh 2:15</td>
<td></td>
</tr>
<tr>
<td>151.</td>
<td>Rifle and Pistol Marksmanship—Open to all</td>
<td>1</td>
<td>Spr (Staff)</td>
<td>MTWThF by arrangement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>undergraduate students.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>153.</td>
<td>Weight Training</td>
<td>1</td>
<td>Spr (Staff)</td>
<td>MTW 11, 1:15, 2:15, 3:15 or 4:15</td>
<td></td>
</tr>
<tr>
<td>192, 193, 194.</td>
<td>Techniques of Athletic Management.</td>
<td>1</td>
<td>Spr (Taylor, Staff)</td>
<td>by arrangement</td>
<td></td>
</tr>
</tbody>
</table>

Coeducational classes are offered as listed under Physical Education for Women.
PHYSICAL EDUCATION for WOMEN

Emeriti: Maud L. Knapp (Professor), Margaret C. Barr (Associate Professor), Sylvia P. Cain (Instructor)

Executive Head: Luell W. Guthrie
Associate Professor: Luell W. Guthrie
Assistant Professors: Carroll S. Gordon, Miriam B. Lidster, Marian S. Ruch, Pamela L. Strathairn
Instructors: Judith R. Book, Mary Margaret Neal, Inga Weiss-Lepnis
Teaching Specialists: Jean P. Helliwell (Fencing), Margaret F. Newport (Badminton, Tennis), Shirley H. Schoof (Bowling), Janice Shaughnessy (Dance)

OFFERINGS AND FACILITIES

The aims of the physical education program for women are threefold: to provide an opportunity for participation in a variety of physical activities, to afford specialization in one or more areas of activity, and to provide instruction for all levels of competency.

The program is designed: (1) to increase understanding of the value and role of physical education activities in developing and maintaining total fitness throughout life, (2) to encourage continued participation, both during and after college, in physical activity appropriate to health status as well as interest, and (3) to develop leadership skills which have particular application to community service, volunteer agencies, recreation groups, and domestic and foreign Peace Corps.

Each student is afforded the opportunity for developing interest in many kinds of physical activity and for developing competency in selected activities in order that future participation is more readily selected for recreational purposes. Instructional, recreational, creative, and several forms of competitive experiences are provided in the variety of aquatic, dance, sports, and other physical education activities. Homogeneous skill groupings for instruction in most activities enable the student, beginner through advanced performer, to achieve success within the limits of her capabilities. The program also includes instruction and recreation for coeducational groups.

COMPETITIVE AND RECREATIONAL OPPORTUNITIES

Recreational and competitive events in the intramural and intercollegiate programs are offered in cooperation with the Women's Recreation Association.

The intramural and intercollegiate programs include: archery, badminton, basketball, bowling, fencing, field hockey, golf, swimming, tennis, and volleyball. A planned co-recreational program includes badminton, bowling, golf, swimming, tennis, and volleyball. Special events offered include ballet, folk and square dancing, modern dance, synchronized swimming, and other activities of current interest.

The Department is affiliated with the Girls' and Women's Sports Division of the American and California Associations for Health, Physical Education and Recreation, the Women's National Officials Rating Committee, the National Association for Physical Education of College Women, and the Western Society for Physical Education of College Women. The Women's Recreation Association is a member of the National and Pacific Southwest Regional Athletic and Recreation Federation for College Women.

Policy governing women's participation in intercollegiate competition is formed by the Department and the Women's Recreation Association in keeping with policies of affiliated organizations.

FACILITIES, EQUIPMENT, COSTUMES, AND FEES

The Women's Gymnasium houses a basketball floor and area for other indoor activities, dance studio, posture studio, dance as well as physical education library, study rooms, offices, and shower and locker room.

The outdoor facilities include a heated 75-foot pool with one-meter springboard; two WRA tennis courts for recreation; six tennis courts used primarily for instruction; short fairway and green for golf practice; turfed field for archery, field hockey, golf, and softball.

In addition the Riding Stable and 18-hole championship Stanford Golf Course are used jointly by men and women.

All equipment, except badminton and
tennis rackets, bowling balls and shoes and golf clubs, is provided by the Department. Golf clubs may be rented and bowling balls and shoes are included in the bowling fees. Gym suits, leotards, swim suits, and towels are furnished and laundered. The student must provide her own white socks and tennis shoes, swimming cap, and appropriate riding clothes.

Fees are charged for enrollment in bowling and equitation classes. The bowling fee includes use of ball and shoes.

**General Studies Program Requirements**

Participation in Group Activity to a total value of 6 non-credit units is required of all undergraduates. During the freshman and sophomore years at least 2 of these units, 1 each year, must be devoted to physical activity courses. All courses listed below may be used to fulfill the remaining 4 of the Group Activity requirements.

1. No more than 2 non-credit units will be counted in any one quarter.
2. Students enrolling in 2 physical education courses may count both toward the requirement or may receive 1 unit of credit for each of the courses. A maximum of 12 such units will be accepted toward graduation.

**Courses for Physical Activity**

The following physical education courses may be taken for 0 units of credit each to fulfill either the physical activity or group activity requirements of the General Studies Program or may be taken for 1 unit of credit each.

**COEDUCATIONAL CLASSES**

Open to men and women. See *Time Schedule* for preregistration and registration procedures.

   *Aut, Win, Spr (Staff) TTh 9, MW or TTh 10, 11, 1:15 or 2:15*

40. Archery, Elementary.
   *Aut, Spr (Book)*

41. Archery, Intermediate — Prerequisite: target shooting from two distances using point of aim technique.
   *Aut, Spr (Book)*

61. Modern Dance, Elementary.
   *Aut (Weiss-Lepnis) MWF 10*

   *Aut, Win, Spr (Weiss-Lepnis) MWF 10*

63. Ballet, Elementary.
   *Aut (Weiss-Lepnis) WF 11:00–12:15*

64. Ballet, Intermediate.
   *Win, Spr (Weiss-Lepnis) WF 11:00–12:15*

68. Social Dance, Elementary.
   *Aut, Win, Spr (Lidster) TTh 3:15–4:30*

69. Social Dance, Intermediate.
   *Win (Lidster) TTh 4:15–5:30*

70. Ethnic Dance, Elementary.
   *Win (Lidster) TTh 11:00–12:15*

   *Spr (Lidster) TTh 11:00–12:15*

72. Folk Dance, Elementary.
   *Aut, Spr (Lidster) MWF 1:15*

73. Folk Dance, Intermediate.
   *Win, Spr (Lidster) TTh 12:50–2:05*

140. Archery, Advanced—Prerequisite: one year’s shooting experience.
   *Aut, Spr (Book)*

148. Equitation.
   Elementary—English and Western seat.
   *Aut, Win, Spr (——) MTTh 1:15*

Intermediate—English and Western seat. Prerequisite: ability to canter securely.
   *Aut, Win, Spr (——) MTTh 4:15*

Advanced — English seat. Prerequisite: secure in all three gaits, knowledge of leads and diagonals, and previous instruction.
   *Aut, Win, Spr (——) MTTh 11*

151. Rifle and Pistol Marksmanship — (See Physical Education for Men.)

161. Modern Dance, Advanced.
   *Aut, Win, Spr (Weiss-Lepnis) MW 4:15–5:30*

166. Dance Workshop—Prerequisite: intermediate or advanced ability in modern dance.
   *Aut (Weiss-Lepnis) T 7:00–9:30 p.m.*
167. Choreography and Production — Prerequisite: 166 or equivalent.
Win, Spr (Weiss-Lepnis) T 7:00–9:30 p.m.

172. Folk Dance, Advanced.
Aut, Win, Spr (Lidster) W 4:15–5:30 and M 7:45–9:00 p.m.

173. Folk Dance, Exhibition.
Win, Spr (Lidster) W 4:15–5:30 and M 7:45–9:00 p.m.

177. Historic Dance: Primitive and Ancient.
Aut (Lidster) TTh 12:50–2:05

COURSES FOR WOMEN STUDENTS
Open to women only. See Time Schedule for preregistration and registration procedures.

1. Posture—Figure control and posture improvement with individual conditioning.
Aut (Ruch) MWF 9, 10, or 1:15
Win (Ruch) MWF 10, 1:15 or 2:15
Spr (Ruch) MWF 10

2. Conditioning — Group exercises to improve agility, strength, balance, coordination and endurance.
Aut, Win, Spr (Shaughnessy) TTh or WF 12 and one hour by arrangement

3. Rhythmic Gymnastics—Exercises to music using small hand equipment.
Aut, Win, Spr (Book) TTh 11:00–12:15

Win (Book) MWF 2:15

Aut (Neal) MWF 1:15
Win (Neal) MWF 1:15

12. Fencing, Elementary.
Aut, Win, Spr (Helliwell)

Aut, Win, Spr (Helliwell)

15. Tennis, Elementary — For students with no previous experience or limited knowledge of and ability in fundamental strokes.
Aut (Neal) MWF 10; (Newport) MWF 1:15; (Neal) TTh 3:15–4:30
Win (Neal) MWF 1:15
Spr (Neal) MWF 10 or 1:15; (Guthrie) TTh 3:15–4:30

16. Tennis, Intermediate — Prerequisite: knowledge of rules and scoring, average ability in fundamental strokes.
Aut (Neal) MWF 9; (Newport) TTh 10 and one hour by arrangement;
(—) WF 11:00–12:15; (Newport) MWF 2:15
Win (Neal) WF 11:00–12:15 or MWF 2:15
Spr (Neal) MWF 9 or TTh 10 and one hour by arrangement; (—) W
11:00–12:15; (Newport) MWF 2:15
Sum (—) MWF 2:15 or 3:15

20. Basketball — Prerequisite: limited experience or average ability.
Win (Strathairn) TTh 3:15–4:30

23. Field Hockey, Elementary.
Aut (Book) TTh 4:15

24. Field Hockey, Intermediate — Prerequisite: one season playing experience.
Aut (Book) TTh 4:15

27. Volleyball.
Aut, Win, Spr (Book)

31. Swimming, Elementary — For students unable to swim safely in deep water.
Aut (Strathairn) MWF 1:15
Spr (Strathairn) MWF 2:15

32. Swimming, Intermediate — Ability to float, tread water, and swim safely in deep water.
Aut (Ruch) MWF 2:15
Spr (Book) MWF 3:15

35. Lifesaving — This is the American Red Cross Senior Lifesaving Course. Prerequisites: strong swimmer; ability to swim a quarter mile without rest, to swim underwater, and to surface dive.
Win (Strathairn) MW or TTh 12:50–2:05
Spr (Strathairn) TTh 11:00–12:15

36. Aquatic Art—Synchronized swimming, water ballet, stunts, and figures. Prerequisite: above average ability in performing the crawlstroke, backstroke, breaststroke and sidestroke.
Aut (Ruch) MW 3:15 and one practice hour
Spr (Ruch) MW 4:15 and one practice hour
44. Golf, Elementary — For students who have never had golf instruction.
   Aut, Spr (Gordon) MW 10 or 2:15; TTh 11 or 2:15; each with one practice hour
   Win (Gordon) MW 10, TTh 11 or 2:15; each with one practice hour
   Sum (———) MTTh 11 or 1:15; each with one practice hour

45. Golf, Intermediate — Prerequisite: instruction or ability to play nine holes with a score under 60.
   Aut, Spr (Gordon) TTh 10, MW 1:15 or 3:15; each with one practice hour
   Win (Gordon) TTh 10 or MW 1:15; each with one practice hour

55. Theatrical Dance — Composition of dance as seen in contemporary American theater.
   Aut, Spr (Shaughnessy) MWF 2:15

56. Jazz Dance — Techniques of dance as seen in musicals.
   Win (Book) MWF 9

61. Modern Dance, Elementary.
   Win (Shaughnessy) MWF 2:15

110. Badminton, Advanced — Prerequisite: promotion from 10 or previous experience which has provided above average ability in clears, smashes, net shots, serves, and knowledge of rules and strategy.
   Aut, Win (Newport) TTh 12:50–2:05

112. Fencing, Advanced.
   Aut, Win, Spr (Helliwell)

113. Fencing, Tournament.
   Aut, Win, Spr (Helliwell)

114. Tennis, Advanced — Prerequisite: promoted from 10, or previous experience which has provided above average ability in forehand, backhand, volley, and serve in addition to knowledge of lob, smash, and chop.
   Aut (Newport) TTh 11:00–12:15; (Guthrie) TTh 2:15–3:30; (Neal) MW 3:15–4:30
   Win (Newport) TTh 11:00–12:15; (Neal) TTh 2:15–3:30
   Spr (Neal) TTh 11:00–12:15; (Newport) TTh 2:15–3:30 or MW 3:15–4:30

115. Tennis, Tournament — Prerequisite: promoted from 114 or equivalent experience including USLTA tournaments or school team participation.
   Aut (Guthrie) TTh 12:50–2:05
   Win (Neal) TTh 12:50–2:05; (Guthrie) W 5 and two practice hours; by permission of instructor
   Spr (Newport) TTh 12:50–2:05

119. Bowling, Tournament — Members of this class will participate in intercollegiate competitions.
   Aut, Win, Spr (Schoof) M 8:30–10:00 p.m.

120. Basketball, Advanced — Prerequisite: above average ability or two seasons of playing experience.
   Win (Strathairn) MW 3:15–4:30

121. Basketball, Tournament — Selected members of this class will play intercollegiate games. Prerequisite: sophomore, junior or senior standing; eligible for 120; and one season of class or intramural participation in college.
   Win (Strathairn) MTTh 4:15

130. Swimming, Advanced — Prerequisite: promoted from 32, or above average ability in performing the crawlstroke, backstroke, breaststroke, and sidestroke.
   Aut (Strathairn) TTh 3:15 and one practice hour
   Spr (———) TTh 3:15 and one practice hour

131. Swimming, Competitive — All members of this class will participate in swimming meets. No prior experience necessary. Prerequisite: good form in at least one of the racing strokes.
   Aut (Strathairn) MW or TTh 4:15 and one practice hour
   Spr (Strathairn) TTh 4:15 or MW 5 and one practice hour

132. General Aquatics — This course will be geared to the abilities and interests of the enrollees.
   Sum (———) MWTh 4:15

135a. Water Safety Instructor’s Course — This is the 15-hour Part I of the American Red Cross W.S.I. course which focuses upon swimming and lifesaving skills of the enrollees. Students should enroll concurrently in 135b (see Courses of Recreational or Avocational Value). Prerequisite: current American Red Cross Senior Lifesaving certificate.
   Spr (Strathairn) MWF 12:50–2:05
144. Golf, Advanced — Prerequisite: promoted from 45, or ability to play 18 holes with a score under 110.
   *Aut, Win, Spr (Gordon) T 1:15 and two practice hours

145. Golf, Tournament — All members of this class will play a limited number of matches (intramural and intercollegiate) during the quarter. Prerequisite: playing experience with average score below 100 for 18 holes.
   *Aut, Win, Spr (Gordon) T 1:15 and two practice hours

COURSES OF RECREATIONAL OR AVOCATIONAL VALUE

The following non-physical activity courses may be taken for 0 units of credit each to fulfill the Group Activity requirements, with the exception of the freshman and sophomore physical activity requirement. These courses may also be taken for 1 unit of credit each. See the Time Schedule for preregistration and registration procedures. Courses are open to men and women students unless otherwise noted.

116. Tennis Officiating.
   *Spr (Guthrie) by arrangement

135b. Water Safety Instructor's Course — This is the 15-hour Part II of the American Red Cross W.S.I. course which focuses upon the teaching of swimming and lifesaving by the enrollees. Prerequisites: concurrent enrollment in 135a or current W.S.I. course completion card. Women only.
   *Spr (Strathairn) MWF 12:50-2:05

138. Aquatics Officiating — Women only.
   *Aut (Strathairn) alternate years, given 1967–68

180. Aquatic Leadership — The organization and management of community aquatic programs. Prerequisites: A.R.C. Water Safety Instructor Course. Women only.
   *Aut (Strathairn) W 5:15 and by arrangement

181. Golf Tournament Organization — Women only.
   *Aut (Gordon) by arrangement

182. Tennis Tournament Organization.
   *Win, Spr (Guthrie, Neal, Newport) T 5:15 and by arrangement

SENIOR COLLOQUIA

Committee on General Studies: Robert A. Walker (Chairman), Friedrich W. Strothmann (Vice-Chairman), Gordon A. Craig, Richard H. Eastman, Lorenz Eitner, H. Bruce Franklin, Robert R. Sears, Ralph J. Smith, Robert J. Wert

Under the General Studies Program, two Senior Colloquia are required of all seniors who are candidates for the A.B. degree, with a few exceptions. The exceptions are those students entering the Schools of Law or Medicine at the end of their third year, and those enrolled in Honors programs in Humanities, and in Social Thought and Institutions. The Colloquia listed below will be offered during the current year unless otherwise indicated.

The Senior Colloquia are limited to 15 students each and are built around subjects or issues of continuing importance, or a basic document of enduring significance. They are designed to stimulate serious thought rather than to impart information for its own sake. Thus the emphasis is on discussion and analysis, not lectures.

In most cases students are not admitted to a Colloquium being taught by a staff member of their major department. This can be determined by consulting the Time Schedule. No more than two Senior Colloquia can be taken for credit.

Descriptions and reading lists can be found in the current General Studies Bulletin.

#2. Church and State.
   2 units, *Aut (McCoy, General Studies) T 8–10 p.m.

#3. Is Industrialization the Panacea for Underdeveloped Countries?
   2 units, *Sum (White, Geography) M 3:15–5:05
#5. The Meaning of Death in Western Culture.
2 units, Win (Black, General Studies)
W 7:30–9:30 p.m.

2 units, Aut, Spr (Dahl, General Studies)
M 2:15–4:05

#7. Canada, Nation or State?
2 units, Spr (Allyn, Graduate School of Business) M 4:15–6:05

#8. Economic and Political Aspects of Petroleum Development.
2 units, Aut, Spr (Marsden, Petroleum Engineering) W 4:15–6:05

2 units, Aut (Peck, Communication) W 8–10 p.m.

#10. The Civil Rights Movement, 1945–65
2 units, Win (Allen, General Studies) M 4:15–6:05

#11. An Introduction to Poetry.
2 units, Win (Dahl, General Studies) M 2:15–4:05

#13. Tax Reform and Expenditure Policy.
2 units, Aut (Freeman, Hoover Institution) given 1967–68

2 units, Aut (Clark, Communication) M 4:15–6:05

#15. The Self and Definitions of Identity in Cross-Cultural Perspective.
2 units, Win (Hotchkiss, Anthropology) W 2:15–4:05

#17. The Social Revolution in China.
2 units, Spr (Skinner, Anthropology) Th 2:15–4:05

#20. Greek Literary Criticism.
2 units, Spr (Mellor, Classics) T 2:15–4:05

#24. Bernard Lonergan on Insight.
2 units, Spr (Novak, Religion) W 2:15–4:05

2 units, Spr (Sokol, Political Science) T 4:15–6:05

2 units, Win (R. Campbell, Hoover Institution) T 2:15–4:05

#28. The Destiny of Europe.
2 units, Aut, Win (Hilton, Modern European Languages) W 4:15–6:05

2 units, Spr (Bark, History) W 2:15–4:05

#34. Contemporary Germany: Aspects of Its Culture.
2 units, Spr (Lohnes, Modern European Languages) W 2:15–4:05

2 units, Win (Hanley, General Studies) M 2:15–4:05

#45. Photography: Composition, Content, and Expression.
2 units, Spr (Kahn, Art and Architecture) T 1:15–3:05

#50. Human Values in a Technological Society.
2 units, Aut, Win (Thompson, Industrial Engineering) T 2:15–4:05

Spr (Thompson, Industrial Engineering) M 2:15–4:05

#51. Geography and Contemporary World Problems.
2 units, Aut, Win, Spr (Williams, Geography) M 4:15–6:05

#52. The Mechanistic Approach to Human Behavior.
2 units, Sum (Baxter, Biological Sciences) M 2:15–4:05

#54. Experiments in Community Living.
2 units, Win (Kincheloe, Electrical Engineering) W 8–10 p.m.

#55. Systems for International Conflict Resolution.
2 units, Spr (Dunn, Electrical Engineering) W 4:15–6:05

#57. Man’s Emerging Evolution.
2 units, Aut (Kincheloe, Electrical Engineering) Th 8–10 p.m.

#58. The Poetry of Wallace Stevens.
2 units, Win (Lohner, Modern European Languages) M 2:15–4:05
    2 units, Spr (Parks, Chemistry)
    Th 4:15–6:05

#60. The Literature and History of the Organ.
    2 units, Aut (——, Music) W 2:15–4:05

#63. Modern Australian Poetry.
    2 units, Spr (Lillyman, Modern European Languages) M 2:15–4:05

#65. Parapsychology.
    2 units, Aut (Smith, Humanities)
    W 2:15–4:05

#66. Thomas Mann's Doctor Faustus.
    2 units, Spr (Boeninger, Modern European Languages) M 4:15–6:05

#68. The Writings of Karl Rahner.
    2 units, Aut (Novak, Religion)
    W 2:15–4:05

#69. The Plays and Philosophical Writings of Gabriel Marcel.
    2 units, Win (Novak, Religion)
    W 2:15–4:05

#70. Asia and the West.
    2 units, Spr (Ike, Political Science)
    T 2:15–4:05

#72. Contemporary Music.
    2 units, Sum (Kuhn, Music) W 2:15–4:05

#75. Masterpieces of Choral Literature.
    2 units, Win (Schmidt, Music)
    Th 2:15–4:05

#78. Man-Machine Decision Responsibility. — (Open to B.S. candidates.)
    2 units, Spr (Bennigson, Industrial Engineering) T 7:30–9:30 p.m.

#79. Leisure in Modern Life.
    2 units, Win (Guthrie, Physical Education) Th 2:15–4:05

#82. Dance in Patterns of Culture.
    2 units, Aut (Lidster, Physical Education)
    W 2:15–4:05

#85. The History of the Book.
    2 units, Aut, Win, Spr (Lenkey, Library)
    T 2:15–4:05

#86. The Concept of Freedom.
    2 units, Aut (Mothershead, Philosophy)
    T 2:15–4:05

#88. Manuscripts, Archives, and Research.
    2 units, Win (Hansen, Library)
    given 1967–68

#90. Current Controversies Over American Education.
    2 units, Spr (Thomas, Education)
    T 4:15–6:05

#91. Rhetorical Humor.
    2 units, Win (Schrader, Hastings, Speech and Drama) Th 2:15–4:05

#92. Bach and Bartok.
    2 units, Spr (Salgo, Music) M 2:15–4:05

#93. The Tragic Sense of Life in Unamuno.
    2 units, Spr (Schevill, Modern European Languages) W 4:15–6:05

#94. Civil Disobedience.
    2 units, Aut (Schrader, Speech and Drama) Th 2:15–4:05

    2 units, Aut (Steiner, Political Science)
    Th 4:15–6:05

#99. Ceremony and Symbol in Religion and Society.
    2 units, Spr (Minto, Chaplain of the University) Th 2:15–4:05

#100. The Mind of Jesus.
    2 units, Aut, Win, Spr (Rathbun, Law School) W 4:15–6:05

#105. Structural Models for Social Roles.
    2 units, Win (Sim, Sociology)
    W 4:15–6:05

#107. Social Mobility in American Society.
    2 units, Spr (Kimberly, Sociology)
    T 2:15–4:05

#110. Man as a Factor in Evolution.
    2 units, Win (Holm, Biological Sciences)
    Th 2:15–4:05

#112. Speech and Social Issues.
    2 units, Spr (Hastings, Speech and Drama) Th 2:15–4:05

#114. The Greek Historian Thucydides.
    2 units, Win (Raubitschek, Classics)
    Th 2:15–4:05

#119. Pseudoscience in Modern Society.
    2 units, Aut (Davis, Geology) T 2:15–4:05

#121. The Succession of Life Through Geologic Time.
    2 units, Aut (Thalmann, Geology)
    T 4:15–6:05

#124. The Manipulation of Human Behavior.
    2 units, Win (Cooper, Psychology)
    T 2:15–4:05
#129. Pessimism in Philosophy and Art.  
2 units, Win (Foulkes, Modern European Languages) W 2:15–4:05

#130. T. S. Eliot: Four Quartets.  
2 units, Win, Spr (Meads, Modern European Languages) given 1967–68

#131. The Place of Women in Different Civilizations.  
2 units, Win (Sokol, Political Science) T 4:15–6:05

#132. Goethe’s Faust.  
2 units, Win (Foulkes, Modern European Languages) given 1967–68

#134. Goethe: The Sorrows of Young Werther.  
2 units, Win (Lillyman, Modern European Languages) M 7–9 p.m.

#138. Frank Lloyd Wright.  
2 units, Win (Thompson, Architecture) Th 4:15–6:05

#139. Modern French Painting.  
2 units, Aut, Spr (Faulkner, Art) Th 2:15–4:05

#141. Communism and World Politics.  
2 units, Aut (Fisher, Hoover Institution) W 4:15–6:05

#142. Communism and the American Response.  
2 units, Spr (Fisher, Hoover Institution) W 4:15–6:05

#143. American and Russian Relations.  
2 units, Win (Fisher, Hoover Institution) W 4:15–6:05

#146. Mystics and Mysticism.  
2 units, Spr (Watkins, Political Science) T 2:15–4:05

#151. Psychology and International Behavior.  
2 units, Win (Geiwitz, Psychology) M 2:15–4:05

#152. Modern American Painting.  
2 units, Spr (Mendelowitz, Art and Architecture) M 2:15–4:05

#154. Franz Kafka.  
2 units, Aut (Boeninger, Modern European Languages) M 4:15–6:05

#156. Plato’s View of the Ideal Society.  
2 units, Aut (Rhinelander, Philosophy) Th 2:15–4:05

#157. Law and the Social Structure.  
2 units, Aut, Spr (Davis, General Studies) T 7:30–9:30 p.m.

#159. The Pattern of Cities.  
2 units, Win (Sanders, Planning and Architecture) W 7:30–9:30 p.m.

2 units, Win (Hamilton, Psychology) T 2:15–4:05

#161. Science, Values, and Anti-Intellectualism.  
2 units, Spr (Krauskopf, Geology) M 2:15–4:05

#171. Hypnosis and Personality.  
2 units, Spr (Hilgard, Psychology) M 2:15–4:05

#172. The Psychology of Mark Twain.  
2 units, Spr (Sears, Psychology) T 4:15–6:05

#176. The Individual and Society in Eighteenth Century French Literature.  
2 units, Spr (Cartwright, French and Italian) M 2:15–4:05

#178. The Writing of Albert Camus.  
2 units, Spr (Cohn, French and Italian) M 4:15–6:05

#179. The Artist and Society.  
2 units, Spr (——, French and Italian) given 1967–68

#180. International Communism.  
2 units, Win (Sxorakowski, Hoover Institution) T 2:15–4:05

#183. Christian Impact on Africa.  
2 units, Win (Minto, Chaplain of the University) Th 2:15–4:05

#184. Theological Atheism.  
2 units, Win (Clebsch, Religion) T 4:15–6:05

#190. Human Nature.  
2 units, Spr (Landauer, Psychology) T 2:15–4:05

#195. Social Science Approaches to Music.  
2 units, Aut (Farnsworth, Psychology) T 2:15–4:05

#200. Psychiatry for Amateur Psychiatrists.  
2 units, Aut, Win (Paulsen, Health Service and Medical School) T 8–10 p.m.
STANFORD LINEAR ACCELERATOR CENTER

Director: Wolfgang K. H. Panofsky
Deputy Director: Matthew Sands
Associate Directors: Joseph Ballam (Research Division); Robert H. Moulton, Jr. (Administrative Services Division); Richard B. Neal (Technical Division); Frederick V. L. Findar (Business Services Division)

Professors: Joseph Ballam, Sidney D. Drell, William F. Miller, Robert F. Mozley, Wolfgang K. H. Panofsky, Martin Perl, Matthew Sands

Associate Professors: Sam M. Berman, James D. Bjorken, David Leith, H. Pierre Noyes, Burton Richter

Senior Research Associates: Karl L. Brown, Jean V. Lebacqz, Richard B. Neal

The Stanford Linear Accelerator Center (SLAC) is devoted to experimental and theoretical research in elementary particle physics, and to developmental activities associated with accelerator and elementary particle physics technology. The major experimental facility of the Center is the two-mile-long linear electron accelerator which has been constructed on the campus under contract with the United States Atomic Energy Commission. The accelerator will reach operation for experimental physics during 1966. The Center is operated by Stanford as a national facility so that qualified scientists from universities and research centers throughout the country and the world, as well as those at Stanford, will participate in the high energy physics research program of the Center.

The Faculty of the Center offers a number of lecture series which cover both the experimental and theoretical aspects of high energy and elementary particle physics. In addition, seminars are offered on topics of current interest. Lecture series are announced at the beginning of the academic year.

Graduate students may work with members of the SLAC Faculty on research for their Ph.D. degrees with the approval of their departments. It is also expected that graduate students from other universities will participate in research programs at the Center.

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.

The Center is located on 480 acres of Stanford property west of the main campus, parallel to and south of Sand Hill Road. The principal buildings of the Center are now complete and are occupied by SLAC staff and other participating scientists.

The accelerator will provide an electron beam with a maximum energy of 20 BeV at maximum beam powers in the neighborhood of one megawatt. Research equipment in the target areas of the facility is being developed which will support a wide variety of experimental investigations.

UNDERGRADUATE SPECIAL PROGRAMS

Dean of Undergraduate Education: To be announced
Associate Dean: Robert R. Hind

UNDERGRADUATE SPECIAL COURSES

In 1964 the Committee on Undergraduate Education established a new category of courses for undergraduates to be called "Undergraduate Special Courses." These courses are not intended to introduce the technical content of the professional schools into the undergraduate curriculum, but are to be general in character. Their principal purpose is to enrich the curriculum for undergraduates by drawing upon the resources of the professional schools and other parts of the University which customarily have not participated in undergraduate work. A
second purpose is to offer an opportunity to introduce experimental courses, interdisciplinary courses, and other types which for various reasons might be listed as "Undergraduate Special" rather than under the auspices of a particular department.

In 1965–66, courses were offered by members of the faculty of the Graduate School of Business, the School of Medicine, the School of Education, the School of Engineering, and the Stanford Linear Accelerator Center. There will be similar offerings in 1966–67.

FRESHMAN SEMINARS
(Program for Undergraduate Creative Development)

The Freshman Seminar program, inaugurated in 1965–66, allows first-year students to explore in depth a subject that holds special personal interest for them and introduces them to other members of the university community who share this interest. Led by a faculty member or advanced graduate student, each seminar group of six to eight students meets for two quarters one afternoon or evening each week in the instructor's home or laboratory. The seminar offers an opportunity for the kind of extended study which can lead to the development of a genuine sense of intellectual and social community between student and instructor.

The Freshman Seminar program is neither an honors program nor an advanced placement program. Although a few seminars do have prerequisites, most are open to any student in the freshman class who is interested in the subject of the seminar and in the challenges of study in a seminar group. Each seminar carries a total of six units of academic credit (three units for each quarter), but fulfills neither the University's General Studies nor major subject requirements. Although students do receive a grade for their seminar work, in most cases this grade is not given until the end of the second quarter of the seminar.

In 1965–66, twenty-two departments or schools in the University participated in the seminar program, offering a total of thirty-eight seminars to approximately 265 members of the freshman class. Departments participating in the program were Biological Sciences, Classics, English, Geophysics, History, Political Science, Speech and Drama, Mathematics, Mechanical Engineering, Electrical Engineering, Computer Science, Music, Philosophy, Physics, Psychology, Sociology, Art and Architecture, and Geology, as well as the School of Medicine, the Hoover Institution, the Institute for the Study of Human Problems, and the Office of Undergraduate Education. There will be similar offerings in 1966–67.

APPLICATIONS AND ADMISSION PROCEDURES

All students who accept admission to Stanford University receive in June a copy of the Freshman Seminar booklet describing seminar offerings for the coming academic year. Approximately two-thirds of these seminars are scheduled for autumn-winter, with the remaining seminars meeting in winter-spring. Applications for the autumn-winter seminars are received and processed late in the summer; students are notified of their seminar status before they arrive at Stanford for preregistration. Except for seminars with prerequisites, seminar participants are chosen at random from among those who apply. Applications for the winter-spring seminars are processed in a similar manner late in the Autumn Quarter.

Correspondence regarding the program should be addressed to the Director, Freshman Seminars, Stanford University, Stanford, California 94305.
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