Courses and Degrees
1963-64
STANFORD UNIVERSITY BULLETINS

[Second-class postage paid at Palo Alto, California. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917. Authorized on August 23, 1918. Issued once a month in February, June, July, October, and November; twice a month in January, March and August; and four times in May.]

Published annually in

INFORMATION .........................................................January

SUMMER SESSION .....................................................February

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LET'S TALK ABOUT STANFORD ..............................October

STANFORD ENGINEERING NEWS. Published in January, March, May, July, and November. [School of Engineering. No charge.]

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THE REGISTRAR

STANFORD UNIVERSITY, STANFORD, CALIFORNIA

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STANFORD UNIVERSITY PRESS

STANFORD, CALIFORNIA
Courses and Degrees
1963-64

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## UNIVERSITY CALENDAR
### 1963

#### Autumn Quarter

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<th>Event</th>
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<tbody>
<tr>
<td>Sept. 23-24</td>
<td>Monday-Tuesday Registration</td>
</tr>
<tr>
<td>Sept. 25</td>
<td>Wednesday Instruction begins</td>
</tr>
<tr>
<td>Sept. 27</td>
<td>Friday Conferring of degrees</td>
</tr>
<tr>
<td>Sept. 29</td>
<td>Sunday Matriculation Sunday</td>
</tr>
<tr>
<td>Oct. 15</td>
<td>Tuesday Last day for registration</td>
</tr>
<tr>
<td>Oct. 22</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. 28-Dec. 1</td>
<td>Thursday-Sunday Thanksgiving Recess</td>
</tr>
<tr>
<td>Nov. 29</td>
<td>Tuesday Last day for filing A.B. and B.S. applications</td>
</tr>
<tr>
<td>Dec. 9</td>
<td>Monday Last day for filing theses</td>
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<tr>
<td>Dec. 9-13</td>
<td>Monday-Friday End-quarter examinations</td>
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#### 1964

#### Winter Quarter

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<tbody>
<tr>
<td>Jan. 6</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>Jan. 7</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>Jan. 10</td>
<td>Friday Conferring of degrees</td>
</tr>
<tr>
<td>Jan. 27</td>
<td>Monday Last day for registration</td>
</tr>
<tr>
<td>Feb. 3</td>
<td>Monday Last day for filing A.B. and B.S. applications for April and June conferral</td>
</tr>
<tr>
<td>Feb. 3</td>
<td>Monday Last day for filing advanced degree applications: A.M., M.S., Engineer for June conferral; Ph.D. for October</td>
</tr>
<tr>
<td>Feb. 8</td>
<td>Saturday Last day for filing Fellowship and Graduate Scholarship applications</td>
</tr>
<tr>
<td>Feb. 10</td>
<td>Monday Last day for filing Ph.D. dissertations</td>
</tr>
<tr>
<td>Feb. 21</td>
<td>Friday Holiday for Washington's Birthday</td>
</tr>
<tr>
<td>Mar. 9</td>
<td>Monday Founders' Day</td>
</tr>
<tr>
<td>Mar. 16</td>
<td>Monday Last day for filing theses</td>
</tr>
<tr>
<td>Mar. 16-20</td>
<td>Monday-Friday End-quarter examinations</td>
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#### Spring Quarter

<table>
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<th>Date</th>
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<tbody>
<tr>
<td>Mar. 30</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>Mar. 31</td>
<td>Tuesday Instruction begins</td>
</tr>
<tr>
<td>Apr. 3</td>
<td>Friday Conferring of degrees</td>
</tr>
<tr>
<td>Apr. 15</td>
<td>Wednesday Last day for filing Undergraduate Scholarship applications, matriculated undergraduates</td>
</tr>
<tr>
<td>Apr. 20</td>
<td>Monday Last day for registration</td>
</tr>
<tr>
<td>Apr. 20</td>
<td>Monday Last day for filing Ph.D. dissertations</td>
</tr>
<tr>
<td>Apr. 27</td>
<td>Monday Last day for filing advanced degree applications: A.M., M.S., Engineer for October conferral; Ph.D. for January</td>
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<tr>
<td>June 4</td>
<td>Thursday Last day for filing theses</td>
</tr>
<tr>
<td>June 5-10</td>
<td>Friday-Wednesday End-quarter examinations</td>
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<td>June 13</td>
<td>Saturday Senior Class Day</td>
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<tr>
<td>June 14</td>
<td>Sunday Baccalaureate Sunday</td>
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<td>June 14</td>
<td>Sunday Commencement</td>
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#### Summer Quarter

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<tr>
<td>June 22</td>
<td>Monday Registration</td>
</tr>
<tr>
<td>June 23</td>
<td>Tuesday Instruction begins</td>
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<tr>
<td>July 3</td>
<td>Friday Holiday for Independence Day</td>
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<td>Aug. 14-15</td>
<td>Friday-Saturday Eight-week term examinations</td>
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<td>Tuesday Quarter closes</td>
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DEGREES

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.

GENERAL STUDIES PROGRAM

The aims of education at Stanford are twofold—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, inaugurated at Stanford in 1956, is directed toward satisfying these aims and is the product of intensive study. They combine to create a better society and a more rewarding individual pattern for living. The General Studies Program 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 new 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 more 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 avocational 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 this lies a host of activities in student government, organizations, the Stanford Daily, literary endeavors, etc., in which the student may participate if he desires.

Requirements and options are set forth below. Candidates for the degree of Bachelor of Arts complete A, B, and C below. Candidates for the Bachelor of Science Degree complete A (Basic requirements) and B (Area requirements) only. Students
majoring in Engineering, Physics, Chemistry, Mineral Sciences, Mathematics, and Statistics are candidates for the Bachelor of Science Degree.

Note: No course may be taken to satisfy more than one General Studies requirement.

A. BASIC REQUIREMENTS FOR ALL STUDENTS

1. English 1, 2, 3—Freshman English (Composition and Literature)
2. History of Western Civilization—History 1, 2, 3
3. Foreign Language or Mathematics—Students may choose to complete either a foreign language or a mathematics series.
   a. Foreign Language
      Acquisition of a reading ability equivalent to that reached in the following courses: Chinese 21, French 23, 53, German 23, 53, Greek 23, Hebrew 23, Italian 23, Japanese 21, Latin 23, Russian 23, 53, 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
      (A series recommended for Social Science majors.)

4. Group Activity
   Students 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. Students who have had military service may be exempt from the group activity requirement.

B. AREA REQUIREMENTS FOR ALL STUDENTS

Every student is exempt from the General Studies Area Requirements within that area—humanities, social sciences (including communications, education, and history, 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:

1. Humanities—A minimum total of 8 units selected from General Studies courses in any 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
d. Political Science 1
   b. Economics 1
e. Psychology 1
   c. Geography 1
   f. Sociology 1

3. Natural Sciences—Students who have not taken biology in high school will take Biology 1, 2, 3. It is also possible to fulfill this requirement by taking the sequence intended for biology majors—Biology 20, 21. 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 (15 units)*
d. Chemistry 1, 2, 3 (13 units)
e. Geology 1, 2 (10 units)

Students who have taken both biology and a physical science in high school must take either a biology series or one of the complete series above.

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 Fr54, G54, R54, Sp54, or by taking a language reading course numbered 100 or higher. Certain courses in Chinese and Japanese with lower numbers will be accepted.)

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 e may be taken without laboratory in satisfaction of this requirement, but credit will be correspondingly reduced. Requirement “B3” must include laboratory.
   a. Biology 1, 2, 3; 20, 21
   b. Chemistry 1, 2, 3 (or 4)
c. Physical Sciences 1, 2, 3
d. Physics 21, 23, 29; 51, 52, 53, 54, 55, 56
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. Physiology 90
   l. Physical Sciences 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 Colloquia 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 the Humanities Honor Programs.

* 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.
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.

This 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, Engineering, or Nursing, or Departments of Chemistry, Mathematics, Physical Sciences, Physics, Physiology, or Statistics 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 minor requirements, 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 reregister
as an undergraduate and will be subject to the usual rules and regulations affecting undergraduates. Specific requirements may be obtained at the Registrar's Office.

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. 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 Secretary. Communications should be addressed to the Graduate Study Secretary, Registrar's Office, Stanford University, Stanford, California.

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.

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 Secretary 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 Secretary 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 office of the Graduate Study Secretary, 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 Business and the University. (Full particulars concerning these requirements will be found in the Bulletin of the Graduate School of Business.)

**Educational Specialist**

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 Educational Specialist (Ed.S.) is conferred on candidates who have satisfied the requirements laid down by the faculty of the School of Education and the University. 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.

**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 Secretary 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 Univer-
DEGREES

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 Secretary 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, 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 office of the Graduate Study Secretary, Registrar's Office.

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.)

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 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 in early music conducting, or music education parallel to the musicological studies leading to the Ph.D. degree in music. A minimum of three years of graduate study (or two years following a Master's degree) is required of each candidate. A final project 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,
DEGREES

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 Bulletin of the School of Medicine.)

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; he must complete at least one of these years (three quarters—a minimum of 36 quarter units) and the final units of credit in fulfillment of degree requirements as a registered student at Stanford University.

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 Uni-
versity 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 Secretary 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 shall be selected in individual cases by the mutual assent of the student and the major school or department. The languages so selected shall 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 shall 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 Secretary for the University oral examination. This examination shall not exceed three hours in length. It shall 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 Secretary 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 shall 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 shall be certified as having passed the examination.

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

Dissertation—Recommendation for the degree shall 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.

Plan A: By the close of the fifth week of the final quarter of candidacy in autumn or winter quarter, or by the close of the third week in spring or summer quarter, the candidate must submit to the Graduate Study Secretary (1) a minimum of four unbound typewritten copies of the dissertation, including one original copy, each copy bearing at least two department signatures, (2) two copies of an abstract of the dissertation, each copy bearing at least one department signature, and (3) two copies of a publication agreement signed by the candidate. Upon the receipt of a Plan A dissertation, the Dean of the Graduate Division shall appoint a special committee of three whose duty it shall be to read the dissertation, conferring with the candidate if it so desires, and to report to the Dean of the Graduate Division whether or not in its opinion the dissertation is of a scope and quality acceptable in fulfillment of this requirement for the degree. (Because of the small number of faculty members on duty, a Plan A dissertation submitted during any Summer Quarter will probably not be examined by a University reading committee until the following Autumn Quarter.)

Plan B: If an interdepartmental dissertation advisory committee is recommended
by the candidate's major department and appointed by the Dean of the Graduate Division at the beginning of a candidate's dissertation research, the signatures of all members of that advisory committee on the submitted dissertation constitute final University approval of the scope and quality of the dissertation, and further review by a University reading committee is not required. The deadline for submitting a signed Plan B dissertation to the Graduate Study Secretary is the last day of instruction in the final quarter of candidacy. (Plan B is not applicable to Graduate Division Special Programs.)

After its final acceptance, the dissertation shall be microfilmed and bound at the direction of the Graduate Study Secretary. A negative microfilm copy of the dissertation shall 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 Secretary. The abstract (600 words or fewer in length) shall be published in Dissertation Abstracts by University Microfilms. The candidate shall 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.
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 1964 will be eight weeks in length, except in certain schools which will offer ten-week courses.

This announcement includes, for the Summer Session of 1964, 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 1964.

GRADUATE SCHOOL OF BUSINESS

Dean: Ernest Comings Arbuckle

The objective of the Graduate School of Business is the education of mature students for professional careers in business administration. The academic programs include the two-year M.B.A. Program and the Doctoral Program (Ph.D.).

The M.B.A. Program stresses the general management approach and is designed for students who as undergraduates majored in the social sciences and humanities, sciences, and engineering. The "case method" is the primary tool of instruction, although other techniques, such as lectures and discussion, are employed whenever desirable. During the second year, M.B.A. students may take 15 quarter units (10 semester units) in other Schools and Departments at Stanford University. No specific undergraduate majors or courses are required for entrance, although prospective applicants are encouraged to include one year of college-level mathematics in their undergraduate programs.

Special bulletins giving detailed information on the M.B.A. Program may be obtained upon request from Dr. Nathaniel C. Allyn, Director of Admissions, Graduate School of Business, Stanford University.

The School of Business also offers a Doctoral Program leading to the Ph.D. degree for individuals interested in preparing themselves for college teaching and/or research. Doctoral applicants should write to Professor Oscar N. Serbein, Director, Doctoral Program, Graduate School of Business, Stanford University, for separate bulletins and application forms.
SCHOOL of EARTH SCIENCES

Dean: Charles Frederick Park, Jr.
Associate Dean: Konrad Bates 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 Air, Military, 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 air, 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
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 February 8 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.

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 Number</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>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</td>
<td>Physical Geology</td>
<td>Any</td>
<td>5</td>
</tr>
<tr>
<td>Geology 2</td>
<td>Historical Geology</td>
<td>W or S</td>
<td>5</td>
</tr>
<tr>
<td>Geology 25</td>
<td>Elementary Mineralogy and Crystallography</td>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>Geology 51</td>
<td>Elementary Petrology</td>
<td>W</td>
<td>5</td>
</tr>
<tr>
<td>Geology 105</td>
<td>Structural Geology</td>
<td>S</td>
<td>5</td>
</tr>
<tr>
<td>Geology 107</td>
<td>Geologic Field Techniques</td>
<td>S</td>
<td>3</td>
</tr>
<tr>
<td>Geology 108, 109</td>
<td>Field Geology (Note 1)</td>
<td>Summer</td>
<td>15</td>
</tr>
</tbody>
</table>

Total ................................................................. 62
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 Number</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 112.</td>
<td>Elementary Paleontology</td>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>Geology 70.</td>
<td>Introduction to Geochemistry</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>Geology 179.</td>
<td>Physics of Underground Fluids</td>
<td>W</td>
<td>5</td>
</tr>
<tr>
<td>At least 9</td>
<td>additional units in geology</td>
<td>Any</td>
<td>9</td>
</tr>
<tr>
<td>Geophysics 190.</td>
<td>General Geophysics</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56.</td>
<td>Elementary Physics</td>
<td>WSA</td>
<td>15</td>
</tr>
<tr>
<td>Mathematics 21, 22.</td>
<td>Calculus</td>
<td>Any</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics 23, or Statistics 50 or 110.</td>
<td></td>
<td>Any</td>
<td>3-5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>49-51</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 111.</td>
<td>Curatorial Methods</td>
<td>S</td>
<td>1</td>
</tr>
<tr>
<td>Geology 112.</td>
<td>Elementary Paleontology</td>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>Geology 113 or 114.</td>
<td>Systematic Invertebrate Paleontology</td>
<td>AW</td>
<td>5, 4</td>
</tr>
<tr>
<td>Geology 115.</td>
<td>Biological Oceanography</td>
<td>S</td>
<td>4</td>
</tr>
<tr>
<td>Geology 118.</td>
<td>Introduction to Micropaleontology</td>
<td>A</td>
<td>5</td>
</tr>
<tr>
<td>Geology 157.</td>
<td>Sedimentary Petrology</td>
<td>S</td>
<td>3</td>
</tr>
<tr>
<td>Geology 160.</td>
<td>Elementary Stratigraphy</td>
<td>W</td>
<td>3</td>
</tr>
<tr>
<td>Physics 21, 23, 29.</td>
<td>Elementary Physics</td>
<td>AWS</td>
<td>12</td>
</tr>
<tr>
<td>Statistics 50.</td>
<td>Elementary Statistics</td>
<td>AS</td>
<td>5</td>
</tr>
<tr>
<td>Biology 25.</td>
<td>Genetics</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>Biology 55.</td>
<td>General Ecology</td>
<td>W</td>
<td>3</td>
</tr>
<tr>
<td>Biology 189.</td>
<td>Quantitative Methods in Biology</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>53 or 54</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 70, 170.</td>
<td>Geochemistry</td>
<td>AW</td>
<td>6</td>
</tr>
<tr>
<td>Geology 179.</td>
<td>Physics of Underground Fluids</td>
<td>W</td>
<td>5</td>
</tr>
<tr>
<td>Geology 116.</td>
<td>Physical Oceanography</td>
<td>S</td>
<td>4</td>
</tr>
<tr>
<td>Geophysics 190.</td>
<td>General Geophysics</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 21, 22, 23, 24.</td>
<td>Calculus</td>
<td>Any</td>
<td>12</td>
</tr>
<tr>
<td>At least 6 additional units in basic science (Note 2)</td>
<td>Any</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56.</td>
<td>Elementary Physics</td>
<td>WSA</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>51</td>
</tr>
</tbody>
</table>

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.

Note 2: Courses to be selected from: Chemistry 112, 113, 171, 173; Physics 57, 61, 110, 111, 120; Mathematics 45, 130, 131; Statistics 50, 110.
*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 123, Optical Mineralogy; Geology 182, Geology of Petroleum; Geology 183, Ore Deposits; Geology 184, Engineering Geology; Geology 185, Hydrogeology.

*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, 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 over-all 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 number of undergraduates with superior scholastic records, interest, and ability the opportunity to undertake independent study and research during their last year or two of undergraduate training. Admission to the program is by invitation of the faculty of the Department of Geology and is contingent upon (a) a minimum grade average of B in all University work, and (b) prior completion of Geology 1, 2, 25, 51, and 105. Entry is possible at any time after the end of the sophomore year. The Honors Program consists of the following:

(a) The courses required of all geology majors:
   Chemistry 1, 2, 3; Mathematics 10, 11; Geology 1, 2, 25, 51, 105, 107, 108, 109.
(b) The courses in other science departments required for any one of the three regular curricula of the department.
(c) Geology 150 a, b, c and 6 units of Geology 155.
(d) At least 13 units of advanced course work in geology or related fields.

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. Certain courses such as Geology 225 and Geology 383 may be taken to satisfy all or part of the research requirement. 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.

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. Not more than 10 units of such work may be counted as part of the minimum total of 45 units. Geology 123 and 124 (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) with the following exceptions: Biology 20; Physics 57, 87, 89. 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 admittance to candidacy for the degree, as early as possible during 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 expressed in satisfactory form. 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

(Courses in the 200, 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, autumn, (Howard), MWF 8; lab., field trips by arrangement
or winter, (Page), MWF 8; lab., field trips by arrangement
or spring, (Davis), MWF 8; lab., field trips by arrangement
or summer (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, winter, (Graham), MWF 8; lab., field trips by arrangement
or spring, (Harbaugh), MWF 8; 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—Folds, faults, other structural features in outer part of the earth. Prerequisites: 1 and 51. Recommended: 2, Engineering 9.

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

107. Geologic Field Techniques—Introduction to geologic field methods, instruments. Prerequisites: 51 and 105 (the latter may be taken concurrently).

3 units, spring, (-----), 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.) Prerequisites: 1, 2, 25, 51, 105, 107. (Not open to women students.)

8 units, summer (first half), (Dickinson)

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
SCHOOL OF EARTH SCIENCES

rocks. Mapping will be mainly on aerial photographs, but will include control surveying and plane table methods. If possible, underground (mine) geologic methods will be presented briefly. Prerequisite: 108. (Not open to women students.)

7 units, summer (second half), (Dickinson)

116. Physical Oceanography—Prerequisites: Mathematics 22, Chemistry 3.

4 units, spring. (———), MTWTh 8

133. Principles of Geomorphology—Land forms; processes which create, modify them. Prerequisite: 1. Recommended: 2, 51, 70.

4 units, winter, (Howard), MWF 10; lab. F 1-4; field trips by arrangement

134. Map Interpretation—Topographic maps in interpretation of geologic structures, analysis of local and regional geomorphic development. Prerequisite: 133 (may be taken concurrently).

4 units, winter, (Howard), MWF 10; lab. F 1-4, to be given in 1964-65

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, autumn, (Staff), by arrangement

150b. Honors Seminar in Geology—Continuation of 150a.

2 units, winter, (Staff), by arrangement

150c. Honors Seminar in Geology—Continuation of 150a, b.

2 units, spring, (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


5 units, winter, (Hubbert), MTWThF 11


3 units, autumn, (Harbaugh), by arrangement

205. Research in Computer Applications in Geology—Guidance in development of methods for treating student's individual research data. Review of literature of statistical methods and of computer applications in geology. One seminar-type meeting per week.

1 to 5 units, winter, (Harbaugh), by arrangement

210. Geology of California.

3 units, spring, (Muller), TTh 11, F 1-4, alternate years, to be given in 1963-64

235. Photogrammetry and Photogeology—Photogrammetric principles, practices applicable to geology; geologic interpretations from air photos. Registration limited. See instructor before enrolling.

5 units, spring, (Howard), MWF 10; lab. W 1-4, one lab. by arrangement

301. Problems in Various Fields of Geology and Geochemistry.

Each quarter, (Staff), 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, autumn, (Page), TTh 11; seminar W 4:00-5:30

337. Seminar in Geomorphology.

2 units, winter, (Howard), by arrangement

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

2 units, winter, (Muller), W 1–4

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. Approximately 100 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, autumn, (Reitan), TTh 10; lab. TTh 1–4, one lab. by arrangement

51. Elementary Petrology—Origin, occurrence, classification of common rocks; emphasis on hand lens identification. Prerequisite: 25.

5 units, winter, (Dickinson), TTh 9; lab. TTh 1–4, one lab. by arrangement, optional field trip by arrangement

70. 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, autumn, (Krauskopf), MWF 8

123. 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, autumn, (Hutton), TTh 11; lab. (I) TTh 1–4; (II) MW 1–4, one lab. by arrangement

124. Petrography—Use of petrographic microscope in identifying, classifying rocks, determining origin, geologic history of rocks, rock masses. Prerequisites: 51 and 123.

5 units, winter, (Hutton), TTh 8; lab. TTh 1–4, one lab. by arrangement

127. Mineralogical Chemistry—(a) Aspects of crystal chemistry, crystal growth, and the properties of surfaces. (b) The distribution of major and minor elements between co-existing minerals. Prerequisites: 70 and 124 (the latter may be taken concurrently), or permission of instructor.

4 units, winter, (Reitan), MWF 10; seminar by arrangement

157. Sedimentary Petrology—Occurrence, characteristics of sedimentary rocks in relation to environment, processes of formation; work with petrographic microscope not included. Prerequisites: 2 and 51 or Pet. Engr. 151b.

3 units, spring, (Dickinson), TTh 1:15; one lab., field trips by arrangement

158. Seminar in Tectonics and Sedimentation—Relationships between tectonic activity and the formation of sedimentary rocks. Concurrent registration in 157 or permission of instructor required for enrollment. Prerequisites: 2, 51, 105 (the last may be taken concurrently).

1 unit, spring, (Dickinson), by arrangement

170. Geochemistry—Application of physical chemistry to geologic problems. Distribution of chemical elements in geologic environments. Prerequisites: 51 and 70, or 1 and Chemistry 171.

3 units, winter, (Krauskopf), TTh 9; lab. T 1–4 or W 1–4

207. Sedimentology—Characteristics, origin of sedimentary rocks as deduced from petrographic and field studies. Prerequisites: 124 and 157 (the latter may be taken concurrently).

4 units, spring, (Dickinson), M 1–4; two labs. by arrangement

223. Mineralogy of Sediments—(a) Laboratory methods for fractionating sedi-
ments. (b) Systematic study of mineral particles, with special reference to those of high density. Prerequisites: 124, and permission of instructor.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Semester</th>
<th>Time Schedule</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 units, spring, (Hutton), Th 9; lab. TTh 1–4, two labs. by arrangement</td>
<td>Advanced Petrology—Advanced topics of igneous and metamorphic petrology.</td>
<td>5</td>
<td>spring</td>
<td>(Compton), TWTh 8; lab. W 1–4, two labs. by arrangement, to be given in 1964–65</td>
<td></td>
</tr>
<tr>
<td>2 units, spring, (Krauskopf), by arrangement</td>
<td>Geochemistry of Ore Solutions—Prerequisites: 170 and 183.</td>
<td>2</td>
<td>spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 units, spring, (Compton), by arrangement, to be given in 1964–65</td>
<td>Seminar in Petrology—Selected topics on igneous, metamorphic rocks.</td>
<td>2</td>
<td>spring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 units, spring, (Krauskopf), by arrangement</td>
<td>Spectrographic Analysis—See Mineral Engineering 205.</td>
<td>2</td>
<td>each quarter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PALEONTOLOGY AND STRATIGRAPHY

111. Curatorial Methods in Paleontology.

1 unit, spring, (Keen), by arrangement

112. Elementary Paleontology—Prerequisite: 2.

5 units, autumn, (Mutter), MWF 11; lab. W 2-5, one lab. by arrangement

113. Systematic Invertebrate Paleontology—Mollusca, Echinodermata, Coelenterata. Prerequisite: 112.

5 units, winter, (Keen), MWF 9; lab. W 2-5, two labs. by arrangement

114. Systematic Invertebrate Paleontology—Brachiopods, Graptolites, Trilobites. Prerequisite: 112.

4 units, autumn, (Evitt), TTh 8; two labs. by arrangement

115. Biological Oceanography.

4 units, autumn, (Keen), MTWTh 9

118. Introduction to Micropaleontology—Principles, techniques of preparation, classification of various fossil plants and animals. Two lectures and two laboratory periods per week. Prerequisite: 113 or equivalent.

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

119. Stratigraphic Micropaleontology—Identification and interpretation of stratigraphically important microfossils.

4 units, winter, (Thalmann), lec. and lab. by arrangement

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

3 units, winter, (Mutter), TTh 10; lab. M 1-4

211. Paleoecology.

2 units, spring, (Thalmann), by arrangement

218. Research in Micropaleontology—Prerequisite: 118.

5 units, spring, (Graham), by arrangement

314. Seminar in Micropaleontology.

2 units, each quarter, (Graham, Thalmann), by arrangement

316. Palynology I—Introduction to study of microfossils smaller than 200 microns.

4 units, winter, (Evitt), by arrangement

317. Palynology II—Continuation of 316.

4 units, spring, (Evitt), by arrangement


2 units, each quarter, (Staff)

Readings in Paleobotany—See Biology 170.

Biogeography—See Biology 174.

Quantitative Methods in Biology—See Biology 189.
ECONOMIC GEOLOGY

182. Geology of Petroleum—Principles of occurrence, origin, and accumulation of petroleum. Laboratory consists of directed individual work in subsurface exploration in California’s Sacramento Valley. Use of digital computer in analysis of subsurface data. Two and a half-day field trip to Ventura Basin.

4 units, spring, (Harbaugh), MWF 10

183. Ore Deposits—Principles of occurrence, processes of deposition, structure of ores. Prerequisites: 51 and 105.

5 units, autumn, (Park), MTWTh 10; lab., field trips by arrangement

184. Engineering Geology—Application of geology to engineering practice in construction of dams, highways, foundations, etc. Prerequisite: 1. Recommended: 25, 51, and 105.

3 units, autumn, (Davis), TTh 8; lab. by arrangement, to be given in 1964–65


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

186. Development of Ground-Water Resources—Numerical, graphical analysis of pumping tests; interpretation of well hydrographs; field techniques used in ground-water surveys. Prerequisite: 185.

3 units, spring, (Davis), TTh 11; lab. by arrangement

265. Foreign Oil Fields.

3 units, autumn, (Thalmann), by arrangement


3 units, winter, (Reitan), M 2–4; two labs. by arrangement


1 unit, winter, (Harbaugh), by arrangement

383. Genesis of the Metallic Ores—Advanced study of mineral, district collections; emphasis on genesis, localization control. Prerequisite: 283.

6 units, spring, (Park), MW 10; labs. by arrangement

387. Seminar in Ore Deposits—Conference discussion of current problems, ideas in economic geology.

2 units, autumn, (Park), by arrangement

487. Seminar in Hydrogeology.

2 units, autumn, (Davis), by arrangement, to be given in 1964–65

Minerals in World Affairs—See Graduate Division Special Programs 287.

GEOPHYSICS

Executive Head: Joshua Lawrence Soske
The Henry Salvatori Professor of Geophysics: Joshua Lawrence Soske
Assistant Professors: To be named. Acting: Norman D. Watkins (autumn quarter)
Research Associates (by courtesy): William Earl Bell, David Grinnell 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:

CURRICULUM

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>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, 21, 22, 23, or 41, 42, 43 and 44</td>
<td>Analytical geometry and calculus</td>
<td>Any</td>
<td>18</td>
</tr>
<tr>
<td>Mathematics 130</td>
<td>Ordinary Differential Equations</td>
<td>A or W</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 131</td>
<td>Partial Differential Equations</td>
<td>W</td>
<td>3</td>
</tr>
<tr>
<td>Geology 1</td>
<td>Physical Geology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geology 2</td>
<td>Historical Geology</td>
<td>W or S</td>
<td>5</td>
</tr>
<tr>
<td>Geology 25</td>
<td>Mineralogy</td>
<td>A</td>
<td>4</td>
</tr>
<tr>
<td>Geology 51</td>
<td>Elementary Petrology</td>
<td>W</td>
<td>5</td>
</tr>
<tr>
<td>Geology 70</td>
<td>Geochemistry</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>Geology 105</td>
<td>Structural Geology</td>
<td>S</td>
<td>5</td>
</tr>
<tr>
<td>Geology 107</td>
<td>Geologic Field Techniques</td>
<td>S</td>
<td>3</td>
</tr>
<tr>
<td>Geology 108, 109</td>
<td>Field Geology (Note 1)</td>
<td>Summer</td>
<td>15</td>
</tr>
<tr>
<td>Geophysics 190, 191</td>
<td>Elementary Geophysics</td>
<td>AW</td>
<td>6</td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56</td>
<td>Elementary Physics</td>
<td>WSA</td>
<td>15</td>
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<tr>
<td>Physics 57</td>
<td>Atomic Physics</td>
<td>W</td>
<td>3</td>
</tr>
<tr>
<td>Physics 61</td>
<td>Optics and Wave Motion</td>
<td>S</td>
<td>3</td>
</tr>
<tr>
<td>Physics 110, 111</td>
<td>Mechanics</td>
<td>WS</td>
<td>6</td>
</tr>
</tbody>
</table>

As electives in the Geophysics Curriculum, the following courses are recommended: Geology 116, 123, 124, 170, 179; Physics 120, 121, 122 and Mathematics 45, 46, 132.

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.

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

3 units, autumn, (Watkins), MWF11

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

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

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

2 units, winter and spring, (Cox, Doell), TTh 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, autumn, (Soske), two lecs.; 3-hour lab. by arrangement


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

293. **Electrical Measurements in Exploration**—Prerequisites: Geology 107, 182, Mathematics 23, and Physics 55.

3 units, winter, (Soske), two lecs.; 3-hour lab. by arrangement

294. **Seismic Exploration**—Principles, uses of reflection, refraction seismographs
as aid to geological studies. Prerequisites: 191, Geology 107, 182, Mathematics 23, and Physics 55.

4 units, spring, (Soške), two lecs.; two 3-hour labs. by arrangement

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

328. 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 or equivalent.

5 units, winter, (Thompson), MWF 9; lab., seminar by arrangement, to be given in 1964–65

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

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

MINERAL ENGINEERING

Emeritus: Welton J. Crook (Professor)

Executive Head: Evan Just  
Professors: Evan Just, Norman A. Parlee  
Associate Professor: George A. Parks

OFFERINGS AND FACILITIES

The Mineral Engineering curricula are designed for the threefold purpose of making graduates competent in the technology of mining, mineral processing, 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.

PROGRAMS OF STUDY

Courses Taken by All Undergraduates

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 1, 2, 3.</td>
<td>General Chemistry</td>
<td>13</td>
</tr>
<tr>
<td>Math. 41, 42, 43.</td>
<td>Analytical Geometry and Calculus</td>
<td>15</td>
</tr>
<tr>
<td>Physics 51 to 56.</td>
<td>Engineering Physics</td>
<td>15</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>Econ. 1.</td>
<td>Elementary Economics</td>
<td>5</td>
</tr>
<tr>
<td>Social Sciences (Psychology 1 recommended)</td>
<td></td>
<td>5</td>
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<tr>
<td>Humanities (English 7 or 9, Art 60, or Music 1 recommended)</td>
<td>5</td>
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</table>
**MINERAL ENGINEERING**

Group Activities (General Studies Requirement) ........................................... (6)
Engr. 11. Engineering Mechanics ................................................................. 2
Engr. 15. Mechanics of Materials (see Note 1) ............................................. 3
Engr. 21. Mechanic of Fluids (See Note 2) .................................................... 4
Engr. 41 and 42. Circuits, Electronics and Electromechanics ............................. 8
Speech 20. Introduction to Public Speaking .................................................. 3
Geol. 1. Physical Geology ............................................................................... 5
Geol. 25. Elementary Mineralogy .................................................................... 4
Min.E. 100. Industrial Report ......................................................................... 1
Min.E. 101. Elements of Mining ..................................................................... 3
Min.E. 103. Principles of Mineral Processing ............................................... 4
Min.E. 105. Extractive Metallurgy Processes ................................................. 3
Min.E. 175 or 176. Field Trip ......................................................................... 3

Total ........................................................................................................... 126

**Mining Option**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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<tbody>
<tr>
<td>Geol. 51</td>
<td>Elementary Petrology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 183</td>
<td>Ore Deposits</td>
<td>5</td>
</tr>
<tr>
<td>Engr. 9</td>
<td>Engineering Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 114</td>
<td>Elementary Problems in Mining Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 115</td>
<td>Mine Exploration</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 117</td>
<td>Mine Mapping</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 118</td>
<td>Mining Methods</td>
<td>2</td>
</tr>
<tr>
<td>C.E. 20</td>
<td>Elementary Surveying</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 245</td>
<td>Advanced Construction Equipment and Methods</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 180</td>
<td>Elementary Structural Analysis</td>
<td>4</td>
</tr>
<tr>
<td>I.E. 108</td>
<td>Work Design and Measurement</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133</td>
<td>Industrial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

Total ........................................................................................................... 54

**Mineral Processing Option**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 50</td>
<td>Introductory Science of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 121</td>
<td>Solid State Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 171, 173, 175</td>
<td>Physical Chemistry</td>
<td>9</td>
</tr>
<tr>
<td>Chem. 176</td>
<td>Physical Chemistry Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Math. 24</td>
<td>Analytical Geometry and Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 106</td>
<td>Mineral Processing Design</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 107</td>
<td>High Temperature Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 109</td>
<td>Ore Testing Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics, Statistics or Computer Science (See Note 3)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>......................................................................</td>
<td>16</td>
</tr>
</tbody>
</table>

Total ........................................................................................................... 53
## Chemical and Extractive Metallurgy Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 171, 173, 175</td>
<td>Physical Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>Engr. 50</td>
<td>Introductory Science of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Math. 24</td>
<td>Analytical Geometry and Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 130b</td>
<td>Transport Phenomena</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 121</td>
<td>Solid State Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 127</td>
<td>Crystallography and X-ray Analysis</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 107</td>
<td>High Temperature Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 124</td>
<td>Physical Chemistry of Metal Refining</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 226</td>
<td>Corrosion and Electrometallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics, Statistics or Computer Science (See Note 3)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Total .......................................................... 54

## Management Option

(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 courses in the Graduate School of Business.)

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Econ. 5</td>
<td>Price Theory and Policy</td>
<td>5</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 108</td>
<td>Work Design and Measurement</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133</td>
<td>Industrial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>Lang. 1, 2, 3</td>
<td>Modern European Language</td>
<td>12</td>
</tr>
<tr>
<td>Phil. 3</td>
<td>Introduction to Logic</td>
<td>5</td>
</tr>
<tr>
<td>Pol.Sci. 1</td>
<td>Major Issues of American Public Policy</td>
<td>5</td>
</tr>
<tr>
<td>and Group A or B below:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (Mining)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geol. 51</td>
<td>Elementary Petrology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 183</td>
<td>Ore Deposits</td>
<td>5</td>
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<tr>
<td>Electives</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

Total .......................................................... 59

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 171, 173</td>
<td>Physical Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Min.E. 106, 107, 124</td>
<td>Mineral Processing Design, High Temperature Laboratory, Physical Chemistry of Metal Refining</td>
<td>8</td>
</tr>
<tr>
<td>Electives</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Total .......................................................... 59

## Recommended Electives

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 121</td>
<td>Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 152</td>
<td>Introduction to Operations Research</td>
<td>3</td>
</tr>
</tbody>
</table>
MINERAL ENGINEERING

3eol. 70 and 170. Geochemistry ........................................... 6

Mining Option
Chem. 171. Physical Chemistry ........................................... 3
3eol. 107. Geologic Field Techniques ................................. 2
3eop. 190. General Geophysics .......................................... 3
C.E. 240. Construction Planning ........................................ 2
Stat. 110. Statistical Methods in Engineering .......................... 4
C.S. 136. Use of Automatic Digital Computers ........................ 3

Mineral Processing Option
3eol. 123. Optical Mineralogy ........................................... 5
3eol. 283. Microscopic Study of Ore Minerals .......................... 3
I.E. 133. Industrial Accounting ......................................... 3
Min.E. 124. Physical Chemistry of Metal Refining .................... 3
Mat.Sci. 127. Crystallography and X-ray Analysis .................... 4
Phys. 57. Atomic Physics ............................................... 3

Chemical and Extractive Metallurgy Option
3eol. 283. Microscopic Study of Ore Minerals .......................... 3
Mat.Sci. 124, 125. Structural Control in Materials .................. 7
I.E. 133. Industrial Accounting ......................................... 3
Min.E. 106. Mineral Processing Design ............................... 2
Phys. 57. Atomic Physics ............................................... 3

Note 1: Engr. 11, 12, and 15 can be replaced by Math. 24 and Physics 110 and 111. Math. 130 is recommended with these.
Note 2: Chemical Engineering 130a may be substituted.
Note 3: Statistics 110, Computer Science 136, or a Math. elective will satisfy this requirement.

GRADUATE PROGRAM

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, and business. Emphasis is usually 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 large 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 six of which must be independent work on a research program; be registered in the graduate school for at least three quarters.
2. Overcome deficiencies in previous training. Not more than ten 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 Research</td>
<td>6</td>
</tr>
</tbody>
</table>

Mining Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.E. 133a</td>
<td>or Business 210-11, Industrial or Management Accounting</td>
<td>6</td>
</tr>
<tr>
<td>Min.E. 230</td>
<td>Mining Seminar</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 231</td>
<td>Mining Seminar</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 232</td>
<td>Mining Seminar</td>
<td>4</td>
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<tr>
<td>Electives</td>
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<td>18</td>
</tr>
</tbody>
</table>

Mineral Processing Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Min.E. 216</td>
<td>Mineral Processing Seminar (Engineering)</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 217</td>
<td>Mineral Processing Seminar (Research)</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 223</td>
<td>Equilibria and Kinetics in High Temperature Reactions</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td>Min.E. 226, Corrosion and Electrometallurgy</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td>Min.E. 225, Surface Chemistry and Flotation</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td>Min.E. 227, Heterogeneous Equilibria and Kinetics in Hydrometallurgy</td>
<td>3</td>
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<tr>
<td>Electives</td>
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</table>

Chemical and Extractive Metallurgy Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.E. 223</td>
<td>Equilibria and Kinetics in High Temperature Reactions</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 227</td>
<td>Heterogeneous Equilibria and Kinetics in Hydrometallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 228</td>
<td>Extractive Metallurgy Seminar</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 229</td>
<td>Principles of Steelmaking</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. Electives</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>18</td>
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</table>

Management Option

<table>
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<th>Units</th>
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<tbody>
<tr>
<td>Bus. 200-01</td>
<td>Business Economics</td>
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<tr>
<td>Bus. 210-11</td>
<td>Management Accounting</td>
<td>6</td>
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<tr>
<td>Bus. 220-21</td>
<td>Business Finance</td>
<td>6</td>
</tr>
<tr>
<td>Bus. 271</td>
<td>Employment Relationships</td>
<td>3</td>
</tr>
<tr>
<td>Mineral Engineering Electives</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

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 Stan-
ford. 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></td>
<td>Graduate School of Business Courses</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 110</td>
<td>Statistical Methods in Engineering</td>
<td>4</td>
</tr>
<tr>
<td>I.E. 152</td>
<td>Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 300</td>
<td>Advanced Research (Thesis)</td>
<td>10</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>25</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 student 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 (3) should he elect as his option Mineral Processing or Extractive Metallurgy, 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, autumn, winter, or spring, (Staff), by arrangement

101. Elements of Mining—Introduction to metal mining. Prospecting, development, mine plant and equipment, mining methods, mine-engineering problems in a condensed course as basis for advanced courses that follow. Serves needs of engineering or geological student who seeks general knowledge of mining.

3 units, autumn, (Just), by arrangement

103. Principles of Mineral Processing—Lectures and independent study of current techniques in mineral separation 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: Chem. 3, Physics 55, Math. 43.

4 units, autumn, (Parks), M 11 and two lecs. and one lab. by arrangement


3 units, winter, (Parlee), MWF 9

106. Mineral Processing Design—Selected topics in equipment and plant design, e.g., scale up problems in solid-liquid separations, comminution and flotation. Aimed
at developing facility in application of principles to engineering problems. Prerequisite: 103.

2 units, winter, (Parks), W 1-4 and one lec. by arrangement

107. High Temperature Laboratory—Lectures and laboratory experiments relating to high temperature processes, atmosphere control, and vacuum technology; thermodynamic and kinetic measurements. (Same as Materials Science 107.) Prerequisite: 105.

2 units, spring, (Parlee), TTh 1-4


2 units, spring, (Parks), W 1-4 and 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, autumn, (Staff), by arrangement

115. Mine Exploration—Lectures, discussion, seminar. A survey of how mines are found, including prospector, geological and geophysical methods, organization, and economic aspects. Prerequisites: 101 and Geology 51.

4 units, winter, (Just), by arrangement

117. Mine Mapping—Field mapping of underground workings, usually with tape and compass control, and emphasizing the recognition of lithology and structures underground. Field work is between the autumn and winter quarters or by arrangement otherwise. One hour per week during the autumn quarter class sessions are held to discuss field methods and study maps used by mining companies. Practice in mine surveying methods is available, optionally. Prerequisite: Geol. 105.

2 units, autumn, (Just), by arrangement

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

2 units, winter, (Just), by arrangement

124. Physical Chemistry of Metal Refining—Refining processes and the physical chemistry underlying them. Prerequisite: 105 or Chem. 173 or equivalent.

3 units, autumn, (Parlee), by arrangement

175. Field Trip—A ten-day field trip to various mining and smelting 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 or Materials Science. Given in alternate years with 176.

3 units, spring vacation, even numbered years, (Staff), by arrangement

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

3 units, spring vacation, odd numbered years, (Staff), by arrangement

177. Metallurgical Field Trip—Visits to metallurgical plants and laboratories.

1 to 3 units, autumn, (Parlee), by arrangement

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

1 or 2 units, autumn, winter, or spring, (Staff), by arrangement

GRADUATE COURSES

203. Advanced Solid Separations: Principles—A sequel to Min.E. 103. Advanced study of separation and auxiliary operations as listed under 103, excluding flotation and hydrometallurgy. Emphasis on use of elementary physical inorganic chemistry and solid state physics in critical study of principles. Prerequisites: 103 or equivalent, Chem. 175.

4 units, autumn, (Parks), MWF 11; one lab. by arrangement
205. Spectrochemical Analysis—Fundamentals of spectrochemical analysis and its application to study of rocks and minerals. Prerequisite: consent of instructor required. Enrollment limited to 6.  
5 units, autumn, (Reitan), MW 9; lab. MW 1-4; one lab. by arrangement

206. Advanced Solid Separations: Engineering—Advanced treatment of material covered in Min.E. 106. Lectures, reading and laboratory study emphasizing scale-up procedures and critical or comparative analysis of operations. Prerequisite: Min.E. 100 or equivalent.  
2 units, winter, (Parks), W 1-4; one lab. by arrangement

209. Separation Flowsheet Development—Advanced work with material similar to that covered in Min.E. 109 with emphasis on more difficult separation problems or diagnosis of problems in operating plants. Prerequisites: 109 or equivalent, Geol. 123 and Mat.Sci. 127 recommended.  
2 units, spring, (Parks), W 1-4 and 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 units, spring, (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 permission. Prerequisite: 107. Can be repeated with credit.  
1 to 3 units, winter, (Parks), by arrangement

1 to 3 units, autumn, winter, spring, or summer, (Parks), by arrangement

220. Drilling and Blasting—Lectures, discussions, and seminar on theory and practice of blast-hole drilling and blasting.  
2 units, spring, (Just), by arrangement

3 units, summer, (Parlee), by arrangement

225. Surface Chemistry and Flotation—Introduction to the principles of surface chemistry and their application in flotation. Lectures and laboratory. Prerequisites: 103, Chem. 176, Mat.Sci. 121, 122 or equivalent.  
3 units, spring, (Parks), TTh 10 and by arrangement, to be given in alternation with 227, odd numbered years only

226. Corrosion and Electrometallurgy—Electrochemical principles with applications to corrosion, electrolytic processes and energy conversion cells. (Same as Mat.Sci. 226.) Prerequisite: Chem. 173.  
3 units, winter, (Shepard), MW F 8

227. Heterogeneous Equilibria and Kinetics in Hydrometallurgy — Review of the principles of physical chemistry and their application to leaching, solvent extraction, and ion exchange and related processes. Lectures and laboratory. Prerequisites: Chem. 176, Mat.Sci. 121, 122 or equivalent.  
3 units, spring, (Parks), TTh 10 and by arrangement, to be given even numbered years

228. Extractive Metallurgy Seminar—Student seminars, discussions and guest speakers on various aspects of extractive metallurgy.  
3 units, spring, (Parlee), by arrangement

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 Chem. 171.

3 units, winter, (Parlee), by arrangement

230. Mining Seminar—Survey of recent and current practice.

4 units, autumn, (Just), by arrangement

231. Mining Seminar—Case histories, economics, design.

4 units, winter, (Just), by arrangement

232. Mining Seminar—New techniques, valuation, law, organization.

4 units, spring, (Just), by arrangement

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

Each quarter, (Staff), by arrangement

Minerals in World Affairs—See Graduate Division Special Programs 287.

PETROLEUM ENGINEERING

Emeritus: Frederick George Tickell (Professor)

Executive Head: Frank G. Miller
Professors: Sullivan S. Marsden, Jr. (on leave 1963–64), Frank G. Miller
Assistant Professor: ———
Research Associates (by courtesy): Thomas D. Mueller, Marshall B. Standing
Acting Instructor: E. Allen Breitenbach

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</td>
<td>General Chemistry</td>
<td>13</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>English 1, 2, 3</td>
<td>Freshman English</td>
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<tr>
<td>History 1, 2, 3</td>
<td>History of Western Civilization</td>
<td>12</td>
</tr>
<tr>
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<td>Stat. 110</td>
<td>Statistics for Engineering and Science</td>
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<td>Engr. 31</td>
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<td>C.E. 20</td>
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<td>Engr. 15</td>
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<td>Engr. 41</td>
<td>Circuits, Electronics, and Electromechanics</td>
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<td>Engr. 161</td>
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<td>Geol. 1</td>
<td>Physical Geology</td>
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<td>Geol. 2</td>
<td>Historical Geology</td>
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</tr>
<tr>
<td>Geol. 25</td>
<td>Elementary Mineralogy</td>
<td>5</td>
</tr>
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</tr>
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<td>Pet.E. 103</td>
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<td>Pet.E. 153</td>
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<tr>
<td>Restricted Electives</td>
<td></td>
<td>8</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>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<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>4</td>
</tr>
<tr>
<td>Pet.E. 271.</td>
<td>Advanced Production and Reservoir Engineering Laboratory.</td>
<td>3</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>2</td>
</tr>
<tr>
<td>Electives*</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>45</td>
</tr>
</tbody>
</table>

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

Engineer (Management Option)

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

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

Additional units needed to make up the required 90 may be electives selected with the consent of the student's adviser. The student must demonstrate by examination his ability to read one modern European language. He must maintain a C average in Graduate School of Business courses. In all other courses he must maintain a B
average. He must prepare a thesis specifically for the Engineer Degree. It is to have the approval of the supervising instructor and the University Committee on the Graduate Division.

**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 of the following languages: Russian, French, German 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 reapply 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 off-shore drilling; development and production methods of oil fields; transportation and storage; refining and petrochemicals; marketing. Chemical properties of petroleum and its products. Prerequisite: Chem. 3 (or consent of instructor.)

3 units, spring, (——), 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. Prerequisite: 103.

3 units, autumn, (——), T 1; lab. TTh 2-5

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

3 units, autumn, (Breitenbach), MWF 10

150b. **Formation Evaluation**—Lectures, problems. Continuation of Course 150a. Electric logging, radioactivity logging, sonic logging.

3 units, winter, (Breitenbach), MWF 9

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

2 units, spring, (Breitenbach), W 10

151a. **Petroleum Reservoir Fluids**—Lectures, problems. Chemical, physical properties of reservoir fluids. Gas laws, behavior of liquids, phase equilibria, viscosities of hydrocarbons; properties of subsurface waters. Prerequisite: 103.

3 units, autumn, (Miller), MWF 9


3 units, winter, (——), MWF 10
152. Development and Production Technology—Lectures, demonstrations, field trips. Oil field equipment for drilling, production. Prerequisite: 103.
   3 units, spring, (Miller), T 9–11, Th 9, alternate years, to be given in 1963–64

   4 units, winter, (———), TTh 1; lab. TTh 2–5

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, (———), by arrangement

   3 units, winter, (———), W 7–10 p.m., alternate years, to be given in 1963–64

   3 units, autumn, (Miller), MWF 11

   3 units, winter, (Miller), MWF 11

   3 units, spring, (Miller), MWF 11

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, autumn, (———), 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, winter, (———), by arrangement

272b. Natural Gas Engineering—Lectures, problems, and group discussion. Field separation processes, reserves estimation, underground storage. Prerequisite: Consent of instructor.
   2 units, spring, (Miller), by arrangement, alternate years, to be given in 1964–65

360. Advanced Work in Petroleum Engineering—Graduate level work in either experimental, computational or theoretical research. Advanced technical report writing.
   Any quarter, (Marsden, Miller), by arrangement
SCHOOL of EDUCATION

Emeriti: Warren D. Allen, Maud Merrill James, Lucien B. Kinney, Maud L. Knapp, Jesse Brundage Sears (Professors); Margaret Barr, Ernest Paul Hunt (Associate Professors)

Dean: I. James Quillen


Assistant Professors: Dwight W. Allen, Miriam B. Lidster, Marian S. Ruch, Helen W. Schrader

Acting Instructor: D. June Carlisle

Lecturers: R. Dudley Boyce, Guy H. Browning, Daniel T. Dawson, James B. Lyon, William H. Strand

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, Richard F. Carter, Howard Dallmar, William Paul Fehring, Charles E. Finger, James Gaughran, D. Conrad Jarvis, Payton Jordan, Raymond E. Lunny, Jr., Virginia Puich, and Clifford F. Weigle.

The School of Education is responsible for the preparation of teachers, supervisors, guidance workers, administrators, and other educational specialists. Four degrees with specialization in education are granted by the University: Master of Arts, Educational Specialist, Doctor of Education, and Doctor of Philosophy. Various teaching and educational service credentials are issued by state departments of education upon certification of the School that properly accredited work has been carried 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

Bachelor of Arts

The Bachelor of Arts degree in Education is available only to men majoring in physical education and in good standing in the five-year teaching credential program for physical education specialists. Candidates in the five-year elementary credential program must fulfill the A.B. requirements of a department outside the School of Education, although they should maintain a close relationship with a credential adviser during their undergraduate years. Candidates seeking a teaching credential in health education should first secure an A.B. degree from the Department of Health Education.

GRADUATE DEGREES

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, Educational Specialist, 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
- Overseas and/or Comparative Education
- Psychological Foundations of Education
- Social Foundations of Education
- Health Education
- General Curriculum
- Child Development
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
- Music
- Physical Education for Men
- Science
- Social Studies
- Speech and Drama

Candidates who select one of the fields of concentration indented 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.

A preliminary interview for all advanced degree candidates is required. 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 (with specializations, such as Physical Education for Men, Social Studies)
- 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. Preliminary application materials, listed below, 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.

3. Satisfaction of all requirements for the degree within four years after the formal application for the degree has been accepted.
4. Completion of student teaching or other appropriate practicum, or one year of teaching experience.
5. 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.

1. Research type: A thesis is required. Recommended for future doctoral candidates, research workers, and college teachers of 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, English, French and Italian, History, Mathematics, Modern European Languages, Physical Sciences, Sociology, Speech and Drama. 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.
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.
   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.

Educational Specialist

The degree of Educational Specialist (Ed.S.) is conferred, upon recommendation of the faculty of the School of Education and the University Committee on the Graduate Division, on students who complete satisfactorily the program of advanced study in education as outlined by the faculty of the School of Education and present a written report of some substantial educational project selected in conference with an adviser. This project will be based on some problem of importance in the candidate’s area of specialization and it must be read and approved by the adviser of the candidate. The program involves a minimum of two years of graduate study, one of which must be taken at Stanford.

This degree will provide an intermediate program of specialized training in education between the Master of Arts degree and the Doctor of Education or Doctor of Philosophy degree. When the degree is granted, the diploma will indicate the area of specialization of the candidate.

Encouragement to study for the degree is based upon recommendation by the adviser and approval of the Committee on Advanced Graduate Degrees of the School of Education. This committee will consider all available evidence relative to the candidate’s fitness to enter upon the program.

After preliminary admission to candidacy the work of the student progresses under the guidance of an adviser chosen by the student from the faculty members in the candidate’s field of concentration.

Educational Specialist programs are offered only in certain specified fields. Further information regarding fields and requirements for the Ed.S. degree may be obtained from the School of Education.

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, of which one full quarter (a minimum of 12 quarter units) must be outside the field of education. Evaluation of Stanford residence is based on tuition payments. Candidates for the degree will be required during the course of work to register at Stanford for a minimum of one academic year (three quarters). 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 in connection with college teaching.

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). 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 the organization of 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 an adviser in education.

CREDENTIALS FOR PUBLIC SCHOOL SERVICE

The University recommends to the State Department of Education the granting of credentials for service in the California public schools, and also recommends to the proper educational authorities in other states that such credentials be issued.

Persons desiring to secure credentials through Stanford University 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 the program. The Credential Secretary in the School of Education should be consulted as to the necessary procedure.

A candidate for any type of Stanford credential must complete the equivalent of one full year's work (three quarters) at the University. For the General Elementary, General Secondary, and Junior College Credentials two of the quarters must be devoted to full-time study; for the Administration Credentials one quarter must be devoted to full-time study. The remaining work (to total at least 39 units) may be
taken on a part-time basis by those candidates who are eligible for such type of registration. The program carried will depend upon the teaching major and minor and the professional objective of the candidate.

As requirements for teaching credentials in the State of California will be changed on July 1, 1963, candidates should consult the Credential Secretary in the School of Education for current information.

**ADMINISTRATION AND SUPERVISION CREDENTIALS**

The Stanford School of Education is authorized to recommend applicants for the following administration credentials:

- **The General Administration Credential**, which authorizes the holder to administer and supervise schools as a superintendent, deputy superintendent, assistant superintendent, principal, vice principal, supervisor, curriculum coordinator, or administrative assistant in elementary or secondary schools.

- **The Secondary School Administration Credential**, which authorizes the holder to administer and supervise a secondary school as superintendent, deputy superintendent, assistant superintendent, principal, vice principal, supervisor, curriculum coordinator, or administrative assistant.

- **The Elementary School Administration Credential**, which authorizes the holder to administer and supervise elementary schools as superintendent, deputy superintendent, assistant superintendent, principal, vice principal, supervisor, curriculum coordinator, or administrative assistant.

- **The School Supervision Credential**, which authorizes the holder to supervise or coordinate instruction in the area in which he holds his basic teaching credential.

**General Requirements**

The following are required of applicants for administration or supervision credentials:

1. A full year of study at Stanford University (a minimum of 39 quarter units).
2. A certificate from a physician that the applicant is physically and mentally fit to engage in school work.
3. A program of study approved by the adviser in the School of Education and filed with the Credential Secretary.
4. Verification of required years of experience at the appropriate level.
5. Qualifications for the basic teaching credential required.

A list of current advisers, programs of study, and order of procedure should be obtained from the Credential Secretary in the School of Education on or shortly after registration day in the first quarter of residence.

**TEACHING CREDENTIALS**

The Stanford School of Education is authorized by the State of California to recommend candidates for the following teaching credentials:

- **The General Elementary Credential**, which authorizes the holder to teach any or all subjects in all grades of any elementary school, including kindergarten.

- **The General Secondary Credential**, which authorizes the holder to teach in all grades of any junior college, senior high school, four-year high school, junior high school, or the seventh and eighth grades of elementary schools.

- **The Junior College Credential**, which authorizes the holder to teach in all grades of any junior college.

**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. The usual method of satisfying this requirement is by enrollment in Exposition (Speech 120a).
3) Fulfillment of the Constitution Requirement, either by passing an examination or by taking satisfactory course work. Either one of the following courses at Stanford will satisfy this requirement:
   - History 151
   - Political Science 10
4) Audio-Visual Requirement, three quarter units or equivalent. All credential candidates are required to take Education 241a before student teaching.
5) 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 upon request.

Exemption from Student Teaching (General Secondary and Junior College)—Part of the student teaching requirement may be waived for one year of successful teaching or student teaching elsewhere after satisfactorily completing 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 the three general credentials follows.

General Elementary Credential

A program of study for the California General Elementary Credential has been arranged whereby students may complete work for this credential at the time of receiving the Master's degree from the University. Students desiring to qualify for this credential should make application in the winter or spring quarters of the sophomore year. Applications are considered from juniors and seniors, provided vacancies exist in the program and a satisfactory course schedule can be arranged. Only a limited number of students (at present about 40 a year) are accepted into the General Elementary program.

Students working for this credential earn their A.B. degree outside the School of Education in accordance with credential requirements for the State of California. Students are urged to check with the chairman of this program in the School of Education concerning appropriate majors. One year of graduate study is completed within the School of Education. As a part of the work of the undergraduate years students must complete the following courses if they are to earn their credential in one academic year after the granting of the A.B.:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psych. 111. Child Psychology</td>
<td>4</td>
</tr>
<tr>
<td>Psych. 116. Development in Middle Childhood</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 143. The Elementary School in America</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 218. Health Foundations of Education</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 215. Psychological Foundations of Education</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 204. Philosophy of Education</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
</tr>
</tbody>
</table>

Failure to do so may necessitate attendance in the Summer Session after graduation.
The General Elementary teaching credential and the Master's degree are awarded following a year of graduate study. Requirements for the graduate year are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ed. 245a. Elementary School Student Teaching I</td>
<td>6</td>
</tr>
<tr>
<td>Ed. 244a. Curriculum and Instruction in Elementary Schools (Reading, Language, Arithmetic)</td>
<td>8</td>
</tr>
<tr>
<td>Ed. 244b. Curriculum and Instruction in Elementary Schools (Science and Social Studies)</td>
<td>8</td>
</tr>
<tr>
<td>Music 288. Music for Elementary Teachers</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 180. Art in the Elementary Schools</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 257. The Elementary School Program in Physical Education</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 241a. Audio-Visual Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Ed. 245b. Elementary School Student Teaching II</td>
<td>16</td>
</tr>
</tbody>
</table>

Total: 50

Admission to and retention in this program assumes an academic average of at least B— in undergraduate and graduate courses.

A program for the California General Elementary Credential is offered for a limited number of A.B. graduates from liberal arts colleges and universities who have had little or no work in professional education. Upon admission to this program the candidate will take four consecutive full-time quarters, summer through spring. Through successful completion of the program, the A.M. degree and the credential may be secured.

For further information concerning the General Elementary Credential program consult with or write to the Chairman of the Elementary Credential Committee in the School of Education.

**General Secondary Credential**

There are two alternate programs through which candidates may qualify for the Stanford General Secondary Credential, the regular Campus Program and the Internship Program. These programs are usually offered in conjunction with earning a Master's Degree.

A. The Campus Program:

To qualify for the Stanford General Secondary Credential, the candidate must complete the following:

1. Sixty quarter units of general education with a minimum of 9 quarter units in each of the following:
   a) Science and mathematics. (The Stanford General Studies program fulfills this requirement.)
   b) The practical arts and the fine arts, such as music, art, health education, physical education, industrial arts, and similar fields. (Courses in art and music are recommended to Stanford undergraduates.)
   c) Social Sciences. (The Stanford General Studies program fulfills this requirement.)
   d) The communicative arts, such as languages, literature, speech. (The Stanford General Studies program fulfills this requirement. Candidates for the credential, however, are required to take also Speech 120a.)

2. At least 39 quarter units in the following professional courses (or their equivalent).

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>210. Social Foundations of Education</td>
<td>4</td>
</tr>
<tr>
<td>215. Psychological Foundations of Education</td>
<td>4</td>
</tr>
</tbody>
</table>
3. At least a B— academic average in undergraduate and graduate courses.

4. At least 45 quarter units at Stanford in graduate standing. One third of the units must be in courses numbered 200 or above. For two quarters of this work, the candidate must be enrolled for full-time study. A minimum of 9 quarter units must be taken in graduate standing in the major or minor academic field.

5. A teaching major and teaching minor, as specified by the California State Department of Education and the Stanford academic departments. Requirements for specific majors and minors may be obtained from the Credential Secretary of the School of Education, Room 43.

6. A battery of tests to be completed not later than the autumn quarter of the year in which the credential is to be received.

7. Personal interview. (See below in Internship Program.)

B. The Internship Program:

This program is organized around two summer quarters of full-time academic work at the University and an intervening academic year of internship experience in teaching approximately half-time in public high schools in the vicinity of Stanford and participating in seminars at the University. Candidates for the internship program are admitted ONLY at the beginning of summer quarter each year. The program lasts for a minimum of fifteen months (five quarters).

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. The number of internships is limited and persons meeting minimum requirements are not assured admission to the program.

2. Closing date for filing applications. Complete applications (available from the Secondary Education Program Office, School of Education) should be filed no later than the first of March.

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.

   1. Friday, December 27, 1963
   2. Saturday, January 25, 1964
   3. Saturday, March 14, 1964

4. Notice of selection. Within three weeks after the personal interview candidates will be notified of selection.

5. School Internship. Cooperating high schools consider for employment persons who have been admitted to preliminary candidacy. School placement is a requisite of internship. Placement may be guaranteed for outstanding candidates at the time of admission. Employment interviews are arranged by the Intern Office. The normal internship pattern involves teaching three classes. In return, the intern receives approximately one half of the salary
for a beginning teacher (approximately $2500). The intern spends the balance of the school day in supplementary activities, such as classroom observation, as a part of the training program in the school in which he is teaching.

6. Course requirements. All interns take a series of seminars in professional education with related field experience which amounts to a total of 34 units. In addition, interns select 16 units of work in their academic major in consultation with their adviser.

7. Fees. Candidates pay full tuition for each of the summer quarters and are registered on a unit basis for the three quarters of internship. Some scholarship aid is available. Application for scholarships should be made after notification of selection.

8. Academic requirements must be met for the teaching major, minor, and general education as set by the California State Department of Education and Stanford University.

9. A battery of tests must be completed during the week prior to the beginning of the first summer quarter of work.

Junior College Credential

A candidate for the Junior College Credential will fulfill the following requirements:

A. Completion of professional course requirements, which include a course on the aims and scope of the junior college, practice teaching, audio-visual aids, fulfillment of the Constitution requirement, and a course in the methods of teaching the major. The methods courses are usually offered in autumn and summer quarters.

B. Completion of the Master of Arts degree in the teaching major.

C. 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, Room 43.

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

General Pupil Personnel Services Credential

Stanford University offers the General Pupil Personnel Services Credential with authorizations in counseling, psychometry, and psychology. For further information concerning this credential write to or consult with the chairman of the Pupil Personnel Services credential program in the School of Education.

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), *i.e.*, 218, Health Foundations of Education

- Administration (Digits 20–29), *i.e.*, 320, Advanced Public School Administration

- Guidance and Personnel (Digits 30–39), *i.e.*, 230a, Guidance in Elementary Schools
General Curriculum and Methods (Digits 40-49), i.e., 244c, Curriculum and Instruction in Elementary Schools
Testing, Evaluation and Research (Digits 50-54), i.e., 251, Educational Testing and Evaluation
Physical Education (Digits 55-79), i.e., 155, Elementary Analysis of Body Movement
Special Curriculum and Instruction in Other Fields (Digits 80-99), i.e., 280a, b. Curriculum and Instruction in Secondary School Art

FRESHMAN-SOPHOMORE

1. Introduction to the Study of Education—For future teachers; a general education experience for students in other fields. Surveys field of education but gives particular attention to structure, administration, policies of public school systems.
   3 units, winter, (Barth), MWF 10

JUNIOR-SENIOR

These courses are also open to graduate students.

111. Child Psychology—(Enroll in Psychology 111.)
116. Development in Middle Childhood—Development of the child from six to twelve. Research readings, observations, development of case study materials. Prerequisite: Psychology 111 or equivalent.
   4 units, winter, (P. Sears), MWF 9 and one 3-hour block by arrangement
119. Adolescent Development—(Enroll in Psychology 119.)
143. The Elementary School in America—An introductory course dealing with the historic foundations, structure, function, and purposes of the public elementary school. Opportunity is provided for guided classroom observation.
   3 units, winter, (——), MW 3 and 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, autumn, winter or spring, (Staff), by arrangement
180. Art in the Elementary Schools—Basic concepts and practice in art education for elementary school teachers.
   3 units, winter, (——), F 9. (I) F 10-12, T 2-4; (II) F 10-12, Th 2-4
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, spring, (Grommon), MWF 3

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, autumn, (Gross), W 7-10 p.m.
   or winter, (Gross), MWF 2
   or summer, (Gross), MTWTh 1
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.
   3 units, summer, (———)
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, winter, (Thomas), MTWTh 9
or spring, (Thomas), MTWTh 11
or summer, (Thomas), MTWThF 2

206. Comparative Education—Comparative study of education in several nations, cultural areas.

4 units, summer, (——), MTWThF 2

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, autumn, (——), MTWTh 1
or spring, (Bartky), MTWTh 10
or summer, (Bartky), MTWThF 11

215. Psychological Foundations of Education—Introductory course in application of psychological principles to educational practices. Prerequisite: Psychology 1 or equivalent.

4 units, autumn, (McDonald), MTWTh 11
or spring, (Gage), MTWTh 9
or summer (McDonald), MTWTh 8 and by arrangement

216. Statistical Analysis in Education—Introduction to statistical description and inference in study and conduct of education. No previous college mathematics necessary. This or equivalent required of all doctoral candidates unless specifically waived by adviser.

3 units, winter, (Atkinson), MWF 3
or 4 units, summer, (Coladarci), MTWThF 9

217. Mental Hygiene—Recent developments in theory and practice leading to understanding of bases for emotional, personality disturbances. Prerequisite: Education 115.

3 units, autumn, (P. Sears), W 7-10 p.m.

218. Health Foundations of Education—Relationship of health and education; nature of a practical school health program.

3 units, autumn, (Byrd), MWF 9
or winter, (Byrd), MWF 11
or 4 units, summer, (Byrd), MTWThF 9

219. Seminar in Secondary Education Internship—Application of the relevant scientific and humanistic disciplines to problems of teaching in secondary schools through the use of clinical materials. Taken during each quarter of internship. Limited to Secondary Education Interns.

2 units, autumn, (Bush, Staff), M 7-10 p.m.
or 1 unit, winter, (Bush, Staff), M 7-10 p.m.
or 2 units, spring, (Bush, Staff), M 7-10 p.m.
or 4 units, summer, (Allen, Staff), (I) MTWTh 1 and by arrangement; (II) MW 2-4 and by arrangement

219a. Special Seminar in Secondary Education Internship—Curriculum and instruction in individual teaching areas. Taken during each quarter of internship. Limited to Secondary Education Interns.

1 unit, autumn, (Allen, Staff), M 7-10 p.m.
or 2 units, winter, (Allen, Staff), M 7-10 p.m.
or 1 unit, spring, (Allen, Staff), M 7-10 p.m.
or 2 units, summer, (Allen, Staff), (I) TTTh 2-4 and by arrangement; (II) MW 2-4 and by arrangement
220. Introduction to Public School Administration—School district organization for administration; emphasis upon development, function of school administration.

3 units, winter, (Odell, Strand), Th 7–10 p.m.
or 4 units, summer, (Odell, Strand), MTWThF 9

221. Elementary School Administration—Roles, problems of elementary school principal with focus on administration of a single school. Course required for elementary school administrative and supervisory credentials.

3 units, autumn, (———), Th 7–10 p.m.
or 4 units, summer, (———), MTWThF 9

222. Secondary School Administration—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 principal.

3 units, spring, (Boyan), Th 7–10 p.m.
or 4 units, summer, (Boyan), MTWThF 11

222a. Secondary School Administration—Limited to students in the Administrator-Internship Program in Secondary Education. Analysis of the role, tasks, and responsibilities of the principal through the use of case studies and other clinical materials, including simulation.

4 units, summer, (Boyan) MW 1–3 and by arrangement

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, autumn, winter or spring, (James, Shaftel), by arrangement

227. Field Practice in Secondary School Administration and Supervision—Field practice in secondary school administration that will meet requirements for California Secondary School Administration Credential and California Supervision Credential. Consent of instructor required.

1 to 6 units, autumn, winter or spring, (Boyan, James), by arrangement

228. Case and Field Studies of the Junior College.

3 units, winter, (Mayhew), M 3–5 and by arrangement

229. Administration of School Health Program—Significant problems in school health facing school personnel.

3 units, spring, (Byrd), W 7–10 p.m.
or 4 units, summer, (Byrd), MTWThF 11


3 units, winter, (McDaniel), M 7–10 p.m.
or 4 units, summer, (———), MTWThF 3


3 units, spring, (P. Sears), MW 4:00–5:30
or 4 units, summer, (———), MTWThF 4

235a, b, c. Military Seminar—For military students on active duty enrolled at Stanford University.

3 units, autumn, winter or spring, (MacConnell), by arrangement

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 di-
rected teaching (239b) of regular college class in developmental reading, study skills.

4 units, autumn, winter, or spring, (Browning), by arrangement

241. Audio-Visual Aids—Theory and laboratory course to acquaint teachers with audio-visual principles, materials, equipment.

3 units, spring, (——), M 7-10 p.m.
or summer, (——), MTWTh 8

241a. Audio-Visual Laboratory—To acquaint student with the use of audio-visual equipment. Enrollment limited. Required of all credential candidates before student teaching. Must be taken concurrently with curriculum and instruction course in major field. (Students must enroll in School of Education office.)

1 unit, autumn or winter, (——), M 2, 3, or 4, or W 2, 3, or 4

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.

3 units, autumn, winter or spring, (Puich), by arrangement

243. Guided Observation—Opportunities are provided for observation of experienced elementary school teachers at work. Enrollment limited to candidates in the general elementary credential program.

4 units, summer, (——), MTWTh 9 and by arrangement

244a. Curriculum and Instruction in Elementary Schools—Methods of teaching in elementary school; particular emphasis on teaching of reading, related language arts, arithmetic. Prerequisite: admission to the elementary school credential program.

8 units, autumn, (Begle, Iverson), MTWTh 2-4

244b. Curriculum and Instruction in Elementary Schools—Continuation of 244a; particular emphasis on teaching of science, social studies; development of teaching units. Prerequisite: 244a.

8 units, winter, (Shaftel, Hurd), MTWTh 10-12

244c. Curriculum and Instruction in Elementary Schools—Advanced curriculum, instruction in elementary school for selected candidates in 5-year elementary credential program.

2 to 4 units, winter or spring, (——), by arrangement

245a. Elementary School Student Teaching I—Opportunity for students to observe, participate on limited basis in classroom activities, half-day assignment under guidance of experienced classroom teachers. Prerequisite: completion of all undergraduate requirements in the elementary credential program.

6 units, autumn (——, Staff), F 10-12 and by arrangement

245b. Elementary School Student Teaching II—Opportunity to observe, teach in elementary classroom; full day assignment under guidance of experienced classroom teacher. Prerequisite: 245a.

16 units, spring, (Sears, Staff), Th 7-9 p.m. and by arrangement

246. The American Secondary School—Orientation to American secondary school, primarily for student teachers; emphasis upon historical development, general curriculum problems. Prerequisites: 210, 215, and approval of Committee on Secondary Education.

3 units, autumn, (Iverson), MWF 8
or winter, (Iverson), MWF 8

247a. Participation and Observation in Secondary School Teaching—Directed observations in public elementary, secondary schools. Prerequisites: 210, 215, and approval of Committee on Secondary Education.

3 units, autumn, winter, or spring, (——), T 8 and by arrangement

247b, c, d. Student Teaching in Secondary Schools—Open only to candidates for Stanford General Secondary Credential. Prerequisites: adequate preparation in teaching major and minor, 246, 247a, and approval of Committee on Secondary
Education. Prerequisite or concurrent enrollment: methods course in teaching major. Students register for 9 units (and 22 hours by arrangement).

247b. 5 units, (major), autumn, winter, or spring, (——), M 4-6

247c. 4 units, (1st minor), autumn, winter, or spring, (——), M 4-6

247d. 5 units, (2d minor), autumn, winter, or spring, (——), M 4-6

248. Student Teaching in the Junior College.
6 units, autumn or spring, (Mayhew), by arrangement

249. Practicum in Secondary Education Internship—Field experience in local secondary schools. Summer: teacher aides and observation; regular school year: internship experience. Taken during each quarter of internship. Limited to Secondary Education Interns.

3 units, autumn, winter, spring, (Allen, Staff), by arrangement
or 2 units, summer, (Allen, Staff), M or T or W or Th 4:00-5:30 and by arrangement

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, summer, (Krumholz), MTWThF 1


3 units, spring, (Olkin), TTh 11:00-12:30

280a, b. Curriculum and Instruction in Secondary School Art—Lectures on foundations of art education; curriculum development in art education; exploration of methods and materials.

4 units, autumn, (——), TTh 4-6
or 2 units, winter, (——), Th 4-6

282a, b. Curriculum and Instruction in Foreign 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. Prerequisite or concurrent enrollment: L260.

4 units, autumn, (Politser), TTh 4-6
or 2 units, winter, (Politser), Th 4-6

284a, b. Curriculum and Instruction in Secondary School English—Evaluation of conflicting views of program 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.

4 units, autumn, (——), MW 4-6
or 2 units, winter, (Grommon), T 4-6


4 units, any quarter, (Weigle), by arrangement

286a, b. Curriculum and Instruction in Secondary School Speech and Drama—Theory, practice in curriculum and instruction in speech and drama.

4 units, autumn, (Schroder), TTh 4-6
or 2 units, winter, (Schroder), Th 4-6

289. Curriculum and Instruction in the Junior College—Curriculum and methods of teaching in student's teaching major. Students will be assigned to the specialist in methods of teaching this subject. See Curriculum and Instruction courses in major field for class hours.

3 units, winter, (Mayhew), T 4-6 and by arrangement
or 4 units, summer, (Mayhew), MTWThF 2

290a, b. Curriculum and Instruction in Secondary School Mathematics—Purposes and program of mathematics in secondary curriculum; teaching materials and methods.

4 units, autumn, (Begle), MW 4-6
or 2 units, winter, (Begle), W 4-6
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, summer, (Hurd), MTWTh 11:00-1:30; field trips F 11-5

294a, b. 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. Special attention to Science Fair, junior academy, field trip, junior research, special programs of scientific societies and industry for high school science students. Prerequisites: major or minor in science and graduate standing.

4 units, autumn, (Hurd), TTh 4-6
or 2 units, winter, (Hurd), T 4-6

295a, b. Curriculum and Instruction in Secondary School Social Studies—Emphasizes the methodology of social studies instruction; reviews curriculum trends; surveys teaching materials; provides opportunities to develop teaching and resource units.

4 units, autumn, (Gross), MW 2-4
or 2 units, winter, (Gross), W 4-6

299. Children's Literature—General survey of children's literature for both preschool, elementary school years.

3 units, winter, ( ), W 7-10 p.m., to be given in 1964-65

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, winter, (Thomas), MTWTh 11
or summer, (Thomas), MTWThF 10

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, summer, (Sanford), by arrangement

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, planning for future. (Enroll in Graduate Special 308.)

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

4 units, winter, (Quillen), MTWTh 10
or summer, (Quillen), MTWThF 10

314. Advanced Educational Psychology I—Frames of reference for defining appropriate educational relevance of psychology and research; the role and requirements of hypothesis development; current problems in educational research. For advanced graduate degree candidates. Prerequisite: 215 or equivalent; 216 or equivalent strongly recommended.

3 units, autumn, (Coladarci), MWF 1
or 3 units, winter, (Coladarci), MWF 1
or 4 units, summer, (Coladarci), MTWThF 11

315. Cultural Transmission—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, autumn, (Spindler), M 7-10 p.m.
or 4 units, summer, ( ), MTWThF 9
316. **Advanced Educational Psychology II**—Principles of learning and motivation relevant to the study of classroom behavior. Prerequisite: 314.
3 units, autumn, (McDonald), MWF 8
or spring, (McDonald), MWF 8

318. **Advanced Educational Psychology III**—Application of theories, concepts, research techniques of social psychology to the educational process. Prerequisite: 314.
3 units, winter, (Gage), MWF 3
or 4 units, summer, (McDonald), MTWThF 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.
3 units, autumn, winter, or spring, (Odell, Strand), W 7-10 p.m.

322a, b, c. **Seminar in Secondary School Administration and Supervision**—Designed primarily for students in the Administrator-Internship Program in Secondary Education. Critical analysis of problems of the secondary school principalship observed in internship assignments as related to function of the secondary school; its curriculum; appraisal of teaching and learning; pupil characteristics; patterns of organization of personnel and resources.
2 to 3 units, autumn, winter, and spring, (Boyce), W 7-9 p.m. and by arrangement

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, spring, (James), M 7-10 p.m.
or 4 units, summer, (James), MTWThF 2

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, summer, (Boyce), MTWThF 2

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, autumn and winter, (MacConnell, Staff), S 9-12

326a. **School Finance**—Principles, problems involved in financing public schools generally; emphasis upon practice, problems, trends in California.
3 units, autumn, (James), M 7-10 p.m.
or 4 units, summer, (James), MTWThF 3

326b. **Public School Accounting**—Designed to familiarize school administrators with techniques of fund accounting as applied to public school operations; emphasis upon applications consistent with requirements in California.
3 units, winter, (James), M 7-10 p.m.

326c. **Public School Business Administration**—Basic principles, methods, and problems in public school administration.
3 units, spring, (James), Th 7-10 p.m.

329. **American Higher Education II**—This course is a continuation of Graduate Special 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, winter, (Cowley), TTh 1-3

333a. **Counseling Techniques: The Interview**—Basic concepts, practices of counseling interview. For graduate students who expect to become school counselors.
4 units, winter, (McDaniel), MW 1-3
333b. Counseling Techniques: Testing—Study and practice with psychological tests employed in counselor's study of individual client. Experience in taking tests, administering them, analyzing and interpreting data.
4 units, winter, (Krumboltz), TTh 1-3

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.
3 units, autumn, (Krumboltz), T 4-5 and eight hours per week by arrangement
or winter, (McDaniel, Krumboltz), T 4-5 and eight hours per week by arrangement
or spring, (McDaniel, Krumboltz), T 4-5 and eight hours per week 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, autumn, winter, and spring, (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, spring, (McDaniel), TTh 1-3

338. Student Personnel Services in Higher Education—Critical examination of operation of student personnel services in American colleges and universities.
2 units, autumn or winter, (L. Allen), by arrangement

340. Supervision—Supervision is defined as face-to-face relationships between teacher, administrator. Emphasizes human relations problems that arise from this relationship.
3 units, spring, (Bartky), Th 7-10 p.m.
or 4 units, summer, (Bartky), MTWThF 10

4 units, autumn, (Bush), TTh 10-12
or 2-4 units, summer, (———), 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, autumn, (Shaftel), M 7-10 p.m.
or 4 units, summer, (———), MTWThF 11

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.
4 units, summer, (Shaftel), MTWThF 11

346. The Junior High School—Comprehensive survey of problems, issues confronting modern junior high school.
4 units, summer, (———)

347. The Junior College—Required of all candidates for junior college credential. Philosophy, problems of the junior college.
3 units, autumn, (Mayhew), M 7-10 p.m.
or 4 units, summer, (Mayhew), MTWThF 1

348. American Higher Education III—An examination of the self-continuity functions of colleges and universities: their administration and government. Although Graduate Special 308 and Ed. 329 are not prerequisites, students are encouraged to take them first.
4 units, spring, (Cowley), MW 1-3
349. Professional Education of Teachers—For doctoral candidates interested in studying programs and procedures for teacher education.
   4 units, spring, (———), TTh 1-3  
   or summer, (———), MTWThF 1

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, autumn, (Coladarci), MW 2-4  
   or spring, (Coladarci), MW 3-5

380. Recent Developments in Art Education—Current contributions of educational foundations to art education.
   4 units, summer, (———), TTh 4-6 and by arrangement

383. Recent Developments in Secondary School Foreign Languages—Basic assumptions, findings of scientific study of language as applied to language teaching methods. Adaptation of currently available textbooks to structural approach. Use of audio-visual aids in language class.
   4 units, summer, (———), TTh 2-4 and by arrangement

384. Recent Developments in Secondary School English—Recent research, materials, methods in secondary school English. For teachers who have had experience teaching English.
   4 units, summer, (———), MTWThF 11

387. Elementary School Language Arts—For experienced teachers, graduate students; reviewing research, curriculum issues, instructional procedures related to language arts in elementary schools.
   3 units, summer, (Iverson), MTWTh 8

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, winter, (Begle), by arrangement  
   or 4 units, summer, (———), MTWThF 10

391. Recent Developments in Secondary School Mathematics—Purposes and program of mathematics in secondary curriculum; teaching materials, methods. For experienced teachers only.
   3 units, summer, (enrollment limited to Shell Merit Fellows), (Begle), MW 2-4

393. Elementary School Science—Content, methods of elementary school science; emphasis on materials, techniques of instruction, curriculum organization, development of teaching units.
   4 units, summer, (———), MTWThF 8

394. Recent Developments in Secondary School Science—Current problems in enrollments; 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. Prerequisite: major or minor in science and teaching experience in science.
   4 units, spring, (Hurd), TTh 4-6  
   or 3 units, summer, (enrollment limited to Shell Merit Fellows), (Hurd), MW 2-4

   4 units, summer, (Gross), MW 2-4 and by arrangement

   4 units, autumn, (Shaftel), MTWTh 9  
   or summer, (Hanna), MTWThF 1
   4 units, summer, (——), MTWThF 8

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, winter, (Iverson), W 7-10 p.m.
or 4 units, summer, (Iverson), MTWThF 9

Economic Geography—See Geography 4.

Educational Television Station Operation—See Communication R201.

Human Geography—See Geography 1.

Instrumental Music in the High School—See Music 182.

Music for Elementary Teachers—See Music 288.

Music in the Junior High School—See Music 180.

Regional Geography—See Geography 8.

Teaching by Television—See Communication R203.

Vocal Music in the High School—See Music 181.

Seminars and Individual Study for Advanced Graduate Students

400i. Individual Study in the History of Education.
   (Gross)

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, spring, (Thomas), M 7-10 p.m.

404i. Individual Study in the Philosophy of Education.
   (Thomas)

406. Seminar in Comparative and Overseas Education—Restricted to candidates in this doctoral concentration.
   1 unit, autumn, (Spindler, Staff), W 12
or 2 units, winter, (Hanna, Spindler), Th 12 and by arrangement
   or spring, (Hanna, Spindler), Th 12 and by arrangement
or summer, (Hanna, Staff), W 12 and by arrangement

410i. Individual Study in Social Foundations of Education.
   (Quillen, Spindler, Thomas)

415. Seminar in Educational Psychology—Topical seminar for advanced students. Admission by permission of instructor.
   4 units, winter, (Coladarci), by arrangement
or spring, (Coladarci), by arrangement

415i. Individual Study in Educational Psychology.
   (Coladarci, McDonald)

416. Special Topics in Cultural Transmission—Seminar on cross-cultural data on cultural transmission. Prerequisite: 315 or permission of instructor.
   3 units, winter, (Spindler), F 3-6

   3 units, winter, (Atkinson), Th 7-10 p.m.

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, autumn, winter, or spring, (Boyce), by arrangement

420i. Individual Study in Administration.
   (Staff)
421. Seminar in School-Community Relations—Factors related to effective communication between schools and communities. Basis in communication theory for working techniques and principles for evaluating effectiveness. Research related to effective school-community relations.

3 units, spring, (Carter), 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.

3 units, autumn, winter, and spring, (MacConnell, Strand), Th 7-10 p.m.

424a, b, c. Seminar in Junior College Administration—Curricular, teaching, administrative and philosophical developments in Junior College Education.

3 units, autumn, winter, and spring, (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, Krumbolts), 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, autumn, (Krumbolts), Th 7:30-9:30 p.m.

or winter, (McDaniel, Krumbolts), Th 7:30-9:30 p.m.

or spring, (McDaniel, Krumbolts), Th 7:30-9:30 p.m.

or summer, (McDaniel, Krumbolts), by arrangement

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, autumn, (Krumbolts), MW 4:00-5:30

440. Seminar in the School Curriculum—Designed for advanced graduate students preparing for leadership positions in either public schools or colleges of education. Prerequisite: recent post-A.M. work in the foundations of education and post-credential work in the elementary and/or secondary school curriculum.

4 units, winter, (Hanna), TTh 8-10

or summer, (———), TTh 3-5 and by arrangement

443. Educational Leadership—Consideration of leadership problems of school administration. Leadership as a theory and a practice; specific emphasis on theory of group and individual leadership in a democracy.

2 units, winter, (Bartky), M 4-6

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, winter, (Shaftel), TTh 1-3

or spring, (Hanna), TTh 8-10

or summer, (———), MW 3-5 and by arrangement

444i. Individual Study in Elementary School Education.

(Hanna, Shaftel)


2 units, winter, (Bush), W 1-3 (Student Personnel emphasis)

or spring, (Bush), W 1-3 (Teacher Personnel emphasis)

or 4 units, summer, (Bush), MW 3-5 and by arrangement (Administration emphasis)

446i. Individual Study in Secondary Education.

(Staff)
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, autumn, winter, or spring, (Bush, Boyan, Allen), 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, winter, (Cowley), by arrangement

448i. Individual Study in Higher Education.

(Cowley, Mayhew)


1 to 10 units, any quarter, (Staff)

452. Educational Specialist Research.

1 to 10 units, any quarter, (Staff)


1 to 30 units, any quarter, (Staff)

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, autumn or spring, (Cowley), by arrangement

480. Seminar in Art Education—(Enroll in Art 480.)

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

(_______)

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

(Politzer)

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

(Grommon)

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

(Schroder)

487i. Individual Study in Elementary School Language Arts.

(Iverson)

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

(Begle)

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

3 units, autumn, (Hurd), Th 7-10 p.m.

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

(Hurd)

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

3 units, spring, (Gross), W 7-10 p.m.

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

(Gross)

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

(Iverson)

Physical Education Courses for Men Majors and Minors

Men students majoring in Physical Education may become candidates for the A.B., A.M., Ed.D., and Ph.D. degrees in Education, with specialization in Physical Education.

Also, men students may follow a major or minor sequence of study in Physical Education leading to teaching credentials for the State of California.
155. Elementary Analysis of Body Movement—Introduction to anatomical, mechanical aspects of human motion. Enrollment by permission of instructor.
   2 units, autumn or spring, (Ruch), TTh 8

156. Foundations of Physical Education—Historical, biological, psychological, sociological, educational bases of physical education.
   3 units, autumn, (Nixon), MWF 8

158. Community Recreation—Philosophy; programs; organization and administration; evaluation; research.
   3 units, winter, (Nixon), MWF 9

159. Evaluation in Physical Education—Evaluation in the school physical education program; test selection, construction, administration, and utilization of results.
   3 units, winter, (Nixon), MWF 8

   4 units, spring, (Ruch), MWF 1-3

171. Curriculum and Instruction in Men's Physical Education—Major emphasis on knowledge of the activities basic to school physical education and athletic programs. Also involves teaching techniques, curricular materials, and evaluation. Theoretical and practical training. Open only to physical education majors and minors. Not open to freshmen.
      2 units, winter, (Fehring), TTh 11 and by arrangement
   171b. Basketball.
      2 units, autumn, (Dallmar), T 9 and by arrangement
   171c. Football.
      2 units, spring, (Staff), TTh 10 and by arrangement
   171d. Track and Field.
      2 units, winter, (Jordan), MW 10 and by arrangement
   171g. Athletic Conditioning.
      2 units, any quarter, (Jarvis), by arrangement
   171h. Adapted Physical Education.
      1 unit, spring, (Ruff), M 1, to be given in 1964-65
   171j. Combatives.
      2 units, winter, (Lunny, Ruff), MWF 2, to be given in 1964-65
   171k. Volleyball, Soccer, Speedball.
      2 units, spring, (Ruff), MWF 2, to be given in 1964-65
   171m. Golf.
      2 units, winter, (Finger), MF 11 and by arrangement
   171n. Aquatics.
      2 units, spring, (Gaughran), TTh 11 and by arrangement
   171r. Gymnastics.
      2 units, winter, (Ruff), MWF 3 and by arrangement, to be given in 1964-65
   171s. Tennis.
      2 units, autumn, (Bugge), WF 11 and by arrangement

175. Administration of Physical Education—Principles of organization and administration applied to programs of physical education and interschool athletics; financial bases; supplies, equipment and facilities; legal aspects; other important management problems.
   3 units, spring, (Nixon), MWF 8

176. Intramural Programs—Administration of intramural sports programs: scope, medium of competition, scheduling, awards, point systems, equipment, finance, personnel problems.
   2 units, winter, (Bugge), TTh 9

257. The Elementary School Program in Physical Education (For Physical Education and Elementary Education majors)—Educational bases, types of
physical education activities included in elementary school program. Demonstration lessons in elementary school, experience in teaching activities.

4 units, winter, (Lidster, Staff), MW 1-3 and F by arrangement

271. Curriculum and Instruction in Men's Physical Education—Development of plans, procedures for organization, conduct of physical education programs. Includes survey of State courses of study.
4 units, autumn, (Nixon), MTWF 1

3 units, autumn, (Nixon), MWF 10
or 4 units, summer, (Nixon), MTWThF 8

357. Recent Developments in Public School Physical Education.
3 units, spring, (Nixon), M 7-10 p.m.
or 4 units, summer, (Nixon), MTWThF 9

358. Special Assignments, Physical Education.
1 to 5 units, any quarter, (Nixon), by arrangement

458i. Individual Study in Physical Education.
2 to 6 units, any quarter, (Nixon), by arrangement

HEALTH EDUCATION

Emeriti: George Sparr Luckett (Professor); Lois Pendleton Todd (Assistant Professor)

Executive Head: Oliver Erasmus Byrd
Professor: Oliver Erasmus Byrd
Assistant Professor: Robert D. Russell. Acting: B. Otis Cobb

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.B., A.M., and Ed.D. degrees with specialization in health education. Candidates not interested in the field of education may secure the A.B. and A.M. degrees through the Department of Health Education. A minimum of 30 units from the curriculum of the Department of Health Education plus 15 units in certain basic sciences is required for the A.B. degree. 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**

**H50. Science of Health**—Function, structure and application of component segments of contemporary medical science. Emphasis placed on health needs of the individual and resources available through application of scientific medical knowledge. Physician specialists are used as guest speakers when appropriate.

3 units, autumn, winter, or spring, (Cobb), MWF 9

**H106. 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, autumn, (Byrd), MWF 11

**H107. 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, autumn, (Cobb), MWF 10

**H109. 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, winter, (Cobb), W 7-10 p.m.

**H121. 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 most crucial for happy marriage—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, autumn, (Russell), Th 7-10 p.m. 
or 4 units, winter, (Russell), MW 3-5 
or spring, (Russell), MTWTh 9

**H122. International Health**—Health practices of other national or ethnic groups; an exploration of the premise that health behavior can be understood only as an integral part of a culture and its values. An approach to international understanding through consideration of issues related to health.

3 units, spring, (Russell), MWF 11

**H125. Family Health**—Study of marriage and family relationships with focus on health aspects—physical, mental, and social. Emphasis placed on the intertwining of health beliefs and practices with other facets of family living. H121 not a required prerequisite but a desirable one.

3 units, spring, (Cobb), to be given in 1964–65

**Graduate Courses**

**H200a,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.

4 units, autumn, (Russell), TTh 2-4 
2 units, winter, (Russell), by arrangement

**H206. Pupil Health Emergencies**—First aid, medical and legal procedures involved in teacher, nurse and school management of pupil health emergencies.

3 units, autumn, (Cobb), to be given in 1964–65

**H207. 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, spring, (Cobb), M 7–10 p.m.

**H214. 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, winter, (Byrd), MTWTh 9
or summer, (Byrd), by arrangement

**H215. 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, (Staff), by arrangement

**H305. 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

**H400. Individual Study in Health Education.**

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

**H405. 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, spring, (Staff), W 2–4
SCHOOL of ENGINEERING

Dean: Joseph Mayo Pettit
Associate Deans: James Monroe Gere (instruction), Leroy Farrell McGhie, William Ralph Rambo (research), Lauress Lee Wise
Secretary of the Faculty: James Monroe Gere
Professor at Large: Peter Andrew Sturrock (Engineering Science)

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 Division of Engineering Mechanics and the Institute for 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 should have taken high school English and mathematics through trigonometry. Extra supervised study of English is required of students who have special difficulties in reading or writing as shown by a departmental test. Tests on algebra and trigonometry are given by the Mathematics Department before final enrollment in engineering mathematics courses. Students who do not pass the placement tests will be required to take Mathematics A, Algebra, and/or Mathematics C, Trigonometry, in addition to the normal graduation requirements. High school courses in physics, chemistry, machine drawing, biological science (biology, botany, or zoology), and more advanced mathematics are recommended but are not required.

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

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 curricula offered by the departments responsible for the undergraduate programs, namely Chemical, Civil, Electrical, Industrial, Mechanical Engineering, and Materials Science, are accredited by the national organization responsible for accredi-
iting of undergraduate curricula: The Engineers' Council for Professional Development.

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 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).

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**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56, 57. Engineering and Atomic Physics</td>
<td>18</td>
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<tr>
<td>Math. 41, 42, 43, 44. Analytic Geometry and Calculus (See Note 1)</td>
<td>18</td>
<td></td>
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<tr>
<td>Chemistry (See Note 2)</td>
<td>8 or 13</td>
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<tr>
<td>Statistics (See Note 3)</td>
<td>3 or 4</td>
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<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>9</td>
<td></td>
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<tr>
<td>History 1, 2, 3. History of Western Civilization</td>
<td>12</td>
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<tr>
<td>General Studies Humanities (See approved list of courses)</td>
<td>5</td>
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<tr>
<td>General Studies Social Sciences (See approved list of courses)</td>
<td>10</td>
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<tr>
<td>English 129. Scientific Writing</td>
<td>3</td>
<td></td>
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<tr>
<td>Speech 20. Public Speaking (See Note 4)</td>
<td>3</td>
<td></td>
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<tr>
<td>Engr. 9. Engineering Drawing</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Engr. 11, 12. Engineering Mechanics</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Engr. 15. Mechanics of Materials (See Note 5)</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mechanics of Fluids (See Note 6)</td>
<td>3 or 4</td>
<td></td>
</tr>
<tr>
<td>Thermodynamics (See Note 7)</td>
<td>3 or 5</td>
<td></td>
</tr>
<tr>
<td>Engr. 41, 41L, 42, 42L. Circuits, Electronics, Electromechanics</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Engr. 50. Introductory Science of Materials</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Engr. 161. Engineering Economy (See Note 8)</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Total | 124 to 133

Note 1. 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 2. Chemical Engineering majors take Chemistry 5, 6, 7. General Chemistry, 13 units; all others take Chemistry 1, 2. General Chemistry, 8 units.

Note 3. Stat. 110, Statistical Methods, 4 units, or Stat. 27, Probability Theory, 3 units. (Consult adviser.)

Note 4. The General Studies Humanities requirement is at least 8 units selected from the list of courses given in the section on the General Studies Program. Speech 20 is a requirement of the School of Engineering and may also be offered as partial fulfillment of the University requirement.

Note 5. This requirement is also satisfied by taking Engr. 18, Mechanics of Deformable Bodies.
Note 6. Engr. 21, Mechanics of Fluids, 4 units, or Chem. Engr. 130a, Transport Processes, 3 units. (Consult adviser.)

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.

Note 8. This requirement is also satisfied by taking Engr. 60, Engineering Economy, or Engr. 61, Engineering Economy—Tutorial.

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 only
- Engr. 9 should be taken freshman year
- Engr. 11 should be taken before end of sophomore year
- Engr. 12, 15, 21, 31, 41, 41L, 42, 42L 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, 41L, 42 before end of sophomore year.

1. Supplementary Requirements, Chemical Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch.E. 100</td>
<td>Industrial Chemical Calculations</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 120a,b</td>
<td>Chemical Engineering Thermodynamics</td>
<td>6</td>
</tr>
<tr>
<td>Ch.E. 130b,c</td>
<td>Transport Processes</td>
<td>6</td>
</tr>
<tr>
<td>Ch.E. 140a,b,c</td>
<td>Chemical Engineering Unit Operations</td>
<td>9</td>
</tr>
<tr>
<td>Ch.E. 141a,b</td>
<td>Chemical Engineering Laboratory</td>
<td>6</td>
</tr>
<tr>
<td>Ch.E. 150</td>
<td>Applied Chemical Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 121, 123</td>
<td>Organic Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Chem. 122</td>
<td>Organic Preparations</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 171, 175</td>
<td>Physical Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Chem. 176</td>
<td>Physico-Chemical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>Approved Electives (See Note 1)</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>70</td>
<td></td>
</tr>
</tbody>
</table>

In order to allow time for the above courses, the following may be omitted from the list of “Courses Normally Taken by All Engineering Students”: Engr. 42, 42L, 50, Engl. 129, Physics 57.

Note 1. Some suggested electives are: Math 45, 46, 106, 107, 131, 132, 136, 137, 138; Physics 57; Engr. 42, 42L; Chem. 112, 113, 116, 125.

2. Supplementary Requirements, Civil Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>M.S. G1.</td>
<td>Geology</td>
<td>5</td>
</tr>
<tr>
<td>C.E. 20.</td>
<td>Surveying</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. 116.</td>
<td>Plain Concrete</td>
<td>3</td>
</tr>
</tbody>
</table>
C.E. 118. Materials Engineering ........................................... 3
C.E. 126. Advanced Surveying ............................................... 4
C.E. 138. Specifications and Contracts ................................. 3
C.E. 150. Transportation Engineering ..................................... 3
C.E. 160. Hydrology .......................................................... 3
C.E. 161. Hydraulic Structures ........................................... 3
C.E. 170. Man and His Environment ...................................... 3
C.E. 180. Elementary Structural Analysis ............................... 4
C.E. 181. Structural Design ................................................ 3
C.E. 182. Structural Design ................................................ 4
C.E. 190. Soil Mechanics and Foundations ............................. 4
C.E. 198. Senior Report ..................................................... 1

Elective Courses as below .................................................. 10

Total .................................................................................... 65

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**: C.E. 144. Construction Estimates and Costs (3 units); C.E. 145. Construction Equipment and Methods (3 units); I.E. 133. Industrial Accounting (3 units) (or I.E. 133a, 5 units); C.E. 151. Highway Engineering (3 units); C.E. 183. Structural Design (2 units); Psych. 113. Industrial Psychology (3 units); Psych. 192. Industrial Relations (4 units).

**Highways**: C.E. 151. Highway Engineering (3 units) plus 7 or more units among:
- C.E. 144. Construction Estimates and Costs (3 units);
- C.E. 145. Construction Equipment and Methods (3 units);
- C.E. 162. Hydraulic Engineering (3 units);
- C.E. 183. Structural Design (2 units);

**Hydraulics and Fluid Mechanics**: C.E. 162. Hydraulic Engineering (3 units);
- C.E. 163. Hydraulic Machinery (2 units);
- C.E. 166. Sanitary Engineering (3 units);
- C.S. 136. Computers (3 units);
- Math. 106. Complex Variable (3 units);
- Math. 130, 131, 132. Differential Equations (9 units).

**Hydrology**: C.E. 162. Hydraulic Engineering (3 units);
- C.E. 166. Sanitary Engineering (3 units);
- C.S. 136. Computers (3 units);
- Geol. 185. Hydrogeology (5 units);
- Math. 130. Ordinary Differential Equations (3 units);

**Nuclear Design**: Engr. 171. Introduction to Nuclear Engineering (3 units) plus 7 units from C.E. 166. Sanitary Engineering (3 units); C.E. 172. Environmental Radioactivity (3 units);
- Math. 130. Differential Equations (3 units);

**Public Works Administration**: Pol.Sci. 100. Public Administration (5 units);
- C.E. 166. Sanitary Engineering (3 units);
- I.E. 133. Industrial Accounting (3 units);
- Pol.Sci. 103. State and Local Government (5 units);
- Pol.Sci. 105. Public Personnel Administration (5 units).

**Sanitary Engineering**: Biology 1 and 2 (6 units); Medical Microbiology 101.
- General Bacteriology (5 units);
- C.E. 166. Sanitary Engineering (3 units);
- C.E. 172. Environmental Radioactivity (3 units).

**Structural Design**: C.E. 183. Structural Design (2 units);
- C.E. 184. Statically Indeterminate Structures (3 units);
- C.E. 162. Hydraulic Engineering (3 units);
- C.E. 166. Sanitary Engineering (3 units);
- Math. 130. Differential Equations (3 units).

**Structural Mechanics**: C.E. 184. Statically Indeterminate Structures (3 units);
- Math. 130 and 131. Differential Equations (6 units);
- Math. 45. Advanced Calculus (3 units);
- M.E. 160. Engineering Dynamics (3 units);
- C.S. 136. Computers (3 units).
Water Resources:  C.E. 162. Hydraulic Engineering (3 units); C.E. 166. Sanitary Engineering (3 units); I.E. 133. Industrial Accounting (3 units); Pol.Sci. 100. Public Administration (5 units).

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

Course No. | Subject | Units
---|---|---
E.E. 103. | Principles of Fields and Waves | 3
E.E. 104* | Circuits | 10
E.E. 128. | Control Systems | 3
E.E. 150, 151, 152. | Electronics | 9
E.E. 156, 157. | Laboratory | 4
E.E. 138 or E.E. 170. | Laboratory ; or Math. 136. Use of Digital Computers | 3
Optional program A, B, or C as below | | 18

Total | | 53

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

List A

Course No. | Subject | Units
---|---|---
E.E. 108. | Illumination | 3
E.E. 124. | Electromechanics | 3
E.E. 138. | Control Systems Laboratory | 3
E.E. 200. | Seminar | 1
C.S. 5. | Computer Programming for Engineers | 2
C.S. 136. | Use of Automatic Digital Computers | 3

List B is for students who expect to engage in technical electrical engineering work such as design or operation of apparatus, 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 18 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

Course No. | Subject | Units
---|---|---
Math. 130. | Ordinary Differential Equations | 3
E.E. 124. | Electromechanics | 3
E.E. 233. | Network Theory and Analysis | 3
E.E. 138. | Control Systems Laboratory | 2
E.E. 108. | Illumination | 3
E.E. 200. | Seminar | 1
C.S. 136. | Use of Automatic Digital Computers | 3

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, and also 12 units are to be elected from reasonably advanced courses in engineering, physics, mathematics, and chemistry (such as Engr. 152, E.E. 138, 171, 233, Math. 45, 46, 106, 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

Course No. | Subject | Units
---|---|---
Phys. 110, 111. | Intermediate Mechanics | 6
Math. 130. | Ordinary Differential Equations | 3
E.E. 161. | Electronic Circuits | 3
E.E. 235. | Network Analysis; or E.E. 242. Linear Systems | 3
Electives, restricted as above | 12
Omissions as above | (-9)

Total | 18

4. Supplementary Requirements, Engineering Science

Courses | Subject | Units
---|---|---
Math. 130, 131 (Diff. Equations), 45, 46 (Adv. Calculus) | 6
Restricted Electives in Engineering Science (see below) | 21 or more
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 five courses listed: M.E. 122, Mechanical Engineering Laboratory (3 units); E.E. 156, 157, Electrical Engineering Laboratory (4 units); E.E. 170, 171, 172, Electronic Measurements (9 units); E.E. 138, Control Systems
Laboratory (2 units); E.M. 205, Experimental Stress Analysis (3 units); C.E. 107, Mechanics of Fluids (2 units); C.E. 114, Mechanics of Materials (3 units); C.E. 118, Materials Engineering (3 units); C.E. 180, Elementary Structural Analysis (4 units); C.E. 281, Theory of Structures (3 units); C.E. 282, Statically Indeterminate Structures (3 units); E.E. 103, Principles of Fields (3 units); E.E. 104, 105, 106, Electric Circuits (10 units); E.E. 116, Transients (2 units); E.E. 124, Electromechanics II (3 units); E.E. 128, Control Systems (3 units); E.E. 150, 151, 152, Electronics (9 units); E.E. 158, Semi-conductor Electronics (3); E.E. 160, Electronic Circuits (3 units); E.E. 234, 235, Network Analysis (6 units); E.E. 242, Linear Systems (3 units); E.E. 270, Elementary Electromagnetic Theory (3 units); E.M. 221, 222, 223, Advanced Dynamics (6 units); M.E. 118, Differential Equations in Engineering (3 units); M.E. 132, 133, 134, 135, 136, Engineering Thermodynamics (16 units); M.E. 160, 161, Engineering Dynamics (6 units); Engr. 171, Introduction to Nuclear Engineering (3 units); Engr. 104, Dynamic Response (3 units); Engr. 152, Electric and Magnetic Properties of Materials (3 units); C.S. 136, Use of Automatic Digital Computer (3 units).

Restricted Electives in Basic Science: A total of 9 units selected from the following list of courses, except that no course may be used to satisfy more than one requirement: Math 45, 46, Advanced Calculus (6 units); Math. 130, 131, 132, Differential Equations (9 units); Math. 106, 107, Functions of a Complex Variable (6 units); Math. 114, Matrix Theory (3 units); Math. 137, 138, Numerical Methods (6 units); Stat. 27, Introduction to Theory of Probability (3 units); Stat. 110, Statistical Methods in Engineering (4 units); Stat. 116, Theory of Probability (4 units); Physics 61, Optics and Wave Motion (3 units); Physics 140, Elementary Nuclear Physics (3 units); Physics 210, 211, 212, Introduction to Theoretical Physics (9 units); Physics 130, 131, 132, Elementary Quantum Mechanics and Atomic Structure (3 units); Physics 170, Thermodynamics (3 units); Physics 171, Introduction to Statistical Mechanics (3 units); Physics 172, Physics of Solids (3 units).

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

Special Notes:
1. 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.”
2. A petition to the School of Engineering is required for admission to this curriculum, as described later under the general heading “Engineering Science.”

5. Supplementary Requirements, General Engineering

Additional courses constituting a coherent program and totaling at least 56 units are required. A minimum of 20 of these units must be in regularly scheduled courses offered by the School of Engineering. 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>
<tr>
<td>M.E. 112a, b, c.</td>
<td>Rapid Visualization and Introduction to Design Product</td>
<td>9</td>
</tr>
</tbody>
</table>
M.E. 114a. Mechanical Engineering Design ........................................ 3
M.E. 116a, b, c. Advanced Product Design ....................................... 9
C.E. 114. Mechanics of Materials .................................................. 3
Art 3. Basic Drawing ................................................................. 2
Art 4. Intermediate Drawing ....................................................... 2
Art 24. Design Fundamentals ...................................................... 3
Art 105. Life Drawing ............................................................... 3
Art 124. Advanced Design .......................................................... 4
Art 61. History of Architecture .................................................... 5
Art 208. Sculpture ................................................................. 4
Electives ........................................................................... 3

6. Supplementary Requirements, Industrial Engineering

<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>I.E. 100</td>
<td>Industrial Organization and Management</td>
<td>4</td>
</tr>
<tr>
<td>I.E. 108</td>
<td>Work Design and Measurement</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 109</td>
<td>Production Engineering</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 110</td>
<td>Systems and Procedures Design</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 118</td>
<td>Work Design and Measurement Problem Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>I.E. 119</td>
<td>Production Engineering Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>I.E. 120/120a</td>
<td>Statistical Quality Control</td>
<td>3/4</td>
</tr>
<tr>
<td>I.E. 133a</td>
<td>Industrial Accounting</td>
<td>5</td>
</tr>
<tr>
<td>I.E. 152</td>
<td>Introduction to Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 161</td>
<td>Introduction to Data Processing</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 190</td>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Stat. 110</td>
<td>Statistical Methods; or Stat. 27. Probability Theory*</td>
<td>3/4</td>
</tr>
</tbody>
</table>

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

Psych. 113. Industrial Psychology ........................................... 3
Psych. 192. Industrial Relations ............................................ 4
Restricted electives .................................................................. 11

Total ........................................................................... 54 to 56

The restrictive electives must include one of the following courses: Math. 45, M.E. 114c, Econ. 6, Engr. 104, Pol.Sci. 100. The electives should be in a coherent related field and are subject to approval of adviser. Appropriate courses for electives include any upper division or graduate courses in the School of Engineering and Econ. 9, 111, 145, 157; Pol.Sci. 100; Psych. 112; Stat. 111, 119, 120, 216.

7. Supplementary Requirements, Materials Science

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 3</td>
<td>General Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>Chem. 171, 175</td>
<td>Physical Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Mat.Sci. 121</td>
<td>Solid State Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 123</td>
<td>Materials Science Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 124</td>
<td>Structural Control in Materials I</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 125</td>
<td>Structural Control in Materials II</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>
</tbody>
</table>
Courses to complete the undergraduate program will be selected according to the student's interest. The following two lists of courses are suggested. Different programs can be arranged to combine materials science with work in some other department.

List A provides professional training for a physical metallurgical or materials engineer together with preparatory training for graduate work in materials science. To allow time for these courses, the requirement in Mechanics of Fluids may be omitted from the list of "Courses Normally Taken by All Students of Engineering" (see "Omissions" under List A, below).

**LIST A**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 130, or M.E. 118. Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M.E. 4. Manufacturing Processes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Min.E. 105. Extractive Metallurgy Processes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 107. High Temperature Laboratory</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 120. Industrial Report</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 151. Materials Engineering Design</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Omissions (see above)</td>
<td>-4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

List B is for the scientifically inclined student who desires a particularly strong background in mathematics and physics in preparation for graduate work in materials science. To allow time for these courses, the requirements in Engineering Mechanics, Mechanics of Materials, Mechanics of Fluids, and Engr. 41, 41L, 42, 42L, and 161 may be omitted from the list of "Courses Normally Taken by All Students of Engineering" (see "Omissions" under List B, below).

**LIST B**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 45. Advanced Calculus</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Math. 130, 131. Differential Equations</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Physics 110, 111. Intermediate Mechanics</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Physics 120, 121, 122. Intermediate Electricity and Magnetism</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Omissions (see above)</td>
<td>-25</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

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. Computer Programming for Engineers; or C.S. 136, Use of Automatic Digital Computers</td>
<td>2 or 3</td>
<td></td>
</tr>
<tr>
<td>Engr. 104. Dynamic Response</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Course</td>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>M.E. 4. Manufacturing Processes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M.E. 50. Engineering Kinematics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M.E. 114a. Mechanical Engineering Design</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M.E. 122n. Mechanical Engineering Laboratory</td>
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<tr>
<td>M.E. 132. Engineering Thermodynamics</td>
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<tr>
<td>M.E. 136. Mechanics of Compressible Fluids</td>
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<tr>
<td>C.E. 114. Mechanics of Materials; or A.E. 240a, Aircraft and Missile Structures</td>
<td>3</td>
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<tr>
<td>Math. 45. Advanced Calculus II</td>
<td>3</td>
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<tr>
<td>Math. 130. Ordinary Differential Equations</td>
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<tr>
<td>Optional Program, from those listed below</td>
<td>23</td>
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<td>Total</td>
<td>57 to 58</td>
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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 advisor may authorize substitutions, or actual combinations of options, if it can be shown that the student's program is thereby strengthened.

**Aeronautics and Astronautics:** 23 units minimum from the following:
- Math. 46, Advanced Calculus III (3 units)
- Advanced Calculus III (3 units)
- Physics 61, Optics and Wave Motion (3 units)
- M.E. 134, Introduction to Kinetic Theory and Statistical Mechanics (3 units)
- A.E. 100, Introduction to Aerodynamics (3 units)
- Engr. 113, Rigid Body Dynamics (3 units)
- E.E. 103, Principles of Fields and Waves (3 units)
- E.E. 128, Control Systems (3 units)
- A.E. 240b, c, Aircraft and Missile Structures (3 units each)
- A.E. 279a, Dynamics of Space Vehicles (3 units)
- A.E. 227, Introduction to Space Physics (2 units)
- A.E. 228, Introduction to Astronomy and Astrophysics (3 units)
- A.E. 280a, Rocket Propulsion Fundamentals (3 units)

**Engineering Design:** 23 units minimum from the following:
- Math. 46, Advanced Calculus III (3 units)
- M.E. 112a, Rapid Visualization (3 units)
- M.E. 112b, Introduction to Product Design (3 units)
- M.E. 114b, Mechanical Engineering Design (4 units)
- M.E. 114c, Design of Mechanical Engineering Systems (3 units)
- M.E. 123, Mechanical Engineering Laboratory (4 units)
- M.E. 135, Heat Transmission (3 units)
- M.E. 161, Engineering Vibrations (3 units)
- E.E. 128, Control Systems (3 units)

**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.) 23 units minimum from:
- Math. 46, Advanced Calculus III (3 units)
- Math. 106, Complex Variables (3 units)
- Math. 131, Partial Differential Equations (3 units)
- M.E. 123, Mechanical Engineering Laboratory (4 units)
- M.E. 114b, Mechanical Engineering Design (4 units)
- M.E. 133, Engineering Thermodynamics (3 units)
- M.E. 134, Introduction to Kinetic Theory and Statistical Mechanics (3 units)
- M.E. 135, Heat Transmission (3 units)
- Engr. 171, Nuclear Energy (3 units)
- Physics 140, Elementary Nuclear Physics (3 units)

**Mathematics, Physics, and Engineering Mechanics:** 23 units from the following:
- Physics 61, Optics and Wave Motion (3 units)
- Physics 110, Intermediate Mechanics (3 units each)
- Math. 130, 131, 132, Atomic and Nuclear Structure (3 units each)
- Math. 46, Advanced Calculus III (3 units)
- Math. 106, Complex Variables (3 units)
- Math. 114a, Linear Algebra and Matrix Theory (3 units)
- Math. 115, Fundamental Concepts of Analysis (3 units)
- Math. 131, 132, Partial Differential Equation (3 units each)
- Stat. 27, Introduction to Probability Theory (3 units)
- M.E. 134, Introduction to Kinetic Theory and Statistical Mechanics (3 units)
- Engr. 152, Electric and Magnetic Properties of Materials (3 units)
- E.E. 103, Principles of
Fields and Waves (3 units); E.E. 255, 256, Semi-Conductor Theory (3 units each); M.E. 161, Engineering Vibrations (3 units); E.E. 128, Control Systems (3 units); E.M. 211, Elementary Theory of Plasticity (3 units).

ROTC

Reserve Officers' Training Corps are maintained at Stanford by the Army, the Navy, and the Air Force (see Air, Military, and Naval Science in this Bulletin). Students following a curriculum to obtain a Bachelor of Science degree in Engineering, without specification of a major field, will be able to graduate in four years while pursuing an ROTC program. Students following an accredited engineering curriculum will usually require more than four academic years (twelve quarters) in the University to obtain a baccalaureate degree.

The individual requirements of each of the Air, Military, 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 the 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.

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 on next page.

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:

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<thead>
<tr>
<th>Aeronautics and Astronautics</th>
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<tr>
<td>Aerodynamics</td>
<td>Physical Gasdynamics</td>
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<td>Aircraft Design</td>
<td>Physical Measurements</td>
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<td>Aircraft and Missile Structures</td>
<td>Guidance and Control</td>
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<td>Astronautics</td>
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<th>Chemical Engineering</th>
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<tr>
<td>Applied Reaction Kinetics</td>
<td>Optimization Theory and Process Dynamics</td>
</tr>
<tr>
<td>Catalysis</td>
<td>Thermodynamics</td>
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<tr>
<td>Interfacial Stability</td>
<td>Transport Properties of Fluids</td>
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<tr>
<td>Heat, Mass and Momentum Transfer in Laminar, Turbulent, or Non-Newtonian Flow Systems</td>
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<th>Civil Engineering</th>
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<td>Civil Engineering Administration</td>
<td>Sanitary Engineering</td>
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<tr>
<td>Construction Engineering</td>
<td>Soil Mechanics and Foundations</td>
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<tr>
<td>Engineering-Economic Planning</td>
<td>Structural Engineering</td>
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<td>Hydraulic Engineering</td>
<td>Water Resources</td>
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<td>Fluid Mechanics</td>
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<td>Hydrology</td>
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<th>Electrical Engineering</th>
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<td>Administration</td>
<td>Network Theory</td>
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<td>Communication Theory</td>
<td>Radio Astronomy</td>
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<td>Computers</td>
<td>Radio Propagation</td>
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<td>Control Systems</td>
<td>Solid-State Electronics</td>
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<td>Electron Tubes</td>
<td>System Theory</td>
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<tr>
<td>Illumination</td>
<td>Transistor Electronics</td>
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<td>Microwaves</td>
<td>Upper Atmosphere</td>
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<th>Engineering Mechanics</th>
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<td>Controls</td>
<td>Fluid Mechanics</td>
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<tr>
<td>Dynamics</td>
<td>Mechanics of Solids</td>
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<td>Experimental Mechanics</td>
<td>Vibrations</td>
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<th>Engineering Science</th>
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<td>Nuclear Engineering</td>
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<th>Industrial Engineering</th>
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<td>Engineering Statistics and Quality Control</td>
<td>Data Processing</td>
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<td>Engineering Economy</td>
<td>Operations Research</td>
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<td>Engineering-Economic Planning</td>
<td>Production</td>
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<th>Engineering-Economic Planning</th>
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SCHOOL OF ENGINEERING

Materials Science
- Physical Metallurgy
- Physical Ceramics
- Electrical and Magnetic Behavior of Solids
- Mechanical Behavior of Solids
- Nuclear Metallurgy
- Reaction Kinetics in Solids
- X-ray and Electron Metallography

Mechanical Engineering
- Thermodynamics
- Heat Transfer
- Fluid Mechanics
- Engineering Design
- Product Design
- Nuclear Engineering

For further details see the department sections following.

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. 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., 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.
SCHOOL OF ENGINEERING

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

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, autumn, (R. J. Smith), TTh 11

5. Computer Programming for Engineers—This course is an introduction to 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 students. (Enroll in Computer Science 5.) Prerequisites: Mathematics A and C, or equivalent.
   2 units, autumn or spring, (Staff), MW 3

9. Engineering Drawing—(Formerly M.E. 9.) Study and application of the language of vision as it applies to the engineer and scientist. Main emphasis is placed on machine drawing, orthographic and isometric projection; free-hand sketching and pictorial representation; and descriptive geometry.
   4 units, autumn, winter, or spring, (J. Arnold, Staff), MW 1; lab. MW 2–5

   2 units, autumn, (Richards, Staff), TTh 9 and 2
   or winter, TTh 9 and 2
   or spring, TTh 9

12. Engineering Mechanics (Dynamics)—(Formerly C.E. 100.) Principles of dynamics of particles and rigid bodies, application to typical mechanical problems. Prerequisites: 11 and Mathematics 43. Should be taken before the end of the junior year.
   4 units, autumn, (Richards, Staff), TWThF 11 and 2
   or winter, TWThF 11
   or spring, TWThF 11 and 2
   or summer

15. Mechanics of Materials—(Formerly C.E. 110.) 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, autumn, (Richards, Staff), MWF 10
   or winter, MWF 10, 11
   or spring, MWF 10
   or summer, MTThF 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: Engr. 11, Mathematics 43.

3 units, autumn, winter, and spring, (Gere), by arrangement


4 units, autumn, (Vennard, Staff), MWF 9; lab. T or W, 1-4 or 3-6
or winter, MWF 9; lab. T or W, 1-4 or 3-6
or spring, MWF 9 or 10; lab. T or W, 1-4 or 3-6
or summer, MTThF 8; lab. F 2-5

31. Elementary Engineering Thermodynamics—Introduction to the basic principles of continuum thermodynamics from elementary considerations of the microscopic nature of matter. Determination by thermodynamics of the relations between properties of matter. Application of thermodynamic principles in analysis of engineering systems. Laboratory demonstrations and discussions one afternoon per week. Prerequisites: Physics 57, Mathematics 44, Engr. 21 (or concurrent Engr. 21).

5 units, autumn or winter, (Reynolds, Kline), MTWF 8; lab. M, T, W, or Th 1-4
or spring, (——), MTWF 11; lab. M, T, W, or Th 1-4

41, 42. Circuits, Electronics, and Electromechanics—(Formerly E.E. 91, 92.) Circuit principles, natural behavior, steady-state response, network theorems, electron physics, and electronic devices. Nonlinear operation of electronic devices, feedback, analog computers, magnetic fields and circuits, voltage generation, electromagnetic forces, and electromechanical devices including control-system devices. Prerequisites for 41: Physics 53 and Mathematics 22 or 42.

41. 4 units, autumn, (Smith, Staff), MWF 9; 2-hour problem session
or winter, MWF 10; 2-hour problem session
or spring, MWF 9; 2-hour problem session

42. 4 units, autumn, (Harman, Staff), MWF 10; 2-hour problem session
or winter, MWF 9; 2-hour problem session
or spring, MWF 10; 2-hour problem session
or summer, MTThF 9, and one hour by arrangement

41L. Laboratory I—To follow 41; best taken in following quarter.
1 unit, autumn, winter, or spring, (Staff), one 3-hour hour lab. by arrangement

42L. Laboratory II—To follow 42; best taken in following quarter.
1 unit, autumn, winter, spring, or summer, (Staff), one 3-hour lab. by arrangement


3 units, autumn, (Huggins), MWF 9
or winter, (Nix), MWF 11
or spring, (Huggins), MWF 10
or summer, (Staff), MTThF 9

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

3 units, autumn or winter, (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, spring, (——), MWF 10

3 units, autumn, (Cannon), TTh 11, F 12:15
or winter, (Bulkeley), MWF 11


3 units, autumn, (Cannon), by arrangement

152. Electric and Magnetic Properties of Materials—Introduction to the physical basis of conduction of electricity, dielectric and magnetic properties. Review of atomic theory, molecular and atomic polarization, metallic conduction, band theory, semiconductors, physical processes in transistors, magnetic materials, magnetic resonance phenomena. Prerequisites: Physics 57, and preferably Engr. 50.

3 units, spring, (Heffner), MWF 11

161. Engineering Economy—(Formerly I.E. 130.) 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, autumn, (Ireson, Staff), TTh 10; one-hour problem session
or winter, TTh 9; one-hour problem session
or spring, TTh 11; one-hour problem session
or summer, MTWThS


3 units, winter, (Connolly), 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, and Physics 57.

3 units, autumn, (P. Kruger), TTh 9

175. Nuclear Measurements Laboratory—(Formerly M.E. 272). Principles and techniques of radiation detection and measurement, radiation characteristics; counter characteristics and calibration methods; beta and gamma spectrum analysis; statistical analysis of counting; radiation safety. Prerequisites: concurrent registration in 171 or 172, or consent of instructor.

3 units, autumn or winter, (Staff), T 1:15 and one lab. 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: Engineering 172 or 175 or consent of instructor.

3 units, winter or spring, (P. Kruger), Th 1:15 and one lab. by arrangement


3 units, autumn, (Sturrock), MWF 10


3 units, winter, (Sturrock), MWF 10

AERONAUTICS and ASTRONAUTICS

Emeritus: Alfred Salem Niles (Professor)

Executive Head: Nicholas John Hoff
Assistant Executive Head: Max Anliker
Associate Professors: Max Anliker, Daniel Bershadar, Chi-Chiang Chao, Wilfred Henry Horton, Krishnamurty Karamcheti, Jean Mayers, William Nachbar.
Visiting: Josef Singer

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, aerodynamic, and guidance and control 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
Aircraft, Missile and Spacecraft Structures
Astronautics
Experimental Methods
Guidance and Control
Physical Gasdynamics
Plasma Dynamics and Magnetoaerodynamics

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 Re-entry
Stability of Thin Shells
Dynamic Response—Wave Propagation
Subsonic Aerodynamics—Boundary-Layer Control
Viscous Flow—Boundary-Layer Theory
Hypersonics—Mathematical Methods of Fluid Mechanics
High-Temperature Gasdynamics—Nonequilibrium Flow
Plasma Dynamics and Magnetoaerodynamics
Attitude Control and Instrumentation for Space Vehicles
Contactor Control—Optimal Control

FACILITIES FOR INSTRUCTION AND RESEARCH

The work of the Department is centered in the Daniel Guggenheim Aeronautic 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 newly constructed 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 gasdynamics, 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 gasdynamics 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 facilities in the aerophysics laboratory include 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 schlieren and interferometer apparatus; ballistic free-flight equipment; and associated control and recording devices.

The Department also sponsors a student branch of the American Institute of Aeronautics and Astronautics which conducts periodic meetings and visits to nearby research, military, and industrial establishments.

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 a good 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 or mathematics may find it necessary to take certain undergraduate engineering 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 21-25 units of course work selected from the following basic areas of aeronautics and astronautics: aerodynamics, propulsion, aircraft and missile structures, dynamics and control. In addition, 6 units of mathematics are required, plus a minimum of 9 units of advanced courses in one of the basic areas and 5-9 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 21-25 units of basic courses 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 2-6 units of approved electives. 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: (a) 24 units of approved electives, of which 15 will usually be taken in one of the following fields: (1) Aerodynamics, (2) Aircraft, Missile and Spacecraft Structures, (3) Astronautics, (4) Guidance and Control, (5) Experimental Methods, (6) Physical Gasdynamics, (7) Plasma Dynamics and Magnetoaerodynamics, and of which 9 units will be in mathematics; (b) 15 units of Engineer's Thesis; and (c) 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 engineering 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 oral 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 formally be started 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 for the Engineering Curriculum, 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 for the Science Curriculum, 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 Aeronautics and Space Administration, National Science Foundation, Douglas Aircraft Company, Sloan Foundation, Stanford University, and Affiliates of Stanford University in Aeronautics and Astronautics carry grants up to $3,500 for the nine-month academic year.

Predoctoral fellowships for students interested in college teaching carry grants up to $3,500, permitting full-time progress toward the Ph.D. When needed, supplementary forgivable loans are available. This program is made possible through the generosity of the Ford Foundation.

Stipends for research assistants vary, depending on qualifications and on the division of time between research and study. Research assistants may use their work as a basis for an Engineer or Ph.D. 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 AVAILABLE TO BOTH UNDERGRADUATE AND GRADUATE STUDENTS

100. Introduction to Aerodynamics—Explanation of principles of flight; prefaced by résumé of aeronautical history, consideration of aircraft classification and atmospheric characteristics. Properties of airfoils and parasitic bodies studied in light of basic aerodynamic principles, then synthesized in discussions of performance, stability, and controllability of airplanes. Prerequisite: Engr. 21.

2 units, autumn, (Reid), TTh 9


3 units, autumn, (Cannon), TTh 11, F 12:15
or winter, (———), MWF 11


3 units, autumn, (Cannon), by arrangement

240a. Aircraft and Missile Structural Analysis—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 beams, including effects of non-uniformity of loading and sectional properties. Prerequisite: Engr. 15.

3 units, autumn, (Mayers), MWF 2

240b. Aircraft and Missile Structural Analysis—Potential energy principle applied to curved and elastically-restrained beams, stability of beams, stability of plates
in compression and shear; Galerkin procedure and applications; complementary energy principle, redundant structures, bending and torsion of non-uniform plates, shear lag; Reissner's variational principle and applications. Prerequisite: 240a.

3 units, winter, (Mayers), MWF 2

240c. Aircraft and Missile Structural Analysis—Further applications of the minimum principles to non-linear 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; analysis of major structural assemblies of aircraft and missiles. Prerequisite: 240b.

3 units, spring, (Mayers), MWF 10

292. Vector Analysis and Its Application to Engineering Problems—Vector algebra. Orthogonal curvilinear coordinates. Differentiation and integration of scalar and vector fields. Gradient, divergence and curl. Theorems of Gauss, Stokes and Green. (All students taking graduate courses in Aeronautics and Astronautics are expected to be familiar with the basic subject matter covered in this course.)

2 units, autumn, (Karamcheti), S 10-12
or summer, (Karamcheti)

COURSES PRIMARILY FOR GRADUATE STUDENTS

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: Engr. 12 and 21, and (or concurrent registration in) 100 and C.E. 107.

3 units, autumn, (Reid), 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, 210a.

3 units, winter, (Reid), MWF 9

200c. Airplane Performance—Generalized drag and power equations; 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, spring, (Reid), 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, winter, (Reid), TTh 9


3 units, autumn, (Flügge-Lotz), MWF 1


3 units, winter, (Flügge-Lotz), MWF 11

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. 238a, or permission of the instructor. (Enroll in E.M. 244.)

3 units, spring, (Flügge-Lotz), MWF 11

209. Dynamics of Viscous and Non-Newtonian Fluids—Introduction to the
physics of non-Newtonian fluids. Examples illustrating the motion of non-Newtonian
fluids. Dynamics of gas or liquids containing small solid particles or gas bubbles.
Selected topics in physiological and chemical hydrodynamics. Prerequisite: 207 or
permission of instructor.

3 units, autumn, (Chang), by arrangement

perfect gas from the standpoint of the aircraft and missile engineer: basic thermo-
dynamics; steady and unsteady one-dimensional flow; shock waves; simple expansion
waves.

3 units, autumn, (Vincenti), MWF 10

210b. Fundamentals of Compressible Flow—Continuation of 210a: airfoils in
two-dimensional supersonic flow; general equations and principles of three-dimen-
sional steady flow; exact solutions; small-disturbance approximation. Prerequisites:
210a (or M.E. 136 or 238a) and 292.

3 units, winter, (Karamcheti), MWF 1

210c. Fundamentals of Compressible Flow—Continuation of 210b; slender-
body theory; similarity rules for subsonic, transonic, supersonic, and hypersonic flow;
simple bodies in transonic flow; method of characteristics. Prerequisite: 210b.

3 units, spring, (Karamcheti), MWF 1

211a. Physical Gasdynamics—The fundamentals of high-speed, high-tempera-
ture 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
steady-state kinetic theory, chemical thermodynamics, and statistical mechanics. Pre-
requisite: 210a (or M.E. 136 or 238a).

3 units, winter, (Vincenti), MWF 2

211b. Physical Gasdynamics—Continuation of 211a: flows 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 M.E. 134).

3 units, spring, (Vincenti), MWF 2

211c. Physical Gasdynamics—Flows with translational and rotational nonequi-
librium; kinetic theory of gases in nonuniform motion: application to continuum,
slip, and free-molecule flows. Prerequisites: 211a (or M.E. 134) and acquaintance
with basic equations of viscous flow, or consent of instructor.

3 units, autumn, (Karamcheti), MWF 1

of gasdynamic equations. Application to simple flows—isentropic, shocks, etc.—for
real gases in local equilibrium. Initial value problems, stability, convergence and
existence. Method of characteristics for external and internal flow fields. Tech-
niques adapted to digital computers are stressed.

2 units, winter, (Lomax), TTTh 9

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 solu-
tions; viscous interaction; numerical methods. Prerequisite: Completion of or con-
current registration in 210c.

3 units, spring, (Van Dyke), MWF 8

217. Aerodynamic Heating—Definition of, and factors that influence aerodynamic
heating; relation of aerodynamic heating rates to structural temperature distribu-
tion; 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 238b.

2 units, winter, (Rubesin), TTh 8, alternate years, to be given in 1964–65

219a. Analytical Methods in Fluid Mechanics—Perturbation methods. Asymptotic expansions; series and iteration schemes; singular-perturbation problems; the method of matched asymptotic expansions; Lighthill's technique; applications to viscous and compressible flow problems. Prerequisites: 210c, Mathematics 106, and Mathematics 132, or equivalent.

3 units, autumn, (Van Dyke), MWF 8

219b. Analytical Methods in Fluid Mechanics—Local solutions. Cylindrical and conical flows; homogeneous solutions; self-similar solutions; phase-plane methods; behavior at infinity; applications to current problems. Prerequisites; 210c, Mathematics 106, and Mathematics 132, or equivalent.

3 units, winter, (Van Dyke), MWF 8

220. Aerodynamic Physical Measurements—Lecture-laboratory course on experimental aerodynamics emphasizing compressible flow; measurement of flow variables 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. Prerequisite: 210a.

3 units, spring, (Bershader), lec. T 2–3; lab. Th 2–5


3 units, autumn, (Bershader), T 2–3 and Th 2–4

226. Modern Astronomy—Introduction to stellar and galactic astronomy: stars, galactic structure, the interstellar medium, stellar evolution. The planetary system: introduction to celestial mechanics, physical properties of sun, moon, planets, and the interplanetary medium; techniques and technical problems.

2 units, spring, (Herbig), M 3:15–5:05

227. Introduction to Space Physics—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. Theory of motion of charged particles in electric and magnetic fields, drifts, adiabatic invariants, mirroring and trapping in a dipole field, magneto-ionic theory, with application to Van Allen belts, cosmic rays and radio wave propagation in the ionosphere.

2 units, autumn, (Spreiter), M 3:15–5:05

229. 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.

2 units, winter, (Stroud, Staff), W 2:15–4:00

230a. Vertical Take-Off Aircraft—Lift, propulsion and control and resulting performance of subsonic VTOL aircraft. Prerequisite: 100.

2 units, winter, (Carlson), M 3:15–5:05, alternate years, to be given in 1964–65

230b. Vertical Take-Off Aircraft—Mechanics, structural design and fatigue prob-
lems of helicopters and VTOL aircraft including ground resonance, propeller whirl, wing flutter and drive-system dynamics.

2 units, spring, (Carlson), M 3:15-5:05, alternate years, to be given in 1964-65

240a, b, c—For course description, see previous page, under "Courses Available to Both Undergraduate and Graduate Students."

242. Classical Dynamics—Dynamics of a particle, relative motion, inertia forces, dynamics of systems of particles, d'Alembert's principle, general theorems of momentum and energy, generalized coordinates, Lagrange's equation, Hamilton's principle.

3 units, spring, (Anliker), MWF 12
or summer, (Anliker)


3 units, autumn, (Anliker), MWF 12


3 units, winter, (Anliker), 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, spring, (Staff), MWF 8


3 units, autumn, (Goodier), MWF 9


3 units, winter, (Goodier), MWF 10


3 units, winter, (Flügge), MWF 9


3 units, spring, (Flügge), MWF 9


3 units, autumn, (Hoff, Nachbar), TTh 1:15-2:30


3 units, winter, (Nachbar), TTh 1:15-2:30

3 units, spring, (Nachbar), alternate years, to be given in 1964–65


3 units, spring, (Hoff, Nachbar), TTh 1:15–2:30, alternate years, to be given in 1963–64

250. 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.

2 units, winter, (Singer), TTh 10


2 units, spring, (Singer), TTh 10

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: 240b.

2 units, autumn, (Singer), TTh 10

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, thermostors, heat-flow discs, radiation transducers, accelerometers, oscillographic and strip chart recorders, scanners, analog-to-digital converters, and digital data systems.

3 units, autumn, (Horton), TTh 2–4

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

3 units, winter, (Horton), TTh 2–4

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. Under-carriage testing, ground resonance testing and the specific application of the techniques outlined in courses 260a and 260b to the varied problems of testing as defined above.

3 units, spring, (Horton), TTh 2–4


3 units, winter, (Hetenyi), TTh 8 and one lab. by arrangement


3 units, spring, (Cannon), TTh 7:30–8:50


3 units, winter, (Cannon), TTh 7:30-8:50


3 units, spring, (Cannon), TTh 11:00-12:15

279a. Dynamics of Space Vehicles—Performance of near-earth satellites and ballistic missiles; low-eccentricity elliptic orbits; influences of non-spherical earth. Aerodynamics of the satellite in the upper atmosphere; decay of satellite orbits.

3 units, winter, (Smelt), TTh 1:15-2:30

279b. Dynamics of Space Vehicles—Continuation of 279a. Ascent and descent of space vehicles; the optimization of launch conditions; dynamics of re-entry into the atmosphere. Rigid body dynamics of space vehicles; stabilization by gravity gradient.

3 units, spring, (Smelt), TTh 1:15-2:30

280a. Rocket Propulsion Fundamentals—Elementary rocket dynamics; fundamentals of nozzle flow; use of performance parameters; thermochemical calculation of performance; heat transfer in rockets; basic design procedures.

3 units, autumn, (Seifert), MWF 8

280b. Liquid Propellant Rocket Technology—Propellant chemistry, propellant feed systems and ignition, injector design; combustion chamber cooling, nozzle design, thrust vector control, structural problems, elementary systems analysis. Prerequisite: 280a.

2 units, winter, (Seifert, Staff), TTh 8

280c. Solid Propellant Rocket Technology—Propellant chemistry and processing; charge design, nozzle heat transfer, two-phase flow in nozzles, thrust vector control. Case fabrication problems, elementary system optimization. Prerequisite: 280a.

2 units, spring, (Seifert, Staff), TTh 8

281. Electric Propulsion—Fundamental electromagnetic field and plasma theory relating to reaction propulsion, propulsion by electrostatic, electrothermal, and electromagnetic means. Electrical power sources in space. Ballistic analysis of electrical systems. Prerequisite: Electromagnetic theory or consent of instructor.

3 units, winter, (Seifert), MWF 8, alternate years, to be given in 1964-65


3 units, winter, (Seifert, Staff), MWF 8, alternate years, to be given in 1963-64


3 units, winter, (Chang), MWF 10


3 units, spring, (Chang), MWF 10
286. 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, autumn, (Griffith), W 2:15-4:00

287. Cosmic Electrodynamics—Fundamentals of hydromagnetics and plasma physics with application to theories of solar phenomena, interplanetary plasma streams and shock waves, geomagnetic storms and wave propagation in the upper atmosphere and interplanetary space. Prerequisite: 227 or E.E. 270.

2 units, winter, (Spreiter), M 3:15-5:05

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, autumn, (Chao), MWF 11

292. Vector Analysis and Its Application to Engineering Problems—For course description, see previous page, under “Courses Available to Both Undergraduate and Graduate Students.”


3 units, winter, (Chao), TTh 11:00-12:15


3 units, spring, (Lee), MWF 10

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 a unit of credit, with a ± grade is optional; a letter grade is given for students presenting talks. (Enroll in E.M. 295.)

1 unit, autumn, winter, and spring, (Goodier), Th 3

296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are expected to attend. Registration for one unit of credit, with a ± grade, is open to students having the Master's degree; a letter grade is given for these presenting talks. (Enroll in E.M. 296.)

1 unit, autumn, winter, and spring, (Flügge-Lotz, Van Dyke, Vincenti), T 4:15

297. Seminar in Flight Control and Guidance—Problems in all branches of vehicle control, guidance and instrumentation. The major purpose of the seminar is to give students who are planning or engaged in thesis research an opportunity to become acquainted with the work of other researchers, both on and off the campus. Students engaged in or anticipating research activity in these areas normally attend. Others are invited. Registration for a unit of credit, with plus or minus grade is optional; a letter grade is given for students presenting talks.

1 unit, autumn, winter, and spring, (Cannon), by arrangement
298. Seminar in Space Technology—Study of recent advances in the design and operation of spacecraft, particularly their propulsion (including electric propulsion) and structures. Aspects of guidance, communications, and the space environment will be discussed when appropriate. Registration for 1 unit optional.
   1 unit, autumn, winter, and spring, (Seifert), W 4

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

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

CHEMICAL ENGINEERING*

Executive Head: David Malcolm Mason
Professors: Andreas Acrivos, David Malcolm Mason
Associate Professors: William Herman Schwarz, Douglass James Wilde
Assistant Professors: Robert Ernst Johnk, John Clarence Zahner
Lecturers: George Anton Agoston, Pierre Van Rysselberghe

PROGRAMS OF STUDY

Bachelor of Science

The undergraduate chemical engineering curriculum leading to the B.S. degree in Chemical Engineering provides the student, in addition to his general studies, with fundamentals from a broad selection of the physical and engineering sciences necessary for a variety of careers in the chemical or petroleum industries; the curriculum is also designed to prepare the student for graduate study in chemical engineering. This background may be applied to such diversified activities as the design, development, operation, or management of plants and processes in these industries; or it may be applied to the many problems of the expanding space and nuclear industries.

Candidates for graduation with chemical engineering as the major subject are required to have received an average grade of at least C in required chemical engineering, chemistry, mathematics, physics, and general engineering courses. Because of the interrelation of the subjects in the chemical engineering program, it is recommended that a course-schedule be carefully prepared in advance with the adviser.

Master of Science and Doctor of Philosophy

The M.S. and Ph.D. degrees in chemical engineering are offered for those capable students who are primarily interested in research and teaching. The general University regulations for these advanced degrees are described in the section "Degrees" in this Bulletin. The departmental requirements are summarized below.

Placement Examinations—Essentially, these examinations cover the subject matter in the undergraduate courses in chemical engineering and physical chemistry described in the Bulletin. The examinations must be taken by all students who have substantially completed the pertinent undergraduate course work at the time that they first register in the graduate division. The chemical engineering examination is given on Friday of the week prior to autumn quarter registration, and the physical chemistry examination is given during the week of registration. Results of these examinations become a part of the student's record and are used in planning his initial program of study.

* The curriculum leading to the B.S. Degree in Chemistry is described elsewhere in this Bulletin.
Basic Lecture Courses — A minimum of thirty units of basic graduate lecture courses which include the following are required: (a) advanced chemical engineering, (b) mathematics including partial differential equations, (c) advanced physical chemistry or physics. An average grade of at least B must be maintained in these courses.

Additional Requirements for the M.S. Degree — To obtain some experience in research, completion of work approximating 15 units in Chemical Engineering Advanced Research, Ch.E. 290, is normally taken by the M.S. Degree candidate. No formal thesis is required; however, satisfactory completion of Ch.E. 290 generally involves a formal written discourse describing the student's research. The form and extent of the discourse will be determined in discussions between the student and his research adviser. In special cases, where the student already has had equivalent research experience in industry, a petition may be submitted to the chemical engineering faculty for substitution of approved technical electives in lieu of Ch.E. 290.

Additional Requirements for the Ph.D. Degree — A Ph.D. student, in addition to completing the basic graduate lecture courses, must take 30 additional units of lecture courses chosen from among the following four areas: (a) chemical engineering, (b) chemistry, (c) mathematics, (d) physics. Three courses each in at least two of these areas are required and an average grade of at least B must be maintained.

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 one or more technical articles 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 broad fields: applied reaction kinetics; catalysis; fluid mechanics; heat and mass transfer; and thermodynamics. Further detailed descriptions of research programs are available upon request.

FELLOWSHIPS AND ASSISTANTSHIPS

Several financially attractive graduate fellowships and assistantships are awarded each year. A description of some of the available fellowships may be found in the University Information Bulletin. Application forms may be procured by writing the Department of Chemical Engineering. Applications should be made by March 15 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 with respect to fellowship or scholarship award offers before April 15.

UNDERGRADUATE COURSES

10. Industrial Chemical Calculations — Logical solution of engineering problems; useful mathematical methods; introduction to computer programming; pressure-volume-temperature behavior of pure materials; properties of binary and multicomponent mixtures; mass and energy balance calculations for simple and complex processes. Three or four "laboratory" sessions will be arranged for instruction and student practice in computer programming.

   3 units, winter, (Staff), MWF, hour by arrangement

120a. Chemical Engineering Thermodynamics — The thermal properties of matter; the first law; the second law; general conditions of equilibrium in thermodynamic systems; phase behavior of chemically pure substances.

   3 units, winter, (Zahner), MWF, hour by arrangement

120b. Chemical Engineering Thermodynamics — Continuation of 120a. Mix-
tions of perfect gases; dilute solutions; equilibrium in binary systems; concept of fugacity and activity.

3 units, spring, (Zahner), MWF, hour by arrangement

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, autumn, (Acrivos), MWF, hour by arrangement

130b. Transport Phenomena: Energy Transport—Thermal conductivity and the mechanism of energy transport, temperature distributions in solids and in laminar flow; the equations of change for nonisothermal systems; heat transfer in turbulent flow.

3 units, winter, (Staff), MWF, hour by arrangement

130c. Transport Phenomena: Mass Transport—Diffusivity and the mechanisms of mass transport; concentration distributions in solids and in laminar flow; the equations of change for multicomponent systems; mass transfer in turbulent flow; interphase transport in multicomponent systems.

3 units, spring, (Zahner), MWF, hour by arrangement

140a. Unit Operations: Stage Operations—Application of the equilibrium-stage concept to design of mass-transfer processes; phase relationships; countercurrent multistage extraction and distillation processes, simplified graphical design methods.

3 units, spring, (Staff), MWF, hour by arrangement

140b. Unit Operations: Fluid Flow and Heat Transfer—The energy balance and fluid friction in laminar and turbulent flow systems; flow measurement; pumps and compressors; phase separations based on fluid mechanics; heat transfer in forced and free convection; heat exchange equipment.

3 units, autumn, (Johnk), MWF, hour by arrangement

140c. Unit Operations: Mass Transfer—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, winter, (Johnk), MWF, hour by arrangement

141a. Chemical Engineering Laboratory—Experiments with discussion questions in transport of momentum and transport of energy. Measurement of viscosities; thermal conductivities; temperature profiles in solids; friction factors; and fluid efflux times.

3 units, winter, (Zahner), by arrangement

141b. Chemical Engineering Laboratory—Experiments in mass transfer distillation, absorption, extraction, and reaction kinetics; computer solution of selected problems of interest to chemical engineers.

3 units, spring, (Johnk), by arrangement

150. Applied Chemical Kinetics—Use of chemical rate expressions in the design of homogeneous and heterogeneous static and flow reactors. Discussion of mechanisms and rate theories; elementary and complex homogeneous reactions; expressions for batch reactor, steady-state tubular flow reactor, and semibatch reactor; catalysis.

3 units, spring, (Mason), MWF, hour by arrangement

190. Chemical Engineering Research—Laboratory or theoretical work for undergraduate students on assigned chemical engineering problems.

(Staff), by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

200. Advanced Applied Chemical Kinetics—Discussion of specialized applied kinetic problems; catalysis; fast reactions; combustion kinetics; non-isothermal kinetics; heat and mass transfer in chemically reacting systems; photochemical reactions; corrosion and electrode kinetics.

3 units, autumn, (Mason), by arrangement, alternate years, to be given in 1963-64
205. The Structure and Analysis of Complex Reaction Systems—Introduction to the use of characteristic direction and characteristic species in chemical reacting systems; applications to the experimental study of kinetics and catalysis.

3 units, autumn, (Zahner), by arrangement, alternate years, to be given in 1964–65

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, internal flows and the Graetz problem.

3 units, autumn, (Acrivos), by arrangement

210b. Advanced Transport Phenomena—A continuation of Course 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, winter, (Acrivos), by arrangement

210c. Advanced Transport Phenomena—A continuation of Course 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, spring, (Johnk), by arrangement


3 units, (Schwarz), by arrangement, alternate years, to be given in 1964–65

220. Homogeneous Turbulence Theory—Some history of the subject. Discussion of topics including statistical theory; kinematic relations; dynamical equations; spectral theory; decay of turbulence behind a grid; decay of a homogeneous scalar field.

3 units, (Schwarz), by arrangement, alternate years, to be given in 1964–65

230. 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, physical chemistry, and related fields.

5 units, autumn, (Van Rysselberghe), by arrangement

231. Electrical Concepts and Conventions—A survey of the fundamentals of electrochemistry, sign conventions, etc. (Enroll in Chemistry 276.)

1 unit, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1963–64

232a. Electrochemical Thermodynamics and Kinetics—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. (Enroll in Chemistry 277a.)

2 units, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1964–65

232b. Electrochemical Thermodynamics and Kinetics—Continuation of Chemical Engineering 232a. (Enroll in Chemistry 277b.)

2 units, spring, (Van Rysselberghe), by arrangement, alternate years, to be given in 1964–65

280. Seminar—Students enrolled in this course will be expected to attend the Seminar in Chemical Engineering and Chemical Engineering Research Conferences. Each graduate student will make periodic reports of the progress of his own research at the
Chemical Engineering Research Conference. Must be taken every quarter by candidates for advanced degrees in Chemical Engineering.

1 unit, autumn, winter, and spring. (Staff)

290. Chemical Engineering Advanced Research—Laboratory or theoretical work for graduate students on specific, approved, advanced 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 Lodewick Grant, Charles Moser, Alfred Salem Niles, Stephen P. Timoshenko, James Bertrand Wells (Professors); Eugene Valentine Ward (Lecturer)

Executive Head: Ray K. Linsley
Associate Executive Head: Joseph B. Franzini
Assistant Executive Head: Robert L. Street

Professors: Jack R. Benjamin (on leave autumn quarter), Rolf Eliassen, Wilhelm Flügge, Joseph B. Franzini, James M. Gere, Miklos Hetényi, Ray K. Linsley, Clarkson H. Oglesby, John K. Vennard, Harry A. Williams, Donovan H. Young

Associate Professors: James Douglas, John W. Fondahl, En Yun Hsu, Paul Kruger, Perry L. McCarty, Henry W. Parker, Byrne Perry (on leave 1963-64), Vincent J. Roggeveen, Cedric W. Richards

Assistant Professors: Norman H. Crawford, Robert L. Street, William Weaver, Jr.

Acting: Carl Allin Cornell, James Marshall Kelly


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:

- Civil Engineering Administration
- Construction Engineering
- Engineering-Economic Planning
- Hydraulic Engineering
  - Fluid Mechanics
  - Hydrology
- Sanitary Engineering
- Soil Mechanics and Foundations
Structural Engineering
Water Resources

Research work under these programs is carried out in two major facilities—the hydraulics laboratory and the newly renovated George Havas Building which houses water quality, sanitary, structural, and strength of material laboratory facilities. Office space is provided for most of the graduate students who are acting as research or teaching assistants.

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: Civil Engineering Administration, Construction, Engineering-Economic Planning, Hydraulic Engineering, Sanitary Engineering, Soil Mechanics, Structural Engineering, and Water Resources. A general M.S. in civil engineering without special designation is also given. Detailed statements of the requirements for all Master’s degrees and the specific course requirements for a degree with special designation may be secured by request to the Civil Engineering Department.

Students having undergraduate degrees in civil engineering normally can satisfy requirements for the M.S. degree with three quarters of graduate work of satisfactory quality. Students with undergraduate degrees in other fields may need longer residence for the M.S. degree 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 early in the fourth quarter of graduate work. Programs leading to the degree of Engineer are offered in the fields of specialization mentioned above. A minimum grade point average of 3.0 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 tern, 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 continuing program of financial aid for graduate students. Fellowship or scholarship awards range from $500 to $4,000. 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 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, spring, (Douglas), TTh 8, MW 1-4

3 units, autumn, (Vennard), TTh 9, Th or F 1-4

114. Mechanics of Materials — Continuation of Engr. 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: Engr. 15.
3 units, autumn, (Richards), MWF 8
or spring, (Young), MWF 11

116. Plain Concrete—Physical properties of concrete and its constituents. (Limited to 20 students per section.)
3 units, autumn, (Douglas), T 1-5, Th 1-4
or winter, (Parker), W 1-5, F 1-4

118. Materials Engineering — Mechanical behavior of solids; effects of stress distribution; dynamic and thermal effects; creep and relaxation; fatigue; statistical methods. Prerequisites: Engr. 15, Chemistry 2, Engr. 50.
3 units, winter, (Richards), TTh 11, W 1-4

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, spring, (Parker), TTh 10, TTh 1-4

138. Specifications and Contracts—Contract principles as applied to engineering practice; varieties of construction contracts; specification writing; composition, arrangement of typical sets of specifications; engineering ethics, practice. Prerequisite: junior standing.
3 units, autumn, (Oglesby), MWF 11
or winter, (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, autumn, (Douglas), MWF 8
   or winter, (Parker), MWF 9

145. Construction Equipment and Methods — Construction procedures, equipment; job planning and scheduling, equipment selection, related problems. (May be taken concurrently with 150 or 151.)
   3 units, autumn, (Fondahl), TTh 8, M 1-4
   or spring, (Douglas), TTh 9, M 1-4

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, autumn, (Roggeween), TTh 11, M 1-2

151. Highway Engineering — Continuation of 150, particular emphasis on traffic engineering, soils, pavements. Prerequisite: 150 or permission of instructor.
   3 units, spring, (Oglesby), TTh 8, M 1-4

155. Transportation Design Seminar — A study of transportation needs for the future and the preparation of designs for a system to meet these needs. Design project will be carried forward as a team effort. Students taking this course need not take C.E. 198.
   3 units, winter, (Oglesby, Linsley), by arrangement

160. Hydrology — Introduction to hydrologic measurements, runoff computations, groundwater, water law, reservoir design, frequency analysis.
   3 units, autumn, (Crawford), MWF 10

161. Hydraulic Structures — Dams, spillways, pipe lines, canals, hydraulic machinery, economy in hydraulic design, water purification, sewage treatment. Prerequisites: 107 and 160.
   3 units, winter, (Crawford), MWF 8

162. Hydraulic Engineering — Continuation of 160, 161; discussion of applications in irrigation, water supply, hydroelectric power, navigation, flood control, drainage, sewerage. Prerequisite: 161.
   3 units, spring, (Crawford), MWF 8

   2 units, winter, (Vennard), TTh 8

166. Elements of Sanitary Engineering — Water purification, sewage treatment, refuse disposal. Open to senior, graduate engineering students; others by permission.
   3 units, winter, (McCarty), TTh 8, T 1-4

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.
   3 units, spring, (Eliassen), MWF 10

172. 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, spring, (Kruger), TTh 11 and one hour 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: Engr. 15.
   4 units, spring, (Young), MTThF 8
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, autumn, (Cornell), 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. Design and discussion sessions on reinforced concrete design. Prerequisites: 114, 180, and 181.
  4 units, winter, (Cornell), MWF 10, T or Th 1-4

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, spring, (Weaver), TTh 10

184. Statically Indeterminate Structures—Analysis of statically indeterminate structures by advanced methods. Prerequisite: 180.
  3 units, spring, (Weaver), MWF 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, spring, (Williams), MWF 9, T or W 1-4

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, winter or spring, (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

206. Advanced Mechanics of Fluids—Similitude and dimensional analysis; fluid friction for incompressible fluids in tubes, boundary layers, and through granular media; lubrication theory; cavitation. (Same as E.M. 241.) Prerequisite: 107.
  3 units, autumn, (Vennard), MWF 10

207. Advanced Hydraulic Laboratory—Prerequisite: 107, or equivalent.
  2 units, winter or spring, (Vennard, Hsu), by arrangement

  3 units, winter, (Vennard), 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, spring, (Vennard), MWF 8

  3 units, winter, (Hetényi), TTh 8 and one lab. by arrangement

  3 to 6 units, spring, (Hetényi), by arrangement

  3 units, spring, (Richards), TTh 10 and one lab. by arrangement
230. Engineering Economy of Public Works and Public Utilities—Application of the principles of engineering economy to the planning of capital improvements to water resource, transportation, urban renewal, recreational and other public works; also to railroad, telephone and electric power companies. Prerequisite: Engr. 161.

3 units, winter, (Roggeveen), TTh 11, F 1

231. Problems in Engineering Economy—Independent study or research of a selected problem in engineering economy of public utilities or public works. By permission of instructor.

2 or more units, autumn, winter, or spring, (Roggeveen), by arrangement

232. Economics of Structural Engineering—Study of professional office practice and economics of business and technical decisions; application of statistical decision theory to professional practice; optimization of design; review and application of principles of Engineering Economy.

2 units, spring, (Benjamin), MW 8

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, autumn, (Oglesby), TTh 2-3, T or Th 3-5

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, autumn, (Fondahl), TTh 10 and one evening by arrangement

243. Construction Administration—Business and management aspects of construction; bonding, insurance, financing, legal, and labor relations; cost control and project scheduling. Prerequisites: 138, 144, and 145.

4 units, winter, (Fondahl), MWF 8 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, winter, (Fondahl), TTh 2

245. Advanced Construction Equipment and Methods—Methods and equipment selection and application in heavy construction. Excavation, tunneling, conveyors, steel erection, underwater foundations, cableways, contractor’s temporary facilities. Prerequisite: 145.

4 units, spring, (Parker), MWF 9 and one evening by arrangement

248. Human Factors in Construction Management—Seminar dealing with the problems of working and communicating with individuals and groups. Enrollment limited to 15.

2 units, spring, (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, spring, (Oglesby), by arrangement

250. 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. By permission of instructor. (Same as E.E.S. 311.)

3 units, spring, (Roggeveen), MWF 1, alternate years, to be given in 1963-64

251. Transportation Problems—Individual investigation. By permission of instructor.

2 or more units, autumn, winter, or spring, (Oglesby, Roggeveen), by arrangement
260. Advanced Hydrology—Meteorology, climatic data, precipitation, evapotranspiration, and streamflow, techniques of measurement and interpretation.  
4 units, autumn, (Linsley), MWF 9, T 1-4

261. Advanced Hydrology—Methods of applied Hydrology: runoff relationships, unit hydrographs, flood routing, frequency analysis, etc. Prerequisite: 260.  
4 units, winter, (Linsley), MWF 10, T 1-4

262. Advanced Hydraulic Engineering—Integration of procedures in hydraulic projects illustrated by discussion, student reports, and design problems. Prerequisite: 261.  
4 units, spring, (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: 261.  
2 units, spring, (Fransini), MW 9

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 series and complex variable techniques. Prerequisites: 107, and Mathematics 130 or permission of the instructor.  
2 units, winter, (Fransini), TTh 9

266. Hydrodynamics of Free Surface Flows I—Theory of water waves including effects of wind, gravity, surface tension, non-uniform density, and viscosity. Formulation of equations and boundary conditions. Exact and approximate methods of analysis. (Same as E.M. 246.) Prerequisite: E.M. 242 or equivalent.  
3 units, winter, (Hsu), WF 1:15-2:45, alternate years, to be given in 1963-64

267. Hydrodynamics of Free Surface Flows II—Continuation of C.E. 266. Classical theory of jet, cavity, and other free surface flows. Application of modern linearized and nonlinear theories to selected problems from naval hydrodynamics, hydraulic engineering, and oceanography. Possible topics include forces on supercavitating hydrofoils, steady and unsteady seepage flow, flow over weirs and spillways. (Same as E.M. 247.) Prerequisite: 266.  
3 units, spring, (Street), WF 1:15-2:45, alternate years, to be given in 1963-64

269. Hydraulic Engineering Seminar—Discussions on all phases of hydraulic engineering.  
1 unit, autumn, (Fransini), T 4-6  
or spring, (Fransini), W 3-5

270. Water Quality Control I—Natural and man-made characteristics of water quality; effect of quality on the use of water; unit operations of water quality control for municipal and industrial use; design of water treatment plants. Prerequisite: 166.  
3 units, winter, (Eliassen), MWF 9

271. Water Quality Control II—Characteristics of waste waters; chemical and biological unit processes for the treatment of sewage and industrial wastes; water quality requirements in stream pollution control; design of waste treatment plants. Prerequisite: 270.  
3 units, spring, (Eliassen), MWF 11

272. Water Resources Chemistry—Application of basic principles of physical, organic, and radio chemistry to the analysis and treatment of water, sewage, and industrial wastes.  
3 units, autumn, (McCarty), TTh 10, M 1-4

273. Water Resources Microbiology—The ecology of streams, lakes and other water resources; identification and control of microorganisms in water and wastes; (microbiological fermentation of organic matter) the self-purification of streams. Prerequisite: 272.  
3 units, winter, (McCarty), TTh 10, W 1-4

274. 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: 273.

3 units, spring, (McCarty), M 1-5, W 1-4


3 units, autumn, (Young), MWF 8

282. Statically Indeterminate Structures—Analysis of truss and frame structures by action and displacement methods, including the use of digital computers, practice in computer programming, and an introduction to matrix algebra. Prerequisite: 281.

3 units, winter, (Weaver), MWF 9

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, spring, (Fligge), TTh 11 and two afternoons by arrangement

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, autumn, (Weaver), TTh 10

285. Advanced Structural Design—Structural geometry; analysis of structures by deflected structures, statics; structural models; bridge analysis, design; bridge types, characteristics; design problems.

4 units, autumn, (Weaver), TTh 8, W 1-4


4 units, winter, (Benjamin), TTh 9, W 1-4

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, spring, (Benjamin), TTh 8, W 1-4

288. Structural Engineering Seminar—Problems in all phases of structural engineering.

1 unit, autumn, winter, and spring, (Staff), alternate W 4

289. Plastic Design of Steel Structures—Limit design concepts applied to the design of steel frames; collapse loads, deflections, secondary considerations, special problems. Prerequisites: 181, 285, E.M. 211.

2 units, winter, (Weaver), TTh 10

290. Soil Mechanics—A re-examination of fundamentals of soil mechanics; advanced theory. Problems studied concern consolidation and settlement, shear of soil masses, pore pressure, and bearing failures. Prerequisite: 190.

2 units, autumn, (Williams), TTh 9

291. Soil Mechanics—Seepage and flow nets; slope stability; embankment design; earth retaining structures. Prerequisite: 190.

3 units, winter, (Williams), TTh 11

292. Soil Mechanics—Flexible bulkhead walls; soil composition and its relationship to soil properties; application of physico-chemical principles to soils. Prerequisite: 190.

2 units, spring, (Williams), TTh 9


3 units, autumn, (Williams), MWF 10

294. Advanced Soil Mechanics Laboratory—Experiments on the mechanical
properties of soils. Topics can be selected to suit individual and class interests. Pre-
requisite: 290 or 291. Open by permission only.

1 unit, winter, (Williams), by arrangement

295. Harbor Structures—Wharves; piers of timber, concrete; sea walls, bulkhead
walls; factors affecting design, life of marine structures. Prerequisite: 190.

3 units, spring, (Williams), MWF 10

296a. Structural Dynamics—Vibration theory, particular reference to structures;
response of structures to pulse loads and earthquakes, vibration of beams. Prerequi-
sites: Engr. 12 and C.E. 281.

3 units, winter, (Young), MWF 11

296b. Structural Dynamics—Continuation of course 296a. General theory of
small vibrations of systems with several degrees of freedom; normal modes, matrix
methods. Prerequisite: 296a.

2 units, spring, (Young), TTh 9

297. Statistics for Structural Engineers—The applications of statistical decision
to engineering practice; probability theory; descriptive statistics; performance
analysis; nature of loads and resistance; factors of safety and load factors; use of
probability density functions in applied statistical decision theory.

3 units, winter, (Benjamin), MWF 10

298. Stability Problems—Elastic and inelastic buckling of columns, including non-
prismatic columns; torsional and lateral buckling of I-beams; buckling of trusses and
rigid frames. Prerequisites: 114, Mathematics 130.

3 units, spring, (Gere), MWF 11

299. Directed Reading and Special Studies in Civil Engineering—Graduate
students by special permission.

Autumn, winter, or spring, (Staff), by arrangement

300. Thesis—Investigation of some engineering problem; required of candidates
for degree of Engineer.

Autumn, winter, or spring, (Staff), by arrangement

301. Thesis—Dissertation; required of candidates for degree of Doctor of Phi-
losophy.

Autumn, winter, or spring, (Staff), by arrangement

381. Matrix Analysis of Structures—Application of matrix methods to static,
dynamic, and stability analyses of structures. Prerequisite: 281.

3 units, autumn, (Gere), MWF 11

385. Special Problems in Structural Mechanics—General theory of linear struc-
tural problems. Energy theorems, reciprocal theorems, normal functions. Applica-
tions to spatial deformation of skeletal structures. Extensions of nonlinear aspects.
(Same as E.M. 265.) Prerequisite: 281.

2 units, autumn, (Hetényi), TTh 10

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, the Depart-
ments of Electrical Engineering, Industrial Engineering, Mechanical Engineering,
Mathematics, Geology, Geophysics, Materials Science, Statistics, Political Science,
and the Project in Engineering-Economic Planning.
ELECTRICAL ENGINEERING

Emeriti: Joseph Snyder Carroll, Ward B. Kindy (Professors)

Executive Head: Hugh Hildreth Skilling
Associate Executive Head: Leland Hermon Brown
Associate Executive Head, Undergraduate Administration: Ralph Judson Smith
Graduate Administration: Robert Arthur Helliwell
Honors Cooperative Program: Willis Walter Harman

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 requires broad ability in both scientific thinking and the art of working with men. As education 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 undergraduate and graduate curricula at Stanford are planned to offer as much as possible of the breadth of education needed for leadership in the profession as well as knowledge of the physical sciences and the basic professional techniques.
The Electrical Engineering Department offers graduate work in the following fields:

- Administration
- Radio Sciences: Ionospheric Propagation
- Electronic Systems
- Radio and Radar Astronomy, Space Electronics
- Techniques
- Solid-State Electronics
- Electron Tubes
- Theory of Systems: Control Systems, Communication
- Illumination
- Theory, Computers, Adaptive Systems
- Microwaves
- Transistor Electronics
- Network Theory

Most student programs include courses in several of the above-listed fields. 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.

An alternative fuller program, giving 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. This program is reserved for students of demonstrated ability. A considerable part of the six academic quarters required for this program is usually devoted to research in collaboration with other students and faculty of the department, and to individual study.

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 and Engineer**

Graduate admission and registration are described on page 81. In preparing a program of graduate study the following four basic requirements should ordinarily be satisfied.

1. **Preparation**—Certain studies, ordinarily included in the undergraduate program, are necessary for proper understanding of advanced work. These include physics, mathematics (through integral calculus), mechanics (e.g., Engr. 11, 12 or Physics 110, 111), electrical circuits (e.g., E.E. 104, 105, 106), electronics (e.g., E.E. 150, 151, 152) electromechanics and fields (e.g., Engr. 42, 42L, E.E. 103), and electrical laboratory work (e.g., E.E. 156, 157). If these courses, or their reasonable equivalent, have not been completed previously they should be taken as soon as possible, and the time needed to obtain an advanced degree may be increased.

2. **Fundamental Courses**—If the following courses or reasonable equivalents have not been taken previously, they should be included in the graduate program: ordinary differential equations (Mathematics 130), atomic physics (Physics 57), circuits; transmission lines (E.E. 117), electronic circuits (E.E. 150, 151, 152), Control Systems (E.E. 128), and elementary electromagnetic theory (E.E. 103 or 270). Since these courses may be part of the graduate program of study, they will not ordinarily increase the time needed to obtain an advanced degree.

The faculty does not prescribe courses to be taken, other than those listed in paragraphs 1 and 2 above. Each student prepares his own proposed program and submits it to the faculty for approval. This is done in the first academic quarter of graduate study (modifications may be made later). The average course of study is about 16 or 17 units per quarter. In planning his program, the student will normally include E.E. 200 (Seminar) each quarter, and any courses in paragraphs 1 and 2, above, not previously taken. He should then review, for possible inclusion in his program, all courses offered by the Electrical Engineering Department, considering their relation to his major and minor objectives.
3. **Major**—The student should normally have a major objective in electrical engineering, related to the field in which he expects to earn his living immediately upon leaving college. It is not well to attempt to define this major objective too narrowly, but distinction may be made between an interest in: research and teaching, engineering practice, and engineering administration.

4. **Minor**—Those working for advanced degrees are normally expected to take an average of at least one course per quarter outside of the Electrical Engineering Department. This outside work should be planned with a specific objective in mind, and can be thought of as representing a minor subject.

* A student must file in the Department office—(1) Application for candidacy for the Master’s degree before the completion of his first 15 units of graduate study. (2) Application for candidacy for the Engineer’s degree before the end of the first academic quarter of graduate study after the Master’s degree has been received. However, for Honors-Cooperative students, the signature of the Research Adviser need not be obtained until the application is due to be filed with the University Committee on the Graduate Division.

General regulations governing the degrees of Master of Science and Engineer will be found in the section “Degrees” in this Bulletin.

**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 three copies 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 two of the four parts of the qualifying examination.

**Special Programs**

**Electronic Science Program**—The Master of Science degree carrying the designation “Electrical Engineering: Electronic Science” on the diploma may be conferred upon students who combine exceptional competence in electrical physics and mathematics with an electronics program in the Department of Electrical Engineering.

It is recognized that there is a professional place for engineers whose work is the
application of science in the field of electronics. The proper education for such men emphasizes the development of scientific and mathematical analysis as well as engineering competence.

A student who wishes to be a candidate for a degree with the designation “Electrical Engineering: Electronic Science” should so indicate when he submits his application for candidacy for the degree (see “Graduate Programs,” given earlier in the general discussion of the School of Engineering). He should plan a program of study to include physics and mathematics courses well beyond the minimum required for an electrical engineering degree. The candidate for such a degree will be expected to show adequate ability in mathematics, physics, field and circuit theory, and electronics; he will not, however, be required to show professional competence in all phases of electrical engineering. This program is particularly called to the attention of those who have Bachelor's degrees in science or mathematics, or in engineering science, as well as graduates of professional electrical engineering curricula.

Electrical Engineering Administration—By a special arrangement, graduate students of engineering are enabled to 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 technical electrical engineering with 30 or more units of study in industrial engineering or business. For 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 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.

Postgraduate Program—Students who have graduated from a department other than electrical engineering may obtain a Master's degree by pursuing the following postgraduate course of study. The student may have graduated in any field, and may hold either a B.S. or an A.B. degree. The postgraduate program leading to the M.S. degree requires two academic years (six quarters) if the student has studied mathematics (through calculus) and general college physics (including electricity) in his undergraduate program. If he has not, the time is somewhat longer. On the other hand if he has included electrical studies in his undergraduate work the time may be less than two years.

This two-year postgraduate program is highly concentrated in science and electronics; it is a difficult course that should be undertaken only by serious, competent, and mature students. It is of special interest to two classes of students:

1. Those who graduate from liberal arts colleges, or from curricula in humanities and sciences at Stanford or elsewhere, with the expectation of pursuing this electronics program after graduation.

2. Those who have graduated in some nonelectrical curriculum and have later found a need for professional education in electronics, perhaps as a result of experience in industry or the armed forces.
The program is outlined below for the student well prepared in mathematics and physics. A possible schedule is suggested.

A student needing review of mathematics may include a review course (possibly Mathematics 24) by rearranging the schedule and adding to the total number of units. If more extensive reviewing is required it will be necessary to add a quarter (possibly a summer quarter) to the six shown. A student who has had neither calculus nor physics may nevertheless pursue this postgraduate course, but three years (nine quarters) will be necessary.

### First Year

| Engr. 41, 42, 41L 42L, Circuits, Electronics, and Electromechanics | 4 | 5 | 1 |
| E.E. 104, 105. Circuits | — | 3 | 3 |
| E.E. 106, 107 or 271, 235 or 242. Circuits, networks | — | — | 4 |
| E.E. 103. Fields | — | — | 3 |
| E.E. 128. Control Systems | — | — | — |
| E.E. 150, 151, 152, 161. Electronics | — | 3 | 3 |
| E.E. 156, 157, 170, 171. Laboratory | — | 2 | 2 |
| E.E. 200. Seminar | 1 | 1 | 1 |
| E.E. 220. Pulse and timing circuits | — | — | — |
| Mathematics 130. Differential equations | 3 | — | — |
| Physics 57, 110, 111. Atomics, mechanics | — | 3 | 3 |
| Optional courses selected from the following list | — | — | 3 |

**Totals**: 12 17 17

### Second Year

| Mathematics 130. Differential equations | — | — | — |
| Physics 57, 110, 111. Atomics, mechanics | — | — | 3 |

**Totals**: 16 16 13

List from which optional courses are selected include:

<table>
<thead>
<tr>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
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<tbody>
<tr>
<td>E.E. 124. Electromechanics</td>
<td>—</td>
<td>3</td>
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<tr>
<td>E.E. 138. Control systems</td>
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<tr>
<td>E.E. 162. Radio Engineering</td>
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<td>—</td>
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<tr>
<td>E.E. 221, 222. Amplifier circuit theory</td>
<td>—</td>
<td>3</td>
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<tr>
<td>E.E. 226. Two-Port Network Theory</td>
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<td>—</td>
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<tr>
<td>E.E. 227, 228. Transistor electronics</td>
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<td>3</td>
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<tr>
<td>E.E. 236, 237. Network synthesis</td>
<td>3</td>
<td>3</td>
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<tr>
<td>E.E. 245, 246. Control System Synthesis I, II</td>
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<td>3</td>
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<tr>
<td>E.E. 251, 252. Theory of communication</td>
<td>—</td>
<td>3</td>
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<tr>
<td>E.E. 271, 272. Applied electromagnetic theory</td>
<td>—</td>
<td>3</td>
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<tr>
<td>Mathematics 106. Complex variable</td>
<td>3</td>
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### 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 include:
- Adaptive Components
- Aerospace Electronics
- Antennas and Interferometry
- Circuit and Device Applications
- Controls
- Defense Systems Engineering
Digital Switching Networks  
Electron Dynamics  
Illumination  
Ion Propulsion  
Microsystem Electronics  
Microwave and Optical Propagation  
Network Theory  
Plasma Physics  
Quantum Electronics  

Radio and Radar Astronomy  
Radio Studies of Ionized Media  
Semiconductor Fabrication  
Signal Synthesis and Analysis  
Solar-Terrestrial Geophysics  
Solid-State Physics  
Space-Probe Experiments  
Statistical Communication Theory  
Systems Theory

COURSES PRIMARILY FOR UNDERGRADUATES

Engineering 41 and 42, Circuits, Electronics, and Electromechanics; 41L and 42L, Laboratory; and Engr. 152, Electric and Magnetic Properties of Materials will be found under "Engineering" elsewhere in this Bulletin.

103. Principles of Fields and Waves—Introduction to field theory: static fields, elements of vector analysis, Maxwell's equations, plane and spherical waves, electrodynamic potentials, radiation. Prerequisites: Engr. 41 (or the former E.E. 100).

3 units, autumn, MWF 9  
or spring, TThS 9

104, 105, 106. Circuits—Analysis of networks, including both transient and steady states of operation: methods of analysis for simple circuits, substitution methods, nonlinear devices, Fourier analysis, polyphase circuits, resonance, graphical analysis, network equations based on Kirchhoff's two laws, network theorems, exponential series, and Fourier integral, transients and the complex frequency plane, Laplace transformation, two-terminal-pair networks. Prerequisites: Mathematics 22 or 42, Physics 53, and Engr. 41 and a C+ average in analytic geometry, calculus, physics, and electrical engineering courses taken. E.E. 105 and 106 may be taken concurrently.

104. 3 units, autumn, MWF 8 or 10  
or winter, MWF 8

105. 3 units, winter, MWF 8 or 10  
or spring, MWF 9

106. 4 units, spring, MTThF 8 or 10

107. Circuits: Transmission Lines—Differential equations of transmission lines and circuits with distributed constants; traveling wave solution; standing wave solution; trigonometric, hyperbolic functions of complex arguments; typical characteristics of lines in power, telephone, radio practice; impedance matching; approximations valid at high frequency; lines as circuit elements. Prerequisite: 104, and preferably 103.

3 units, autumn, MWF 10  
or winter, MWF 9  
or spring, MWF 10

108. Illumination—Production of light; characteristics of light sources; methods of measuring, controlling, and applying light; home, school, commercial, and industrial lighting. Prerequisite: Engr. 41.

3 units, autumn, MWF 8

108a. Architectural Illumination—Light and color, light sources, light control, design of lighting systems for homes, schools, commercial and industrial buildings. Primarily for pre-architectural and education majors.

3 units, autumn, MWF 8

124. Electromechanics—Theory of electromechanical energy conversion in such devices as electromagnets, loudspeakers, microphones, vibration pickups, control system components, motors, generators. Prerequisites: 106 and Engr. 42.

3 units, autumn, MWF 9  
or winter, MWF 9
128. Control Systems—Introduction to the analysis and design of linear feedback control systems by means of root locus and frequency response methods. Discussion of stability, transient errors, and steady state errors. Prerequisite: 106 or Engr. 104. (124 suggested.)

3 units, autumn, MWF 10
or winter, MWF 8
or spring, TThS 11


3 units, winter or spring, T 1 and one 3-hour lab. weekly

150, 151, 152. Electronics—Basic electronic devices and circuits. Physical basis of charge motion in conductors, semiconductors, vacua, and plasmas. Emission and junction phenomena. Operating principles of electronic devices with major emphasis on semiconductor diodes and transistors. Models and analysis techniques: graphical, analytical, and piecewise-linear. Applications to rectification, amplification, oscillation, switching, and wave-shaping circuits. Prerequisites: Engr. 41 or Physics 120, and previous or concurrent registration in E.E. 104.

150. 3 units, autumn, MWF 8 or 10
or winter, MWF 11

151. 3 units, winter, MWF 8 or 10
or spring, MWF 11

152. 3 units, spring, MWF 8 or 10
or autumn, MWF 11


2 units, winter and spring, T 1 and 3-hour lab. weekly

160. Microwave and High-Power Tubes—Short review of fundamentals of vacuum triodes and tetrodes; introduction to electron guns and beams; emphasis on problems and requirements introduced in modern applications in high-frequency and high-power systems. Tuned power amplifier circuits; klystron amplifiers, reflex klystrons, and traveling-wave tubes. Prerequisites: 106 and 152 (may be concurrent).

3 units, autumn, MWF 8

161. Electronic Circuits and Processes—Frequency conversion, signal processing and noise; emphasis on engineering applications and considerations; continuation of 152 with particular attention to modulation, detection, spectrum analysis, characteristics of modulation systems, etc.; physical sources of noise, noise figure and temperature concepts, basic statistics of noise. Prerequisites: 106 and 152.

3 units, winter, MWF 8 or 1

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: 161.

3 units, spring, MWF 8

170, 171, 172. Electronic Measurements—Primarily laboratory, one or two lectures per week; principles and methods of electronic measurement. Prerequisites: 152, 157; 117 and 161 should precede or be taken concurrently with 171.

3 units, autumn, winter, and spring, TTh 9 and 3-hour lab. weekly

180. Design Project—Individual or team project emphasizing creative design of electrical devices or systems to meet specifications. Prerequisite: senior standing.

3 units, spring, TTh 8 and three hours by arrangement

191. Special Studies in Electrical Engineering—Special studies, laboratory work, reading, etc. under direction of faculty member. Student must find faculty sponsor and have approval of his adviser. A term paper is required.

2 or 3 units, by arrangement
COURSES PRIMARILY FOR GRADUATE STUDENTS

200. Seminar—Weekly discussion of special topics of current interest in electrical engineering. Normally taken each quarter by graduate students.

1 unit, autumn, winter, and spring, (Garriott), Th 11

208. Illumination Seminar—Discussions on current literature, research, developments in all branches of illumination engineering. Students desiring to do special research in illumination should register under this number. Prerequisite: 108 or 108a.

2 or more units, autumn, winter, and spring, (Brown)

For description of Courses 209p-219p, see Physics 255-378


3 units, autumn, spring, and summer, (McWhorter, Staff)

221. Amplifier Circuit Theory—Representation of tubes and transistors over wide frequency ranges; simplified equivalent circuits. Amplifier design based on steady-state and transient performance. Prerequisites: 106 and 153 or equivalent.

3 units, winter, (McWhorter, Tuttle)


3 units, spring, (McWhorter, Staff)

225. Solid-State Circuits Laboratory—Special experimental projects on electrical properties, performance and circuit design for various solid-state devices, with emphasis on relationship of external performance to physical mechanisms. Registration by permission of instructors. Prerequisite: previous or concurrent registration in 226, 227, 228.

2 units, autumn, winter, and spring, (Angell, J. Linvill)


3 units, autumn or winter, (Angell, J. Linvill, Newcomb)

227. Transistor Electronics—Quantitative description of physical processes relevant to transistor performance. Development of a range of circuit models based on physical processes, including the approximation of distributed structures by lumped models applying both to small- and large-signal cases. Prerequisites: 106 and Mathematics 24.

3 units, autumn or winter, (Angell, Gibbons, J. Linvill)

228. Transistor Electronics—Discussion of linear amplifiers, active circuits, non-linear switching and regenerative circuits based on the network theory of 226 and the
circuit models developed for transistors in 227. Prerequisites: 226 or 236 with approval of instructor, and 227.
3 units, spring, (J. Linvill, Angell)

229. Seminar on Semiconductor Devices—Physical theory and design of various semiconductor devices with particular emphasis on varactor diodes, field effect structures, PNPN diodes and triodes. Prerequisites: 227 or 255.
Units by arrangement, spring, (Gibbons)

230. Solid-State Electronics Seminar—Discussion by faculty, students, and guest specialists of research topics and current literature in the circuit and device aspects of solid-state electronics.
1 unit, autumn, winter, and spring, (Angell, Gibbons)

3 units, spring, (Tuttle)

235n. Introduction to Network Synthesis—A one-quarter survey of the principal ideas of network theory, for both passive and active networks. (Given as E.E. 233 in 1962–63.) Properties of networks, practical limitations on their performance, and procedures for their synthesis. (The study of network synthesis is continued in 236, 237 for those interested in advanced work in the subject.) Prerequisite: 106.
3 units, autumn, (Tuttle)

236, 237. Advanced Network Synthesis—A continuation, with greater detail and more extensive coverage, of the study of Network Synthesis begun in 235n. Topics include: rigorous discussion of the basic limitations on network performance, synthesis of two- and four-terminal networks of various classes, methods of approximation (with particular attention to the potential analogy), conventional and insertion-loss methods of filter design, transformerless and transmission-line networks. Prerequisite: 235n.
236. 3 units, winter, (Tuttle)
237. 3 units, spring, (Pantell)

242. Introduction to the Theory of Linear Systems—Fourier, Laplace and Z-Transform Theory for periodic, aperiodic and discrete signals; Theory of residues and evaluation of the inverse Laplace transform; definition of linear systems; response of linear systems to deterministic inputs; definition of random processes; auto-correlation function and power spectral density; response of linear systems to random signals. Prerequisite: 106. Previous or concurrent registration in Statistics 116 is advisable.
3 units, autumn or spring, (Abramson, Mattson, W. Linvill)

3 units, autumn, (Bracewell)

244. Introduction to Communication Theory—Mathematical representation of determined and random signals; sampling theorems and signal space; information measure, channel capacity, coding; shot-noise model, gaussian random process; network analysis with random signals. Not intended for students who plan to take 251, 252, and 254. Prerequisite: 106. Previous or concurrent registration in Statistics 27 or Statistics 116 is desirable.
3 units, winter, (Harman)

3 units, winter, (Franklin, Widrow)


3 units, spring, (Franklin, Widrow)


3 units, autumn, (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.

1 unit, autumn, winter, or spring, (Abramson, Flügge-Lots, Franklin, W. Linvill, Widrow)


3 units, spring, (Widrow, Franklin)


3 units, winter and spring, (W. Linvill)

251. Statistical Communication Theory—The Gaussian Random Process; statistics of various measurements; calculation of the spectra of amplitude modulated, frequency modulated and some pulse modulated signals; the physical generation of noise; nonlinear systems; analysis of the output of nonlinear systems with random inputs. Prerequisite: 242.

3 units, winter, (Abramson)

252. Applied Statistical Decision Theory—Matched filters; optimum linear estimates; Wiener filters; statistical decision theory; synthesis of optimum systems and evaluation of their performance; additive Gaussian communication channels; multipath communication channels; the theory of optimum learning. Prerequisite: 251.

3 units, spring, (Abramson)

254. Information Theory—Information sources and channels; the measure of information; language structure; the binary symmetric channel; capacity of some practical communication channels; group codes and cyclic codes; coding for binary symmetric channels. Prerequisite: Statistics 116 or equivalent.

3 units, autumn, (Abramson)
255. Semiconductor Theory—Physical basis for band structure in solids and application to semiconductors. Conduction mechanisms in metals and semiconductors. Extrinsic and intrinsic semiconductors. Static and dynamic behavior of p-n junctions and junction transistors. Prerequisite: Physics 57; Mathematics 130 recommended.  
3 units, autumn, (Moll)

256. Semiconductor Theory—Physical basis for carrier mobility in semiconductors as limited by lattice and impurity scattering, nonlinear high field mobility, secondary ionization, and avalanche breakdown of junctions and the theory of tunnel or Zener breakdown and Esaki diodes. Prerequisite: 255.  
3 units, winter, (Moll)

257a, b, c. Solid-State Electronics Laboratory—Experiments on semiconductor crystal growth, gaseous diffusion of impurities, Hall effect, minority-carrier diffusion and drift mobility, etc. Prerequisite: 255 or Physics 172.  
3 units, autumn, winter, and spring, (Pearson)

3 units, autumn, (Epley)

262. Theory of Switching—Extension of 261 to sequential digital networks. Analysis and synthesis procedures for synchronous and asynchronous networks, with emphasis on the relations between state behavior and internal logic. Special consideration of codes, linear networks, feedback shift registers, counters, data checkers, sequence generators, and arithmetic units. Turing machines and the general theory of automata. Prerequisite: 261.  
3 units, winter, (Epley)

266. Digital Computer Circuitry—Arithmetic operations in digital computers. Survey of storage, switching, input-output devices finding applications in computing, data processing, control systems, communication systems. Prerequisites: 143 or 152, and Mathematics 24.  
3 units, spring, (Peterson, Mattson)

268. Analog Computer Circuitry—Application of analog methods to solution of engineering problems. Operating principles of integrators, function generators, multipliers, analog-to-digital converters. Simulation; design of control systems. Prerequisites: 152 or 143 with approval of instructor and Mathematics 24 and 130.  
2 units, winter, (Peterson)

270. Elementary Electromagnetic Theory—Introduction to field theory: elements of vector analysis, Maxwell’s equations, plane and spherical waves, electrodynamic potentials, radiation, simple antennas, waveguides. Prerequisites: Physics 53, Mathematics 24, normally senior or graduate standing.  
3 units, autumn, (Heffner, Spicer)

271, 272. Electromagnetic Theory—Solutions to static field problems, Maxwell’s equations, field basis for circuit concepts, skin effect and circuit impedance, guided waves, common waveguides and transmission lines, resonant cavities, microwave networks, radiation theory, antennas. Prerequisite: 270.  
271. 3 units, autumn or winter, (Dunn, Manning, Eshleman)  
272. 3 units, winter or spring, (Dunn, Eshleman)

3 units, autumn, (Siegman)

274b. Quantum Electronics—The application of quantum mechanics to problems of generation, transmission, and detection of electromagnetic waves. Dirac for-


277. Space Radar and Communications—Theory of radio wave scattering from electron ensembles (e.g., meteor trails), and from turbulent and thermal fluctuations in a plasma. Elements of magneto-ionic theory extended to include magnetohydrodynamic propagation. Emphasis on physical descriptions and on applications to communications, radar astronomy, and space probes. Prerequisite: 271.

280. Radioscience Seminar—Student-faculty discussion of research problems in general field of radio propagation, ionospheric physics and radio astronomy.

286. Plasma Dynamics—Plasma as a new medium, its significance in space and fusion research, collective and individual phenomena, Boltzmann and Vlasov equations, oscillations, Landau damping, cold and hot plasma in a magnetic field, sheaths, confinement, magnetohydrodynamics. Prerequisites: 270 and 271.

290. Special Studies in Electrical Engineering—Special studies, under direction of 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.)

291. Reports and Papers in Electrical Engineering—Special studies, under direction of 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 290.

292. Special Seminars—Seminars on particular subjects will be given from time to time. See the Time Schedule for detailed announcements. Subjects of seminars that have been given in the past include:

- Crossed Fields
- Medical Electronics
- Digital Devices
- Biocommunications
- Binary Coding Theory
- Space Charge Flow
- Magneto Phenomena Devices
- Electrodynamics of Moving Media
- Optical Properties of Solids
- Communication Channels

295. Electrical Engineering Instruction—Open to a very limited number of Electrical Engineering students who plan to make teaching their career.

296. Electrical Engineering Instruction Seminar—Weekly discussion of problems for guidance of those who intend to make a profession of engineering teaching. Open to all.

1 unit, winter, (Skilling)
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

**Numerical Methods and Theory and Operation of Computing Machines**—See Mathematics 137, 138, 239.

**Elementary Nuclear Physics, Quantum Mechanics and Atomic Physics, and Solid State Physics**—See Physics 130, 140, 172.

**Introduction to Nuclear Engineering**—See M.E. 171.

**Nonlinear Oscillations and Contactor Control**—See Engineering Mechanics 231, 232, 236.


**DIVISION of ENGINEERING MECHANICS**

*Emeriti:* Stephen Prokofievich Timoshenko, Lydik Siegumfeld Jacobsen (*Professors*)

*Executive Committee:* James Norman Goodier (*Chairman*), Wilhelm Flügge, Irmgard Flügge-Lotz, Miklos Hetényi, Thomas R. Kane, Erastus Henry Lee, Donovan Harold Young (*Professors*)

*Affiliated Faculty*


*Associate Professors:* Max Anliker, Daniel Bershader, Chi-Chang Chao, Krishnamurty Karamcheti, Byrne Perry (on leave 1963–64), William Craig Reynolds, Cedric W. Richards

*Acting Assistant Professor:* James Marshall Kelly

**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 plastic elements of machines and structures, vibrations and nonlinear dynamics, 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. 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 expected.

The program assumes that the student is adequately prepared to undertake graduate study in Engineering Mechanics and that he has already had the equivalent of the following Stanford courses: C.E. 114 (Mechanics of Materials), Mathematics 130 (Ordinary Differential Equations), M.E. 160 and 161 (Engineering Dynamics and Dynamics of Machinery). A student who, at the time of admission, is deficient in any or all of these 12 units will be required to make them up during his graduate study; in which 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. 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 included.

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. The requirements for the M.S. degree (see above) must be included, except that 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. Reading proficiency in German or Russian must be demonstrated before thesis research is begun.

FELLOWSHIPS AND ASSISTANTSHIPS

University Fellowships are open to all (prospective) graduates. See "Scholarships" in the Information Bulletin obtainable from the Registrar. In addition, several special fellowships and research assistantships are offered by the Division. Information and application forms (due February 8 for University Fellowships, March 15 for all others) may be obtained through the Secretary, Division of Engineering Mechanics.
COURSES


3 units, autumn, (Young), MWF 8


3 units, autumn, (Goodier), MWF 9


3 units, winter, (Goodier), MWF 10


2 units, winter, (Chao), TTh 1


2 units, spring, (Chao), TTh 1

204. Advanced Theory of Elasticity—Topics from contact stress, thermal stress, static instability and finite deformation, dynamic instability, selected in relation to current research. Prerequisites: 202a, b.

2 units, spring, (Goodier), TTh 11


3 units, winter, (Hetenyi), 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 M.E. 118.

2 units, autumn, (Goodier), TTh 11, alternate years, to be given in 1964–65


2 units, winter, (Goodier), TTh 11, alternate years, to be given in 1964–65


2 units, spring, (Goodier), TTh 11, alternate years, to be given in 1964–65


3 units, winter, (Flugge), MWF 9


3 units, spring, (Flugge), MWF 9


2 units, autumn, (Flügge), by arrangement

3 units, winter, (Chao), TTh 11


3 units, autumn, (Flügge), MWF 10


3 units, winter, (Flügge), TTh 10, M 1


3 units, spring, (Lee), MWF 10


3 units, spring, (Richards), TTh 10 and one lab. by arrangement


3 units, autumn, (Flügge), MWF 2


3 units, winter, (Lee), MWF 2


2 units, autumn, (Young), TTh 9

222. Dynamics—Dynamics of a rigid body. General momentum and energy theorems; applications to variable mass systems, impact, gyroscopes. Prerequisites: Math. 130 and E.M. 221.

2 units, winter, (Young), TTh 9

223a. Advanced Dynamics—Brief review of D'Alembert's principle, momentum and energy principles, laws for impulsive motions. Generalized particle and rigid body kinematics, inertia properties, forces, and force functions. Lagrange's form of D'Alembert's principle. Prerequisites: 221 and 222 or equivalent.

2 units, spring, (Kane), TTh 9


2 units, autumn, (Kane), TTh 9

223c. Advanced Dynamics—Hamilton's principle, the principle of Least Action, Hamilton's canonical equations, the Hamilton-Jacobi differential equation. Integra-
tion in series, ignorance of coordinates, use of the energy integral, integral invariants, contact and point transformations. Prerequisite: 223b.

2 units, winter, (Kane), TTh 9


3 units, autumn, (Anliker), MWF 12


3 units, winter, (Anliker), MWF 12


2 units, autumn, (Kane), TTh 11


2 units, winter, (Kane), TTh 2


2 units, spring, (Kane), TTh 2


2 units, winter, (Flugge-Lotz), TTh 1


3 units, autumn, (Vennard), MWF 10


3 units, autumn, (Flugge-Lotz), MWF 1


3 units, winter, (Flugge-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.E. 210a, or M.E. 238a, or permission of the instructor.

3 units, spring, (Flugge-Lotz), MWF 11

246. Hydrodynamics of Free Surface Flows—Classical theory of water waves, jets, cavity flows, and bodies moving near the surface. Formulation of equations
and boundary conditions. Exact and approximate methods of analysis. Effects of
gravity, surface tension, nonuniform density, and viscosity. Prerequisite: E.M. 242.

2 units, winter, (Hsu), WF1, alternate years, to be given in 1963–64

247. Engineering Hydrodynamics—Continuation of E.M. 246. Selected theoretical topics from naval hydrodynamics, hydraulic engineering, and oceanography. Possible topics include ship waves, forces on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, steady and unsteady seepage flow, density currents, stability of jets, flow over weirs and spillways. Prerequisite: E.M. 246.

2 units, spring, (Street), by arrangement, alternate years, to be given in 1963–64


3 units, autumn, (Lee), MWF 11


3 units, winter, (Kelly), MWF 8


3 units, spring, (Flügge), M 1, TTh 8

265. Special Problems in Structural Mechanics—General theory of linear structural problems. Energy theorems, reciprocal theorems, normal functions. Applications to spatial deformation of skeletal structures. Extensions to nonlinear aspects. (Same as C.E. 385.) Prerequisite: 200.

2 units, autumn, (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, spring, (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 a unit of credit, with + or − grade, is optional; a letter grade is given for students presenting talks.

1 unit, autumn, winter, and spring, (Goodier, Hetényi, Lee), Th 3

296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are expected to attend. Registration for one unit of credit, with a ± grade, is open to students having the Master’s degree; a letter grade is given for those presenting talks.

1 unit, autumn, winter, and spring, (Flügge-Lotz, Van Dyke, Vincenti), T 4:15


Autumn, winter, and spring, (Staff), by arrangement


Autumn, winter, and spring, (Staff), by arrangement
ENGINEERING SCIENCE

Program Advisers: James M. Gere (Chairman), Andreas Acrivos, Richard H. Bube, Robert H. Eustis, Wilhelm Flügge, Krishnamurty Karamcheti, Gerald L. Pearson

This curriculum is a program in applied science, leading in most cases to further study at the graduate level, and designed particularly 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.

To be admitted to the Engineering Science program, the student must have reached sophomore standing and must submit a petition to the School of Engineering outlining his course program and plans. Such petitions will be examined by the Engineering Science Committee of the School and approved only if they provide for a coherent plan which is adequate in depth and breadth of study. These petitions must be filed not later than the middle of the third quarter preceding graduation. Petitions received later will normally be acted upon unfavorably.

INSTITUTE in ENGINEERING-ECONOMIC SYSTEMS

Emeriti: Eugene L. Grant, Marion Rice Kirkwood (Professors)

Executive Committee: William K. Linvill (Chairman), W. Grant Ireson, Gerald J. Lieberman, Ray K. Linsley, Lorie Tarshis (ex officio), (Professors)

Affiliated Faculty

Professors: Kenneth Arrow, Karl Brandt, Rolf Eliassen, Joseph B. Franzini, Robert V. Oakford, Clarkson H. Oglesby

Associate Professors: Hubert R. Marshall, Vincent J. Roggeveen, Harvey M. Wagner

Assistant Professor: David V. Heebink

Lecturer: John Johnson

OFFERINGS AND FACILITIES

Recent advances in computers, data processing and automation have greatly increased the incidence of planning and systems problems in engineering. The engineering of modern systems often requires competence in a wide range of technological areas in addition to much greater knowledge of economic and operational factors than was common in engineering some years ago. In order to provide a central focus for the interdepartmental interests in these areas, the Institute in Engineering-Economic Systems has been established. The field of Engineering-Economic Systems is still evolving and no degree is offered presently by the Institute; students can earn their degrees in the departments of the School of Engineering, in the Operations Research Program, or in a Graduate Division Special Program.

The central theme of the Institute in Engineering-Economic Systems is to carry on research projects in various areas in which planning and systems considerations dominate. In particular, stress is placed on study of physical or operational systems...
with complicated interaction between parts; those situations in which decision making must take place under uncertainty; those situations in which characteristics or states evolve with time and in which control is a significant factor; generally, model-making and computer simulation are stressed; the various optimization procedures receive strong attention.

The work of the Institute of Engineering-Economic Systems is centered around the development of a research program and a program of graduate courses in the systems and planning area. The interdisciplinary program includes affiliated faculty members from the Departments of Civil, Electrical, and Industrial Engineering, Economics, Political Science, Statistics, and the Graduate School of Business.

**Research Programs**

The research program stresses two kinds of activities which have somewhat different emphases: the projects on engineering-economic planning stress problems of planning of public works projects in which improved criteria and methodology for decision making will be developed; the projects on planning and system design for computer-coordinated systems emphasize the technico-economic problems of automation. In the automation studies both the physical problems of system analysis and design and the economic problems of evaluation, justification, and planning are considered. In both kinds of projects the research is aimed at establishing specific results in specific areas as well as developing general theoretical results.

The project on Engineering-Economic Planning under the directorship of Professor Linsley has received its initial support through a grant from the Ford Foundation. The Ford Foundation grant will permit distinguished visiting faculty to be in residence during the academic year, provide support for resident faculty and for research, and provide fellowships to unusually competent students in the planning area.

The projects on computer-coordinated systems have a mixture of industrial, governmental, and foundation support. In order to provide adequate interaction with practical work and to provide implementation and follow-through on specific projects, an internship program with private industries has been developed. Governmental and foundation support is obtained for exploratory work on new projects and for development of general theoretical results. Graduate students receive fellowships, research assistantships, and some are industrial interns. The industrial internship program is unconventional and involves periods of University study and research alternated with strongly related engineering projects with affiliated industrial concerns.

In both the planning area and the system area direct attention is given to developing a strong theoretical basis for the new field. Mathematical and statistical principles have been applied to optimum allocation of effort, optimal control, system theory, analysis and simulation of multi-variable systems, and scheduling and traffic control problems. Continued research in these areas will be encouraged and supported independently of the immediate application. The meaningfulness of theoretical work is enhanced by correlating it to practical areas. To provide a strong practical orientation to both the course work and to the theoretical research work, a fairly broad set of specific planning and system research projects is carried on.

The list below represents a partial list of practical projects. Not all projects are active at any one time but are underway when there is some particular interest in them. No exclusiveness is intended in the listing of practical areas. The aim is to undertake whatever practical projects are technically interesting, have practical significance at the moment, and involve theoretical considerations of general interest. Many of the projects listed are managed within one engineering department and almost all are operated by individual professors rather than by an Institute Committee. Generally the function of the Institute committee is to provide the interdisciplinary interaction necessary to develop interdisciplinary areas.

I. Projects on Public Engineering-Economic Planning

1. **Development of Water Resources**
a) Hydrology and hydraulic engineering.
b) Water quality control.
c) Planning and financing of water projects.
d) Legal aspects of water resource planning.

2. **Construction and Transportation Planning**
   b) Methods and equipment for heavy construction.
   c) Transportation Planning: Comparison of costs and benefits of all modes of transportation; urban land use—transportation models; computer simulation of traffic flow.
   d) Legislation and financing of transportation system.

3. **Analysis of Foreign Policy and Military Problems**
   a) Analysis of military weapons systems.
   b) Production planning of military systems.
   c) Physical analysis of military equipment and simulation of its operations.
   d) Logistics planning for military operations.
   e) Development of requirements for weapons systems.
   f) Analysis of international conflict situations.
   g) Control of American foreign policy.

II. **Planning and System Design for Computer-Coordinated Systems**

1. **The Development of the Electric Power Industry**
   a) Technological survey of the state-of-art in energy conversion, transmission, and distribution.
   b) Models of steam boiler and turbine systems.
   c) Simulation of multivariable systems.
   d) Automatic control of plants and coordination of systems.
   e) Long-range planning for expansion. Demand estimation, survey of new uses for power.
   f) Planning for overseas markets. Development and design for overseas equipment.

2. **The Development of Teaching Machines**
   a) Survey of present capabilities.
   b) Learning theory.
   c) Design of communication and data processing equipment.
   d) Experiments and field trials.

3. **Automation in the Steel Industry**
   a) Models of rolling mill and analysis of control problem.
   b) Analysis of steelmaking process and evaluation of computer control.
   c) Dynamic scheduling of steelmaking and steelworking operations.
   d) Coordination of production and marketing in the steel industry.
   e) Economic planning for expansion of steel industry to meet foreign competition.

**PROGRAMS OF STUDY**

**Master of Science and Engineer Degrees**

The Master of Science and Engineer degrees may be earned in Civil and Industrial Engineering with designation Engineering-Economic Planning. To secure this designation, students must meet the degree requirements of their respective departments and include about 20 units of courses selected from the list of core or casework courses below. The selection must meet the approval of a departmental adviser who is one of the affiliated faculty in Engineering-Economic Systems. For the Engineer's degree the research project should be in the systems or planning area.
Doctor of Philosophy

The program of courses and research has not yet been formalized to the point that a degree is awarded by the Institute for Engineering-Economic Systems. Generally if a program largely falls within one department the doctorate is awarded by that department. Theses generally are reviewed by interdepartmental committees. For a course of study involving several departments a special doctoral program as described in the section “Graduate Division Special Programs” in this Bulletin is encouraged.

COURSES OF STUDY

There are many more courses available in the systems area than any one student would want to take. Generally, each program should be selected so as to give a broad coverage of the whole area as well as work in depth in one or more specialty areas. There are three categories of courses which fit into the program: (1) foundation courses from physical sciences, social sciences, and mathematics; (2) general core courses being developed in engineering; (3) casework courses for the various particular practical areas.

1. General Foundation Courses

Mathematics
- 114a, b. Linear Algebra
- 115, 116. Analysis
- 136, 137, 138. Numerical Analysis
- 120, 121. Modern Algebra
- 205a, b, c. Real Variables
- 206a, b, c. Complex Variables
- 220a, b, c. Methods of Mathematical Physics

Statistics
- 116. Theory of Probability
- 217a, b. Introduction to Stochastic Processes
- 219, 220. Statistical Inference

Physics
- 210, 211, 212. Introductory Theoretical Physics

Economics
- 106. Price Theory and Policy
- 108. Intermediate Mathematical Economics
- 109. Income and Employment
- 202. Price and Allocation Theory
- 241. Public Finance and Taxation
- 255. The Structure of Industry

Political Science
- 100. Public Administration
- 107. Government Control of Business
- 110. Administrative Behavior

2. Core Courses in Systems

Analysis
- E.E. 242. Introduction to Linear Systems
- E.E. 244, or 251, 252, 254. Information Theory
- E.E. 245, 246, 247. Control Systems
- E.E. 250a, b. System Analysis
- Stat. 255. Linear Programming
- Stat. 256. Inventory Theory

Design and Simulation
- I.E. 257. Data Processing in Operations Research
- M.E. 214. Philosophy of Design
C.S. 237a, b, c. Advanced Numerical Analysis

Planning
I.E. 229, 230. Engineering Economy
I.E. 232. Capital Budgeting
Econ. 159 or E.E.S. 211. Economics of Public Works
E.E.S. 214. Public Finance
E.E.S. 313. Institutional Setting for Public Works Planning
E.E.S. 316. Cost Allocation for Multiple-Purpose Projects
Pol. Sci. 113. Seminar in Government and Natural Resources
Pol. Sci. 115. Seminar in Administrative Responsibility
Pol. Sci. 116. Seminar in Administrative Regulation

3. Casework Courses in Engineering-Economic Systems
E.E.S. 304, 315. Development of Electric Power Industry
C.E. 250, 251; E.E.S. 213, 310, 311. Transportation Planning
E.E.S. 312. Decision Problems in National Defense
E.E.S. 314. Developing Nations

COURSES

Courses numbered 300 and above are open only to second- and third-year graduate students and first-year students with permission of instructor.

210. Introduction to Economics—A brief review of the general principles of economics for students who have not had Economics 1 or equivalent.
2 units, autumn, (———), TTh 10

211. Economics of Public Works—Criteria for investment and pricing decisions in public works programs for national resources, public facilities, and national defense.
4 units, winter, (———), TWThF 8

212. Water-resources Planning—Integration of technical, economic, political and social factors in decisions relating to water resources.
3 units, spring, (Linsley), MWF 8

213. Highway Planning—A study of the decision process in highway planning as influenced by engineering, economic, political and social problems.
3 units, spring, (Oglesby), MWF 9

3 units, winter, (Roggeveen), MWF 2:15

299. Directed Reading and Research in Engineering-Economic Planning—Directed study and research on subject of mutual interest to student and staff member. Required of all doctoral candidates prior to their qualifying examination.
2 or more units, any quarter, (Staff), by arrangement

304. Seminar in Electric Power Resources—Discussion by faculty, students and guest specialists of factors influencing long-range decisions on the development of electric power resources. Reference will be made to: expected technological developments in the processes for generating, transmitting and distributing electric power; the problem of long-range planning in the face of uncertain demands in specific areas at specific times; costs and benefits or interconnection as a means of matching up diverse power loads and sources of supply in individual geographical regions. Particular reference will be made to the interactions between technological and economic factors.
1 unit, autumn, winter, and spring, (W. K. Linvill), by arrangement

310. Introduction to Regional Planning—A review of concepts and criteria involved in regional and urban planning.
3 units, spring, (Roggeveen), MWF 9, alternate years, to be given in 1964–65

311. Planning of Transportation Systems—A study of urban transportation, its
impact on the city, and the economic, social and political considerations in design.
(Same as C.E. 250.)

3 units, spring, (Roggevecn), MWF 1:15, alternate years, to be given in 1963-64

312. Decision Problems in National Defense—A study of national defense planning and the factors controlling decision.
3 units, spring, (———), MWF 8, alternate years, to be given in 1963-64

313. The Institutional Setting for Public Works Planning—The role of government organization and policy in decision making.
3 units, winter, (Marshall), TTh 8, alternate years, to be given in 1964-65

3 units, autumn, (———), MWF 1:15, alternate years, to be given in 1964-65

3 units, winter, (Heckiuk), MWF 10, alternate years, to be given in 1964-65

316. Cost Allocation in Public Works and Public Utilities—A critical examination, the purposes, techniques and limitations of cost allocations.
3 units, autumn, (Grant), TTh 9, alternate years, to be given in 1963-64

317. Water Law—A survey of water law and its relations to water resources planning and economics.
3 units, winter, (———), MWF 8, alternate years, to be given in 1964-65

318. Planning and Management of Local Public Works—A study of decision problems in public works planning at the level of local government.
2 units, winter, (Johnson), by arrangement, alternate years, to be given in 1963-64

3 units, autumn, (Grant), MWF 11, alternate years, to be given in 1963-64

390. Doctoral Seminar—Discussion of research in progress under E.E.P. program. Required of all Ph.D. candidates.
1 unit, all quarters, Staff

GENERAL ENGINEERING

Program Advisers: James M. Gere (Chairman), Frank R. Arnold, Robert H. McKim, David A. Thompson, David F. Tuttle

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 (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; 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 and plans. Each petition will be examined
by the committee of Program Advisers for General Engineering of the School of En-
gineering and approved 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.

INDUSTRIAL ENGINEERING

Emeritus: Eugene Lodewick Grant

Executive Head: William Grant Ireson
Professors: William Grant Ireson, Gerald J. Lieberman, Robert Vernon Oakford
Associate Professor: Harvey M. Wagner
Assistant Professors: David Van Driest Heebink, Frederick Stanton Hillier, Donald
Eugene Porter, David Alfred Thompson, Arthur Fales Veinott, Jr. Acting:
Sanford Barry Thayer

PROGRAMS OF STUDY

Bachelor of Science

The program leading to the degree of Bachelor of Science in Industrial Engineer-
ing 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 funda-
mentals of engineering are stressed; 69 per cent of the program is common to all
of the engineering curricula and an additional 13 per cent is of technical nature in
engineering, mathematics, and statistics. The remaining 18 per cent consists of
courses in a number of fields that are important as preparation for management
activities.

Many 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 Uni-
versity.

Advanced Degrees

The Industrial Engineering Department, in collaboration with other departments
of the University, offers programs leading to the degrees of Master of Science, Engi-
neer, and Doctor of Philosophy in Industrial Engineering. The programs emphasize
the analytical approach to industrial engineering problems using quantitative meas-
ures. Specialized work is available in engineering statistics (including quality con-
trol) and data processing; this includes a number of courses in the Departments of
Statistics and Mathematics. Special emphasis may also be given to engineering econ-
omy 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 sub-
stantial progress in the major field beyond the equivalent of a Bachelor's degree.

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 six fields: 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 $3,260 a year are awarded each year. Application forms and detailed information may be obtained by writing the Department of Industrial Engineering. Applications normally should be made by February 8 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 available scholarships and fellowships and for a description of the procedure for making application.

UNDERGRADUATE COURSES

100. Industrial Organization and Management—Organization theory; research in organizational behavior; relationships among organizational functions; the industrial engineer in organizations.
   4 units, autumn, (Porter), MTWF 8
   or winter, (Porter), TWThF 11
   or spring, (Porter), MTWF 10

108. Work Design and Measurement—Design and measurement of man-machine work systems based on analysis of fundamentals of biophysics and statistical inferences. Prerequisite: 120. (I.E. 120 may be taken concurrently.)
   3 units, autumn, (———), MWF 9
   or spring, (Thompson), MWF 11

Operation methods—tools, jigs, fixtures; assembly, inspection procedures; plant facilities; materials handling, plant layout. Prerequisite: 108.

3 units, autumn, (Hillier), MW 9
or winter, (——), MW 9

110. Systems and Procedures Design—Techniques of analysis and principles of design of systems for repetitive administrative functions. Applications in manufacturing organizations, particularly to inventory management and production control. Prerequisites: I.E. 100 and knowledge of basic accounting.

3 units, autumn, (——), MW 1:15
or winter, (——), MW 10

118. Work Design and Measurement Problems Laboratory—Design and case study analysis of practical problems in industry. Prerequisite: 108.

1 unit, autumn or winter, (Staff), T 1-4

119. Production Engineering Laboratory—Production tooling, layout design practice. Plant visits. Prerequisites: 109 and 118.

1 unit, winter, (Staff), Th 1-4
or spring, (Staff), T 1-4

120. Quality Control by Statistical Methods—Use of statistical techniques in control of quality of manufactured product. Basic statistical concepts. Shewhart control charts. Introduction to probability theory with applications to sampling acceptance procedures.

4 units, autumn, (Hillier), MTWF 8
or spring, (Hillier), MTWF 10

120a. Quality Control by Statistical Methods—Same as 120 except knowledge of basic probability and statistical concepts is assumed. Prerequisite: Statistics 27 or 110 or 116.

3 units, winter, (Ireson), MW 11


2 units, spring, (Thompson), Th 9 and 1-4


133. Industrial Accounting—Brief introduction to general accounting, cost accounting; particular emphasis on cost accounting. (Students who have taken or are taking a University course in elementary accounting are not admitted to this course.)

3 units, spring, (Thayer), MW 8
4 units, summer, (——), MTWThF 10

133a. Industrial Accounting—Alternative to 133. More attention to such matters as use of standard costs in cost accounting, fixed capital accounting and depreciation, budgetary control, interpretation of financial statements. (Students who have taken or are taking a University course in elementary accounting are not normally admitted to this course.)

5 units, autumn, (Thayer), MTWThF 11
or winter, (Heebink), MTWThF 8

152. Introduction to Operations Research—Application of mathematical models to industrial problems; linear programming, queueing, games theory, inventory. Discussion, solution of actual problems encountered in management, production, economics of industry. (Same as Statistics 152.) Prerequisites: Statistics 27, or 110, or 116 (or concurrent registration in any one of these courses).

3 units, autumn, (Veinott), MW 4:15-5:30
or winter, (Lieberman), MW 4:15-5:30
or spring, (Veinott), MW 10

161. Introduction to Data Processing—Use of data processing equipment, appli-
cations to industrial problems. Includes laboratory application of computers and auxiliary equipment.

3 units, autumn, ( ), MWF 2:15
or winter, ( ), MWF 1:15
or spring, ( ), MWF 8

190. Seminar—Special topics by guest speakers. Students prepare a formal engineering report on approved subject.

1 unit, winter, (Staff), Th 11

191. Observations in Industry—Visits to selected industries with observations of their organization and manufacturing procedures. Analytical reports on assigned topics. Prerequisites: 109, 110.

1 unit, spring, (Staff), F 1-4

COURSES PRIMARILY FOR GRADUATE STUDENTS

201. Seminar in Organizational Theory—Selected topics in organization; effects of technology on organization structure and members; dysfunctional aspects of organization; communication; leadership; morale; research methods. May be taken twice for credit. Prerequisite: 100 and consent of instructor.

2 units, winter and spring, (Porter), T 2-4


3 units, winter, (Thompson), MWF 3:15


2 units, spring, ( ), TTh 9

220. Quality Control Applications—Current practices in industrial quality control. Problems of application of statistical quality control methods in various industries. Prerequisite: 120.

3 units, spring, (Ireson), TTh 10 and Th 1-4


2 units, autumn, (Lieberman), TTh 4:15


2 units, autumn, ( ), TTh 12

230. Advanced Engineering Economy—Application of engineering economy to problems of competitive industry. Income tax aspects of economy studies. Relationship between accounting and engineering economy. MAPI formula; other approaches to replacement economy. Discounted cash flow method. (See also Civil Engineering 230.) Prerequisite: 130.

2 units, winter, (Heebink), TTh 10
or spring, (Heebink), TTh 8

231. Problems in Engineering Economy—Independent study of selected problem in engineering economy. Prerequisites: 130 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: 133a or equivalent, and Engr. 161, or consent of instructor.

3 units, autumn, (Heebink), MWF 10

247. Advanced Production Engineering—Advanced problems in factory planning, materials handling, production-line techniques, automation, plant facilities. Prerequisite: 109 (I.E. 109 may be taken concurrently.)

3 units, autumn, (———), TTh 9 and Th 1-4

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, spring, (Linsley), TTh 11

252. Operations Research—A rigorous treatment of linear programming, queueing, inventory theory, and other mathematical techniques used in operations research. (Same as Statistics 252.) Prerequisite: 152.

3 units, winter or spring, (Veinott), MW 4:15-5:30

253. Seminar in Operations Research—Case studies appearing in the operations research literature. Student teams work in local industry on problem in operations research. Special topics, including some presentations by guest specialists. (Same as Statistics 253.) Prerequisite: I.E. 252.

3 units, spring, (Lieberman), MW 4:15-5:30

257. Data Processing in Operations Research—Selected topics in the application of electronic computers to operations research activities. (Same as Statistics 257.) Prerequisites: I.E. 161 and I.E. 252.

3 units, spring, (Hillier), MTW 3:15

259a, b, c. Workshop in Management Science—Advanced topics drawn from current literature in management science. (Enroll in Statistics 259a, b, or c.) Prerequisite: consent of instructors.

3 units, autumn, winter, and spring, (Staff), by arrangement

261. Data Processing—Case studies, selected topics, laboratory applications. Prerequisite: 161.

3 units, winter, (———), MWF 2:15; lab. by arrangement
or spring, (———), MWF 11; lab. by arrangement

263. Data Processing Laboratory—Application of electronic data processing machine to problem of business management or operations research. Student will choose problem, program solution, test program, prepare data input, obtain and analyze output. Prerequisite: 261.

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

281. Individual Study in Ergonometics—Directed reading or research in physiological, neurological bases of industrial work. Prerequisite: consent of instructor.

1 or more units, winter and spring, (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.

Autumn, winter, and spring, (Staff), by arrangement

301. Dissertation—Required for degree of Doctor of Philosophy.

Autumn, winter, and spring, (Staff), by arrangement
MATERIALS SCIENCE

Emeritus: Welton J. Crook (Professor)

Executive Head: O. Cutler Shepard
Professors: Robert A. Huggins, O. Cutler Shepard, Oleg D. Sherby
Associate Professors: Richard H. Bube, John C. Shyne, William E. Spicer, Robert L. White
Assistant Professors: Victor G. Macres, William D. Nix, David A. Stevenson
Lecturers: Claus G. Goetzel, Donald R. Mash

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 professional 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. Construction will start this year on a new building, which will supply 35,000 square feet of additional space for materials research.
PROGRAMS OF STUDY

Bachelor of Science

The undergraduate Materials Science program provides training in solid state fundamentals 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 admission and registration are described under the "Graduate Division" section of the School of Engineering.

Master of Science

The University's basic requirements for the Master of Science degree are discussed in the section "Degrees" in the 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 10 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) A minimum of 20 units of advanced courses in the general area of Materials Science (excluding research and special problems), including:
      Mat. Sci. 222. Statistical Thermodynamics
      Mat. Sci. 230. Materials Science Colloquium
      Mat. Sci. 237. Defects in Crystalline Solids
   b) A minimum of 9 units of courses outside of the Materials Science Department.
   c) A minimum of 6 units of Mat. Sci. 200 (Special Problems) with a Master's Research Report approved by two faculty members.
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, G10 or R10, 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.

Course work must have the approval of the major professor (who supervises the dissertation) and one other faculty member. A minimum of 48 course units, of which 30 must be graduate, should be taken in areas relevant to Materials Science. A minimum of 18 units of course work must be taken outside of the Materials Science Department. At least 6 units of courses outside of the Materials Science Department should be taken at Stanford.

COURSES

50. Introductory Science of Materials—Introduction to the physical basis of the mechanical, electrical and magnetic behavior of solids. Electron theory, imperfections in solids. Relations between structural features and properties. (Enroll in Engineering 50.) Prerequisites: Physics 55 and Mathematics 23 or 43.

3 units, autumn, (Huggins), MWF 9
   or winter, (Nix), MWF 11
   or spring, (Huggins), MWF 10
   or summer, ( ), MTWTh 9

107. High Temperature Laboratory—Lectures and laboratory experiments relating to high temperature processes, atmosphere control and vacuum technology; thermodynamic and kinetic measurements. (Enroll in Mineral Engineering 107.) Prerequisite: Mineral Engineering 105.

2 units, spring, (Parlee), TTh 1-4

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, spring, (Stevenson), MWF 9

122. Solid State Thermodynamics—Systematic development of thermodynamic relations and applications to solid state phenomena including phase equilibria, phase transformations and solution thermodynamics. Prerequisite: Chemistry 173.

3 units, autumn, (Stevenson), MWF 9

123. Materials Science Laboratory—Introduction to laboratory techniques for the study of materials: metallography, photomicrography, thermal analysis, dilatometry and pyrometry. Prerequisite: Engineering 50.

3 units, autumn, (Shyne), Th 1, and lab. TTh 2-5

124. Structural Control in Materials I—Relation of structure to physical properties; energy of surfaces and internal boundaries; diffusion; first and second order phase changes. Free energy relations; binary and ternary phase diagrams. Prerequisite: Engineering 50

3 units, autumn, (Sherby), MWF 10

125. Structural Control in Materials II—Solidification; recovery and recrystallization; kinetics of diffusion controlled and martensitic transformations; effect of structural transformations on properties; formation and control of heterogeneous structures; surface treatments, hardenability. Prerequisites: 123, 124.

4 units, winter, (Shepard), MWF 10; lab. Th 1-4

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: 125.

2 units, spring, (Shepard), TTh 9
127. **Crystallography and X-Ray Analysis**—Crystal geometry and the reciprocal lattice; fundamentals of x-ray absorption, diffraction and spectroscopy with applications to crystalline materials. Prerequisite: Physics 55.

*4 units, autumn, (Macres), MWF 11; lab. M 1-4 or by arrangement*

130. **Mechanical Behavior of Solids**—Elements of dislocation theory. Mechanisms of plastic deformation. Elastic, anelastic and plastic properties of single crystalline, polycrystalline, amorphous and high polymeric materials. Relation of the defect solid state to mechanical properties. Prerequisite: 50.

*3 units, winter, (Sherby), TTh 9; lab. T 1-4*

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, approval of Materials Science Faculty.

*2 units, autumn, (Shepard); winter, (Huggins); spring, (Nix), by arrangement*

152. **Electric and Magnetic Properties of Materials**—Introduction to the physical basis of conduction of electricity, dielectric and magnetic properties. Review of atomic theory, molecular and atomic polarization, metallic conduction, band theory, semiconductors, physical processes in transistors, magnetic materials, magnetic resonance phenomena. (Enroll in Engineering 152.) Prerequisites: Physics 57 and Engineering 50.

*3 units, spring, (Heffner), MWF 11*

200. **Special Problems.**

*Any quarter, (Staff), by arrangement*


*1 unit, winter, (Goetzl), by arrangement*

212. **High Temperature Materials**—Applications, product specifications, properties, and fabrication methods for refractory metals, dispersion alloys, reactive metals, graphite, ceramics, cermets, and intermetallic compounds. Prerequisite: 210.

*1 unit, spring, (Goetzl), by arrangement*

214. **Physical Ceramics**—Seminar on the structure of vitreous and crystalline non-metals. Influence of thermal treatments on structure. Relation of structure to thermal, mechanical, optical, electrical and magnetic properties. Prerequisite: 125.

*3 units, winter, (———), MWF 9*

220. **Phase Transformations in Solids**—Thermodynamic, kinetic and crystallographic aspects of nucleation and growth reactions, martensitic transformations and second order transitions in solids. Prerequisite: 125.

*3 units, spring, (Shyne), MWF 10*

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

*3 units, winter, (Stevenson), MWF 11*

226. **Corrosion and Electrometallurgy**—Electrochemical principles with applications to corrosion, electrolytic processes and energy conversion cells. (Same as Mineral Engineering 226.) Prerequisite: Chemistry 173.

*3 units, winter, (Shepard), MWF 8*

230. **Materials Science Colloquium**

*1 unit, autumn, (Shepard); winter, (Bube); spring, (Shyne); summer, (Shepard), M4*


*3 units, spring, (Mash), MWF 9*

bands in one and three dimensions, Brillouin zones, effective mass, time-dependent wave mechanics. Prerequisite: 152.

3 units, autumn, (Bube), MWF 1:15


3 units, winter, (Bube), MWF 1:15


3 units, spring, (Bube), MWF 1:15


3 units, winter, (Macres), TTh 9; lab. by arrangement

237. Defects in Crystalline Solids — Theory of dislocations, vacancies and other defects; their effects on mechanical and physical properties of materials. Prerequisite: 130.

3 units, autumn, (Nix), MWF 8


3 units, spring, (Macres), MWF 8

242. Properties of Surfaces — Seminar on the physical and chemical nature of surfaces, influence of surfaces on solid state phenomena.

2 units, autumn, (———), W 3-5, alternate years, to be given in 1963-64


3 units, spring, (———), T1, TTh 2-5

245. Thermoelectric Materials and Systems — Seminar on topics related to thermoelectric materials and the effect of structure on thermoelectric properties. Use of these materials in power conversion and refrigeration systems. (Same as M.E. 245.) Prerequisite: 122 or M.E. 231A.

2 units, winter, (Stevenson, Eustis), W 3-5, alternate years, to be given in 1963-64

246. Crystalline Anisotropy — Seminar on the application of tensor notation to the description and analysis of the properties of crystalline materials.

2 units, autumn, (Shyne), TTh 10

247. Solidification and Crystal Growth — Seminar on thermodynamic, kinetic and structural aspects of the nucleation and growth of crystals. Prerequisite: 125.

2 units, spring, (Huggins), W 2-4

248. Magnetic Materials and Phenomena — Seminar on physical basis of magnetic phenomena, structural effects. Prerequisite: 152.

2 units, winter, (Huggins), W 2-4

249. Mechanisms and Theories of Creep — Theories of creep of solids. Relation of structure to strength and ductility of materials at elevated temperatures. Prerequisite: 237.

2 units, spring, (Sherby), W 2-4


3 units, summer, (———), TTh 3-5

251. Seminar in Advanced Diffraction and Spectroscopy — Prerequisite: 236.

2 units, spring, (Macres), by arrangement

252. Research.

Any quarter, (Staff), by arrangement
MECHANICAL ENGINEERING

Emeriti: Boynton Morris Green, Lydik Siegumfeldt Jacobsen, Stephen P. Timoshenko (Professors)

Executive Head: William Morrow Kays
Division Directors: Stephen Jay Kline (Thermosciences), John Edward Arnold (Design), Thomas Joseph Connolly (Nuclear)
Associate Professors: Frank Robert Arnold, Thomas Joseph Connolly, William Craig Reynolds, Rudolph Sher
Assistant Professors: Peter Zane Bulkeley, Joel Henry Ferziger, James Paul Johnston, Robert Edward Keller, Charles Herman Kruger, Bernard Roth

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 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, transportation, and product manufacturing industries.

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 mechanical component design, comprehensive systems design, and industrial product design. The Nuclear Division offers work in reactor physics and all aspects of nuclear reactor technology. It should be noted that this department does not offer specialized work in the areas of engineering mechanics, and students interested in concentrating in engineering mechanics should consult the 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 gas, liquid, combustion, and refrigeration machinery, a gas turbine, high and low velocity wind tunnels, a gas dynamics facility, a magnetohydrodynamics power conversion sys-
tem, a shock tube, extensive heat transfer equipment, as well as adequate instrumentation, utilities, and space for research, together with a machine shop.

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 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 mechanical engineering (for example, fluid mechanics, applied thermodynamics, applied mechanics, circuit theory) may be required 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 4 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 mechanical 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; Math. 106, 131, 132. (Ordinary differential equations, e.g., Math. 130, may not be used to fulfill this requirement and is treated as a make-up course if taken.)

2. 6 units in each of two of the following four categories, plus fulfillment of the minimum indicated units in one of the two remaining categories.
   a) Design and Mechanics (4 units minimum) from:
      M.E. 214a, b; M.E. 216a, b; M.E. 218a, b; E.M. 202a, 202b, 222, 223a
   b) Fluid Mechanics (3 units minimum) from:
      M.E. 238a (unless M.E. 136 taken as undergraduate with “B” grade, in which case 238a may not be used to fulfill M.S. requirements), 238b, 238c;
      E.M. 241, 242, 243; A.E. 210a, 210b, 210c
   c) Thermodynamics and Heat Transfer (3 units minimum) from:
      M.E. 231a, 231b, 231c, 233a, 233b, 211a, 211b
   d) Nuclear Science (3 units minimum) from:
      Physics 140; M.E. 271a, 271b, 271c

3. 18 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. Exceptions to the graduate level rule are Engr. 50, 104, 113, 152, 171, 172 and M.E. 133, 134, 161, 171, 175.

4. 5 or 6 units of free electives, making up a total of 45 units. Students who have already fulfilled in full or in part any of the area requirements as a result of their undergraduate work may place the released units in the free elective category.

Although it is possible to fulfill any 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 9 units of course work in courses presented in the Department.

Students may choose or will be assigned an adviser in the Division that most nearly fits their major interests and will ordinarily use their electives to develop a program with some depth in those interests.

Candidates for the degree of Master of Science will be expected to have a minimum scholastic average of 2.75 in engineering courses to secure the Department’s recommendation for the degree. Students falling below 2.25 at the end of 12 units, or 2.50 at the end of 30 units, may be disqualified from further registration. Students failing to meet the 2.75 grade level at the end of 45 units may be allowed to register for some additional courses if it appears probable that the grade point average can be brought up to 2.75 in a reasonable period of time. However, the conditions must be personally arranged with the Head of the Department.

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 45 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.
**SCHOOL OF ENGINEERING**

<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>Human Factors in Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 215</td>
<td>Seminar in Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 299a, b, c</td>
<td>Product Design Project</td>
<td>15</td>
</tr>
<tr>
<td>Art 237</td>
<td>Product Design</td>
<td>4</td>
</tr>
<tr>
<td>Approved electives</td>
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<td></td>
</tr>
<tr>
<td>Free electives</td>
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<td></td>
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<tr>
<td><strong>Total</strong></td>
<td>46 to 47</td>
<td></td>
</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 for which up to 15 units credit will be allowed. 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 being 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 3.0 for work in engineering courses 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.
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 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 will be assigned to an adviser who will assist him in attempting to arrange with an appropriate faculty member for supervision of his research, if he has not already done this before admission. 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.

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. 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 or Division secretaries.

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 gener-
ally 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. In so far 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—Through lectures, problems, and laboratory work, some of the more basic principles pertaining to the mechanical, metallurgical, and economical aspects of manufacturing will be covered. An understanding of how products are formed and an appreciation for the skills associated with manufacturing are essential to more advanced work in mechanical engineering, design, production, and quality control. Prerequisite: Engr. 9.

50. Engineering Kinematics—Application of graphical and analytical techniques to the solution of kinematic problems in two and three dimensions. While analysis will be stressed, some attention will be paid to the synthesis of linkages, cams and gears in specialized machines, and computing and control systems. Prerequisites: Engr. 9 and Physics 51.


112a. Rapid Visualization—Freehand perspective and shading techniques for rapidly visualizing design concepts. Emphasis is upon two-dimensional visual communication which is lucid and quickly executed. Prerequisite: Engr. 9 or consent of the instructor.

112b. Introduction to Product Design—A study, through lecture and laboratory exercises, of the human values in product design, including functional, human engineering, psychological, and esthetic factors. Laboratory exercises consist of developing simple product concepts three-dimensionally, with rapid model making techniques. Prerequisite: 112a.

112c. Product Design and Presentation—A continuation of 112b, with emphasis shifted to the influence of mass production methods and materials upon design. Pres-
entation techniques for communicating design concepts to others, especially to non-designers, will also be considered. Prerequisite: 112b.

3 units, spring, (McKim), MW 1-4

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, Engr. 9, 15, C.E. 114.

3 units, autumn, (Bulkeley), TTh 10; lab. T or Th 2-5

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, winter, (Roth), TTh 10; lab. T or Th 1-4

114c. Design of Mechanical Engineering Systems—Optimization of steady state and transient behavior of power systems. Design of systems by analogy, with emphasis on nonlinear and active elements. Introduction to automatic control. Analog computation including analysis of computing circuits, scaling of computer systems, and individual practice in computer operation. Switching theory applied to system control and decision making devices. Examples and discussion of digital computer techniques. Prerequisite: 104.

3 units, spring, (Keller), TTh 10 and third lab. by arrangement

116a. Advanced Product Design—Invention and development of new product concepts with emphasis upon methods for determining unfulfilled human needs. Each design concept is developed into a working model. Prerequisites: 112a, b, c.

3 units, autumn, (McKim), TTh 12-2

116b. Advanced Product Design—Continuation of 116a, with emphasis upon the influence of technology, especially "technological breakthrough," upon the formulation of new product concepts. Prerequisite: 116a.

3 units, winter, (McKim), TTh 1-4

116c. Advanced Product Design—Continuation of 116a, b, with emphasis upon developing a large, complex design to solve a "big" need, i.e., mass transportation or city planning. Prerequisite: 116b.

3 units, spring, (McKim), TTh 1-4

122n. 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: Engr. 21, 31, and preferably M.E. 132.

4 units, autumn, winter, and spring, (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: 122n and 132.

4 units, winter and spring, (Staff), one afternoon by arrangement


3 units, autumn or winter, (Kays, 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, spring, (———), 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, winter, (——), MWF 8


3 units, autumn, (——), MWF 11


4 units, winter, (——), MWF 10; one lab. by arrangement or spring, (——), MWF 8; one lab. by arrangement

146. Introduction to Aerodynamics—Explanation of principles of flight; prefaced by résumé of aeronautical history, consideration of aircraft classification and atmospheric characteristics. Properties of airfoils and parasitic bodies studied in light of basic aerodynamic principles, then synthesized in discussions of performance, stability, and controllability of airplanes. Prerequisite: Engr. 21. (Enroll in A.E. 100.)

2 units, autumn, (Reid), TTh 9


3 units, spring, (Bulkeley), MWF 11


3 units, winter, (Connolly), MWF 9

175. Nuclear Measurements Laboratory—Principles and techniques of radiation detection and measurement; radiation characteristics and calibration methods; beta and gamma spectrum analysis; statistical analysis of counting; radiation safety. Prerequisites: Concurrent 171, Engr. 181, or consent of instructor. (Enroll in Engr. 175.)

3 units, autumn or winter, (Connolly, P. Kruger, Sher), T 1:15 and one lab. by arrangement

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 a thorough investigation of the techniques of analysis, synthesis and evaluation that he uses. Emphasis will be placed on understanding of the creative process and the factors that influence it. Limited registration. Prerequisite: permission of instructor.

3 units, winter, (——), M or T 2-5
214b. Human Factors in Design—A study of man's strength and weaknesses in opposition to and/or in cooperation with machines. The problems associated with the transfer of information, energy, and matter between man and machine will be investigated. Limited registration. Prerequisite: 214a.

3 units, spring, (——), M or T 2-5

216a. Kinematic Analysis—The relative motion between links in a mechanism is studied in terms of rolling centroids. 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, winter, (Roth), MWF 12

216b. 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, spring, (Roth), MWF 12

216c. 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, autumn, (Roth), MWF 12


3 units, autumn, (Bulkeley), MWF 10


3 units, spring, (Bulkeley), MWF 8, to be given in 1964-65

218a. Control System Components—Electronic components. The static and dynamic characteristics of the diode, triode, and transistor, including consideration of non-ideal qualities of importance in control system design. The behavior, technical specification, and general design considerations of amplifiers, oscillators, vibrators, regulators, modulators, and radio systems. Laboratory includes individual construction of each of the foregoing components on an analog computer; no reports required. Prerequisite: E.E. 128 or equivalent.

3 units, autumn, (Keller), TTh 8; one lab. by arrangement

218b. Control System Components—Hydraulic and pneumatic components and systems. Fluid properties which affect the static and dynamic performance of systems. Derivation of transfer functions for fluid pumps, motors, and valves. Engineering considerations in the design of hydraulic and pneumatic systems. Hydraulic realization of amplifiers, oscillators, etc. Comparison of lumped and distributed parameter models of fluid systems. Laboratory work with fluid system components.

3 units, winter, (Keller), 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 as in M.E. 218a, with emphasis on experimental techniques in control system design.

3 units, spring, (Keller), TTh 8; one lab. by arrangement, to be given in 1964-65
Thermosciences

211a. Physical Gasdynamics—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 steady-state kinetic theory, chemical thermodynamics, and statistical mechanics. (Enroll in A.E. 211a.) Prerequisite: 238a (or A.E. 210a or M.E. 136).

3 units, winter, (Vincenti), MWF 2

211b. Physical Gasdynamics—Continuation of 211a; flows of gas mixture in local thermodynamic and chemical equilibrium; physical and chemical basis of rate equations; flows with vibrational and chemical nonequilibrium. (Enroll in A.E. 211b.) Prerequisites: 238b (or A.E. 210b) and 211a (or M.E. 134).

3 units, spring, (Vincenti), MWF 2

211c. Physical Gasdynamics—Flows with translational and rotational nonequilibrium; kinetic theory of gases in nonuniform motion; application to continuum, slip, and free-molecule flows. (Enroll in A.E. 211c.) Prerequisites: 211a (or M.E. 134) and acquaintance with basic equations of viscous flow, or consent of instructor.

3 units, autumn, (Karamcheti), MWF 1

231a. Heat Transmission—Application of principles of heat transfer, thermodynamics to solution of transient, steady state heat transfer problems. Methods of dimensional analysis and model experimentation, as well as strictly analytical procedures, emphasized. Prerequisite: graduate standing and concurrent registration in differential equations.

3 units, autumn, (Leppert, London), MWF 9

231b. Heat Transmission—Continuation of 231a. Heat exchanger analysis and design. Thermal convection: laminar and turbulent flow in tubes and external boundary layers. Prerequisites: 231a, and concurrent 238a, or consent of instructor.

3 units, winter, (Kays), MWF 9

231c. Heat Transmission—Continuation of 231b. Turbulent boundary layers, high velocity flows, convective mass transfer and mass diffusion. Prerequisite: 231b.

3 units, spring, (Kays), 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.

2 units, spring, (London), 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, autumn, (London), TTh 10

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, winter, (Kline), TTh 11, alternate years, to be given in 1964-65

236. Combustion—Analysis of thermodynamics and kinetics of flow systems undergoing chemical change. Application of principles of mass and heat transfer to homogeneous and heterogeneous combustion phenomena, including flame propagation, liquid and solid propellant combustion, and ignition. Prerequisites: 211a or 134, 135 or equivalent

3 units, spring, (Wise), MWF 4

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 re-
action as applied to internal combustion engine systems. Prerequisites: 132 and graduate standing.

4 units, spring, (London), MWF 10 and one hour by arrangement

237b. Special Problems in Internal Combustion Engine Systems—A laboratory and directed study course concerned with the special problems associated with internal combustion engine components including cooling, carburetion, fuel injection, combustion, and control problems. Prerequisite: graduate standing.

2 units, spring, (Rosen), by arrangement

238a. Mechanics and Thermodynamics of Fluid Flow—Systematic development of laws of mechanics and thermodynamics as applied to problems of fluid flow. One-dimensional gasdynamics: area change, shock waves, heat transfer, friction in subsonic, supersonic flow. Applications to ducts, nozzles, diffusers, jets, wind tunnels, flow metering. Prerequisites: 132 and concurrent elementary differential equations. (Students with B grade in M.E. 136 should omit this course and take M.E. 238b.)

3 units, autumn, (———), MWF 8


3 units, winter, (Kline), MWF 11


3 units, spring, (Johnston), MWF 9, alternate years, to be given 1963–64

239. Fluid Dynamics of Turbomachinery—Application of the fundamentals of fluid mechanics and thermodynamics to analysis of problems of turbomachinery design. Emphasis will be placed on the development of methods of analysis and discussion of current research on flow in non-inertial coordinate systems, particularly steadily rotating systems. Prerequisites: 238a, b, or equivalent.

3 units, spring, (Johnston), MWF 9, alternate years, to be given in 1964–65

245. Thermoelectric Materials and Systems—Topics related to thermoelectric materials and effects of structure on thermoelectric properties. Use of thermoelectric materials in power conversion and refrigeration systems. (Same as Mat.Sci. 245.)

Prerequisites: Mat.Sci. 122 or M.E. 132 and preferably Engr. 50.

3 units, winter, (———), MWF 1:15

248. Thermionic Power Conversion—Principles of thermionic emission. Consideration to analysis and design of devices for direct conversion of heat to electricity employing the thermionic principle. Applications to space solar and nuclear power systems.

2 units, summer, (Olds), MWF 1:15

252. Magnetohydrodynamic Energy Conversion—Elements of electromagnetic theory, MHD one-dimensional channel flow, d.c. and a.c. power generation, MHD waves, transport processes in plasmas, propulsion concepts. Prerequisite: 238a or A.E. 210a, preferably E.E. 103.

3 units, spring, (———), MWF 1:15


2 units, winter, (Leppert), TTh 9

256. Advanced Convection Heat Transfer—Modification of conventional convective heat transfer techniques to account for effects of temperature-dependent fluid properties, dissociation, and chemical reaction; application to rocket nozzles and aerodynamic heating problems. Prerequisites: 231c, E.M. 244 or M.E. 238b.

2 units, summer, (McCuen), MWF 10

evidence of nucleate, transitional, and film boiling. Flow in boiling systems. Applications to nuclear reactor design. Prerequisite: 231b.

3 units, spring, (Leppert), MWF 11, alternate years, to be given in 1964–65


3 units, winter and spring, (Reynolds), MWF 8; 260b to be given in 1964–65

264. Advanced Boundary Layer Theory—Derivation and critical review of the governing equations. Asymptotic solutions; similarity methods; boundary layer transformations. Approximate integral methods: steepest descent, modification and generalization of the Pohlhausen method to include compressibility and heat transfer. Application to attached and separated flows: subsonic and supersonic base pressure problem, shock wave–boundary layer interaction. Prerequisite: 238b or E.M. 244.

2 units, summer, (Abbott), MWF 9

Nuclear Engineering

271a. Nuclear Reactor Theory—Neutron diffusion and slowing down theory. Homogeneous reactors. Two-group theory. Prerequisite: concurrent Physics 140 or consent of instructor.

3 units, autumn, (Sher), MWF 10


3 units, winter, (Sher), MWF 11


3 units, spring, (Sher), MWF 10


3 units, winter, (Staff), Th 1:15 and one lab. by arrangement


3 units, spring, (Staff), Th 1:15 and one lab. by arrangement


3 units, spring, (Fersiger), MWF 9, alternate years, to be given in 1963–64


3 units, spring, (Connolly), TTh 11:00–12:15

283. Nuclear Shielding—Interaction of gamma radiation, charged particles, and neutral particles with matter. Sources of radiation. Correlation of radiation type, intensity, and duration with damage to materials and organisms. Semi-empirical approaches to shielding design, e.g., removal cross sections, buildup factors. Stream-
MECHANICAL ENGINEERING

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Units</th>
<th>Time</th>
<th>Instructor</th>
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<tr>
<td>285</td>
<td>Nuclear Reactor Dynamics</td>
<td>Reactor kinetic analysis. Self-regulation, control and stability of reactors and reactor systems. Prerequisite: 271b concurrently.</td>
<td>2</td>
<td>winter</td>
<td>(Ferziger), TTh 10</td>
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<tr>
<td>215</td>
<td>Seminar in Design</td>
<td>Problems touching on all aspects of design. For all graduate students in both Product Design and Engineering Design. Speakers from industry and Stanford illustrating the cross-discipline responsibilities of the designer will be featured. Registration for one unit of credit with + or − grade, is optional; a letter grade is given for students presenting talks.</td>
<td>1</td>
<td>autumn, winter, and spring</td>
<td>(Staff), W 4</td>
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<tr>
<td>291</td>
<td>Engineering Problems</td>
<td>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.</td>
<td>1 to 5</td>
<td>any quarter</td>
<td>(Staff), by arrangement</td>
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<tr>
<td>292</td>
<td>Experimental Investigation of Engineering Problems</td>
<td>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.</td>
<td>1 to 5</td>
<td>any quarter</td>
<td>(Staff), by arrangement</td>
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<tr>
<td>296</td>
<td>Seminar in Fluid Mechanics</td>
<td>Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are expected to attend. One unit of credit with + grade is open to students having M.S. degree; a letter grade is given for those presenting talks. (Enroll in E.M. 296.)</td>
<td>1</td>
<td>autumn, winter, or spring</td>
<td>(Staff), T 4:15</td>
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<tr>
<td>299a</td>
<td>Design Project</td>
<td>Consists of a minor and a major project. Ten-week minor project emphasizes economic and marketing determinants. Three-quarter major project requires student to identify an unexplored problem area which will exercise all design determinants. In the first quarter, student submits statement of intent and performs research. In the second and third quarters he performs analysis, experimentation, and synthesis, culminating project with a working prototype of his design concept. For Product Design students only.</td>
<td>5</td>
<td>autumn</td>
<td>(McKim), by arrangement</td>
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<tr>
<td>299b</td>
<td>Design Project</td>
<td>Continuation of 299a.</td>
<td>5</td>
<td>winter</td>
<td>(McKim), by arrangement</td>
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<tr>
<td>299c</td>
<td>Design Project</td>
<td>Continuation of 299b.</td>
<td>5</td>
<td>spring</td>
<td>(McKim), by arrangement</td>
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<tr>
<td>300</td>
<td>Thesis</td>
<td>Investigation of some engineering problems. Required of candidates for degree of Engineer.</td>
<td>2 to 15</td>
<td>any quarter</td>
<td>(Staff), by arrangement</td>
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<tr>
<td>301</td>
<td>Thesis</td>
<td>Dissertation for degree of Doctor of Philosophy.</td>
<td>2 to 15</td>
<td>any quarter</td>
<td>(Staff), by arrangement</td>
</tr>
</tbody>
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SCHOOL of HUMANITIES and SCIENCES

Dean: Robert R. Sears
Associate Deans: Halsey L. Royden, Virgil K. Whitaker
Assistant Dean: Curtis W. Tarr

ORGANIZATION

The School of Humanities and Sciences includes all members with the rank of instructor or above of the Departments of Air Science, Anthropology, Art and Architecture, Asian Languages, Biological Sciences, Chemistry, Classics, Communication, 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 wishing to take a departmental major leading to the degree of Bachelor of Arts should consult appropriate sections of the announcements following. Further information concerning requirements may be obtained from the department concerned.

A student desiring to fulfill the requirements for the degree of Bachelor of Arts or Bachelor of Science in one of the special interdepartmental programs (see Humanities Special Programs, 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 Air, Military, 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 Air, Military, and Naval Sciences, 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.

Programs of study have also been established in the interdepartmental program in International Relations. Information regarding enrollment for the degree of Master of Arts in International Relations will be found in the section “International Relations Program” in this Bulletin.

AIR SCIENCE

Professor of Air Science: Joseph E. Terry (Lieutenant Colonel, USAF)
Assistant Professors: Charles E. Fulbeck (Lieutenant Colonel, USAF), Joseph W. Craver (Captain, USAF)

GENERAL

The Department of Air Science offers a course of instruction and pre-commission training which, in conjunction with a baccalaureate degree, qualifies a student for a commission in the United States Air Force.

CURRICULUM

The Air Science course of study is divided into a Basic Course, the freshman and sophomore years, and an Advanced Course during the junior and senior years. A four-week summer training period at an Air Force Base is required. This training is normally accomplished between the junior and senior years.

The two years' Basic Course is designed to provide a fundamental understanding of aerospace power and its implications in the conduct of world affairs. Basic Course students earn two hours' credit in the spring quarter of freshman year and in the autumn and winter quarters of the sophomore year. (See listing of yearly courses.) A one-hour drill period is scheduled weekly in each quarter.

The Advanced Course provides instruction designed to develop the leadership and professional potential of each cadet. Close attention is given to his ability to communicate, to think clearly, and to organize and lead the activities of others. The Advanced Course develops the cadet's knowledge and understanding of global and space concepts and Air Force operational principles. Stress is placed on that framework of knowledge of principles, attitudes, and operating procedures which will prepare the student for active service in the Air Force. Cadets earn four units of academic credit per quarter. Four hours of classroom instruction and a one-hour drill period are scheduled for each week. During the academic year 1963-64, all Advanced Course cadets will be enrolled in Air Science 3 courses.

Throughout the Air Force ROTC courses of study, cadets follow an educational program complementary to fields of study in the University. Air Science courses satisfy the Group Activity requirement of the General Studies Program and acceptably replace the University's physical education requirement. While the Air Science program is intended to prepare cadets as Air Force officers, the course of instruction will develop leadership abilities of value in professional or industrial careers.

The curriculum also includes many features to stimulate the cadet's interest in the Air Force and help him to develop the qualities of an Air Force officer. Tours of Air Force installations are offered to acquaint cadets with the facilities and operations required to accomplish Air Force missions. Orientation flights, often in jet aircraft,
are offered to selected students. The Peter Duncan McArthur Group and the Lanphier Squadron of the Arnold Air Society sponsor social activities and inter-ROTC competition. Through these activities students have many opportunities to apply principles of leadership, management, and staff work in actual working situations. A number of awards and their appropriate certificates for academic and leadership distinction are made each year to freshman, sophomore, junior, and senior cadets.

**DEFERMENT—DELAY**

Cadets enrolled in the AFROTC program are granted deferment from selective service induction. This deferment can insure completion of undergraduate and graduate courses of study. Upon commissioning and graduation, educational delay (postponement of active duty) may be granted to students pursuing graduate studies. This delay will be commensurate with the time required for completing graduate objectives.

**EMOLUMENTS**

All necessary military textbooks and uniforms are furnished without cost to the students. Advanced Course students receive subsistence at the rate of $27.00 per month. During the summer training period, cadets receive $78.00 plus a travel allowance of 5 cents per mile to and from the training unit.

**DISTINGUISHED GRADUATES**

Under provisions of federal law, advanced students who are outstanding, both academically and in leadership, in military courses and in campus activities are designated Distinguished AFROTC Graduates upon the concurrent recommendation of the Professor of Air Science and the President of the University. Such graduates are given special consideration and may apply for regular commissions in the Air Force prior to graduation. *Note:* Other graduates may apply for a regular commission after 18 months' service in a commissioned status.

**AIR FORCE INSTITUTE GRADUATE PROGRAM**

Distinguished graduates who accept regular Air Force commissions and exceptionally qualified cadets may apply for graduate education in fields of study which meet Air Force requirements. These courses lead to advanced degrees and are offered either at selected civilian colleges and universities or in residence at the Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio.

When selected for this program the officer is called to active duty at the educational institution. He receives full pay and allowances during his period of study, and the Institute pays his tuition, textbooks, and other school expenses.

**COURSE SUBSTITUTION**

A continuous effort is made to determine the courses offered by the University which cover the same material as those courses required by the AFROTC program. Whenever possible, the University course is substituted for the AFROTC course. An explanation of the substitution is included, when appropriate, in the course descriptions. Attendance in Overseas Campus will be credited toward AFROTC requirement.

**FIRST-YEAR COURSES**

10. University General Studies requirements or options will be substituted for and will satisfy the Air Science academic requirement during this quarter. One hour of drill or leadership training per week is required.

   *Activity credit, autumn*

11. University General Studies requirements or options will be substituted for and will satisfy the Air Science academic requirement during this quarter. One hour of drill or leadership training per week is required.

   *Activity credit, winter*
12. **Foundations of Aerospace Power**—A detailed study of the AFROTC program followed by a study of concepts and fundamentals of aerospace power; air research, development, and procurement; and the aircraft industry.

   2 units, spring, (Craver), TTh 10 or 1:15

**SECOND-YEAR COURSES**

34. **Fundamentals of Aerospace Weapons Systems**—A survey of development of aerial warfare with emphasis on principles of war, concepts of employment of forces, and changing weapon systems.

   2 units, autumn, (Staff), TTh 10 or 1:15

35. **Fundamentals of Aerospace Weapons Systems**—A study of aerial warfare is undertaken to include targets, weapons, aircraft, and missiles.

   2 units, winter, (Staff), TTh 10 or 1:15

36. University General Studies requirements or options will be substituted for and will satisfy the Air Science academic requirement during this quarter. One hour of drill or leadership training per week is required.

   Activity credit, spring

**THIRD-YEAR COURSES**

122. **Air Force Officer Development**—Knowledge and skills required of a junior staff officer in the Air Force. This includes staff organization and functions, communicating, and instructing.

   4 units, autumn, (Staff), MTWTh 9 or 11

123. **Air Force Officer Development**—Problem solving techniques are taught as applied to Air Force Staff and command problems. In addition the military justice system is taught.

   4 units, winter, (Staff), MTWTh 9 or 11

124. **Leadership**—The principles and theories of problem solving and leadership as related to Air Force situations are covered. Practice is offered in solving problems in leadership and management.

   4 units, spring, (Staff), MTWTh 9 or 11

**FOURTH-YEAR COURSES**

Regular Stanford courses will be substituted for Air Science academic requirements during the fourth year as shown below:

142. **International Relations**—Enroll in Political Science 20.

   Autumn

143. **Military Aspects of World Political Geography**—Enroll in Geography 191.

   Winter

144. **International Relations**—Enroll in Political Science 145.

   Spring

199. **Leadership Laboratory**—Open only to Advanced Course cadets on the Staff, and Squadron Commanders with the concurrence of the Professor of Air Science; directed by the Commandant of Cadets.

   1 unit, autumn, winter or spring
ANTHROPOLOGY

Executive Head: Bernard Joseph Siegel
Associate Professors: Alan Robin Beals, Bert Alfred Gerow, Antone Kimball Romney
Assistant Professors: Roy Goodwin D’Andrade, Charles Oliver Frake, Duane Gerald Metzger
Research Associates: Louise Spindler, Gene McNaughton Stirling

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. Graduate students should apply formally through the Admissions Office, which will submit their names to the Department for approval when application requirements are completed. In addition to the general requirements for admission to graduate standing, all applicants are required to take the Aptitude Test and the appropriate Advanced Test of the Graduate Record Examination. Candidates expecting to take this examination at scheduled centers in Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming, Alaska, Australia, Canada (Alberta and British Columbia), Hawaii, Mexico, and all Pacific Islands should write to the Educational Testing Service, P.O. Box 27896, Los Angeles 27, California.

Candidates who plan to take the Graduate Record Examination at a center in any state or place not listed above should write to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey.

Every candidate is required to file with the Educational Testing Service a formal application for examination and to pay an examination fee. Initial inquiries may also be addressed directly to the Department.

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 scholas-
tic 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 over-all 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 co-ordinated program in anthropology, may wish to consider a choice from the following courses as being particularly relevant: 1 (General Anthropology); 120 (The Growth of Cultures); 130 (Social Anthropology); 140 (Comparative Social Systems); 148 (Cultural Ecology); 163 (Cultural Dynamics); 164 (Culture and Personality).

For majors in humanities fields the following anthropology courses are correspondingly brought to special attention: 1 (General Anthropology); 5 (Development of Man); 120 (The Growth of Cultures); 141 (Anthropological Approaches to Religion and Philosophy); 144 (Mythology and Folklore); 170 (Prehistoric Archaeology); 176 (Language and Culture); 177 (Anthropological Linguistics).

For students in the biological sciences the most relevant courses are: 5 (Development of Man); 148 (Cultural Ecology); 175 (Physical Anthropology).

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 field work 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, 182.

**Master of Arts**

To undertake a program of study for the degree of Master of Arts in anthropology a student is required to have a Bachelor's degree, or evidence of equivalent training, in anthropology. In addition he must complete an introductory course in statistics.

To be recommended for the Master's degree a candidate must complete an approved course of graduate study at this University amounting to not less than 45 units of credit, normally the equivalent of three quarters of work. It must include one of the following plans: (a) With the approval of the Department and the acceptance of a member of the staff as director, a candidate may complete a thesis which may be submitted for a maximum of 12 units of the 45 units required; or (b) the candidate may obtain his training in research by participating in one of the formal research programs within the Department for a maximum of 12 units. In the approved course
of graduate study no units will count which do not have a grade of C or higher, and
the candidate must receive an average grade of B or higher. Candidates must have
completed the following courses or equivalent work: Anthropology 120, 130, 170,
175, 177. They will also take approved graduate seminar work. Within the program
of approved seminars, all incoming graduate students will be required to take a one-
year sequence consisting of the Pro-Seminars, Anthropology 200, 201, and 202.

Doctor of Philosophy

To be recommended by the Executive Head of the Department to the University
Committee on the Graduate Division for admission to candidacy for the degree of
Doctor of Philosophy in anthropology, the student must satisfy the following re-
quirements:

(1) He must have demonstrated in his initial graduate work an ability and pre-
paredness to pursue advanced studies to the professional level; (2) he must present,
ordinarily by the beginning of his second quarter of doctoral work, a comprehensive
plan of study, including an area of interest for his dissertation; and (3) he must meet
the foreign language requirements of the University and of the Department. These
consist of either demonstrating competence in two foreign languages approved as
contributing to his professional training and advancement, or demonstrating compe-
tence in one foreign language, and completing not less than 15 units of work in ap-
proved courses which give greater control of symbolic operations (e.g., statistics,
symbolic logic) beyond the regular requirements of the Department program. The
sequence of work would be established in consultation between the student and staff.
Competence in one foreign language has to be certified by the Department to the Uni-
versity Committee on the Graduate Division with the formal application for doctoral
 candidacy; the second language or the alternative 15 units will ordinarily be com-
pleted prior to taking the written and oral examinations.

The major emphasis in the doctoral program is on cultural anthropology, includ-
ing training in linguistics for research and field work use. General competence
is also required in physical anthropology, archaeology, and museum work. To be
recommended for this degree the candidate must (a) demonstrate in Departmental
written examinations and in the University oral examination his scholarly proficiency
in cultural anthropology, and (b) complete an acceptable doctoral dissertation, which
will include evidence of adequate field-work training and experience. The Depart-
mental written examinations and the University oral examination will cover the fol-
lowing fields: (1) History and Modern Viewpoints (Ethnology and Ethnography,
Social Anthropology); (2) a regional field (e.g., North America, Middle America,
Oceania, East Asia); (3) at least two other fields of specialization approved by the
staff from among such topics as Social Organization, Culture and Personality, Cul-
tural Dynamics, Cultural Ecology, Archaeology, Linguistics, Folklore, Applied An-
thropology, Educational Anthropology, Medical Anthropology. For each field a fac-
ulty member will be appointed as adviser. The approved program will ordinarily
consist of:

A. History and Modern Viewpoints, a regional field, three areas of specialization,
   and a course of study of at least 15 units of graduate work in some other de-
   partment, the work to be related directly to the elected fields of specializa-
   tion, or

B. History and Modern Viewpoints, a regional field, two areas of specialization,
   and a minor in some other department.

Comprehensive written examinations in the candidate's selected fields will be
arranged by the Executive Head of the Department. They must be passed satisfac-
torily by the candidate before he may be certified for the University oral examination
for the degree. Ordinarily the written and oral examinations will be taken several
weeks apart and in the same quarter.
Candidates for the degree of Doctor of Philosophy who wish to offer anthropology for their minor must have completed at Stanford or elsewhere courses in anthropology amounting to not less than 35 units of credit as a general background before working in their special minor fields. In order to satisfy the Department that they are properly qualified to undertake this work, candidates may be required to submit to brief qualifying oral examinations by designated staff members.

To be recommended for the degree of Doctor of Philosophy with anthropology as the minor subject, a candidate must acquire scholarly proficiency in two of the recognized fields of the minor. The selection of these fields is subject to the approval of the Department. When the candidate has passed a written examination in each of the two fields chosen, the Department will recommend to the University Committee on the Graduate Division that he be permitted to take the University oral examination. Ordinarily the written and oral examinations will be taken within the same quarter.

A special minor is offered in social anthropology, with a study program concentrated in those anthropological fields of greatest relevance to the behavioral sciences. Choice of fields, to be worked out in consultation with the Departmental adviser, might cover such areas of specialization as Culture and Personality Studies, Social Organization, Cultural Dynamics, Educational Anthropology. For the graduate student electing to take a co-ordinated program in social anthropology as alternative to a minor such courses as 120, 130, 140, 163, 164, and 176 are suggested; at least one approved graduate seminar should also be taken.

**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 $444 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 February 8 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, autumn**: (——)—, MTWThF 1
- **or spring**: (Spindler), MTWThF 1
- **or summer**: (——)—, MTWThF S 9

5. **The Development of Man**—Human evolution; early man; racial and other differences in modern man; early development and differentiation of culture. Introduction to physical anthropology and prehistory.

- **5 units, spring**: (——)—, 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.)

120. The Growth of Cultures—Varieties, historical development, and distribution of world cultures and civilizations. Emphasis is placed upon theories and methods of investigating long-term cultural change.
   4 units, winter, (Beals), MTWTh 9

130. Social Anthropology—Theories and schools in social anthropology, including contemporary functional, psychological, interactional studies. Prerequisite: 1, or Sociology 1, or Psychology 1, or permission of instructor.
   4 units, spring, (———), MTWTh 10

140. 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 permission of instructor.
   4 units, winter, (D'Andrade), MTWTh 10

141. Anthropological Approaches to Religion and Philosophy—Examination of anthropological theories relating to the origin and nature of religion; these fields of creativity and experience looked at cross-culturally, and in relation to the total social and cultural life.
   4 units, spring, (Beals), MTWTh 11

144. Mythology and Folklore—Anthropological contributions to understanding of these fields of human creativity; comparisons with Western literature.
   4 units, autumn, (———), MTWTh 9

147. Anthropological Approaches to Law—Examination of anthropological field studies and theory relating to law; opportunities for special work on chosen problems.
   4 units, autumn, (Metzger), to be given in 1964-65

148. Cultural Ecology—The relations between cultural systems and habitat conditions; exploration of recent creative work in this field.
   4 units, spring, (Frake), to be given in 1964-65

149. Peoples of Europe—Anthropological contributions to understanding the peoples and cultural traditions in the various European regions; opportunities to read on special areas, including those in which Stanford campuses are located.
   4 units, autumn, (———), MTWTh 11

150. Peoples of the Pacific—Racial, linguistic, cultural backgrounds and characteristics of the Oceanic islanders; opportunities to read on special areas.
   4 units, autumn, (Frake), to be given in 1964-65

152. Peoples of East Asia—Racial, linguistic, cultural backgrounds and characteristics; opportunities to read on special areas.
   4 units, autumn, (———), to be given in 1964-65

153. Peoples of India—Anthropological contributions to understanding of peoples, community development, and cultural traditions of India. Special attention to recent “village” studies.
   4 units, spring, (Beals), MTWT 9

154. Peoples of Africa—Racial, linguistic, cultural backgrounds and characteristics; opportunities for special work on chosen areas.
   4 units, spring, (Greenberg), MTWT 10

155. Indians of North America—Racial, linguistic, cultural backgrounds and characteristics; cultural relationships with “nuclear” America.
   4 units, winter, (Beals), MTWTh 11

158. Peoples of South America—Anthropological contributions to understanding the peoples and cultural traditions of the various South American regions; opportunities to read on special areas.
   4 units, autumn, (———), to be given in 1964-65
161. 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.
   4 units, spring, (———), MTWT 1

163. Cultural Dynamics—Interrelations between cultural, social, psychological processes in dynamics of cultural growth and change, including acculturation. Prerequisite: 1, or Sociology 1, or Psychology 1, or permission of instructor.
   4 units, winter, (———), MTWTh 11

164. Culture and Personality—Anthropological contributions to understanding the role of culture in personality development; comparative studies; present status of problem. Prerequisite: 1, or Sociology 1, or Psychology 1, or permission of instructor.
   4 units, autumn, (D'Andrade), MTWTh 10

170. Prehistoric Archaeology—Methods, findings in this field; correlations of prehistory of Europe and Near East with that of other zones over the world. Prerequisite: 5, or permission of instructor.
   4 units, autumn, (———), MTWTh 11

175. Physical Anthropology—Methods, findings relating to human evolution, fossil man, racial differences, bodily growth; includes laboratory exercises. Prerequisite: 5, or Biology 1, 2, 3, or permission of instructor.
   4 units, spring, (———), MTWTh 9

176. 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.
   4 units, winter, (Greenberg), MTWTh 9

177. Anthropological Linguistics—Descriptive linguistics, including phonemic and morphological analysis and comparative techniques.
   4 units, autumn, (Greenberg), MTWTh 1

180. Archaeological Field Methods—Studies, excavations of local archaeological sites, and related work in the Department archaeological laboratory. Prerequisite: consent of instructor.
   4 units, spring, (———), by arrangement

182. Museum Methods—Directed work on anthropological collections in Stanford Museum. Prerequisite: consent of instructor.
   4 units, winter, (———), by arrangement

190. Directed Individual Study—For undergraduate students with special needs, and showing capacity to do independent work. Prerequisite: 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.
   2 units, spring, (D'Andrade), M 2–4

195. Honors Program—Directed independent study and honors thesis work for students admitted to this program.
   Any quarter, (Staff), by arrangement

COURSES PRIMARILY FOR GRADUATES

200. Proseminar—Replication of major research strategies in ethnology and social anthropology. To include problems in such areas as, e.g., culture history, life history, controlled comparison, cross-cultural method, genealogical method, etc. Use of HRAF materials, myth and folklore compendia, culture element lists, and other data compilations, including field notes.
   4 units, autumn, (D'Andrade, ————), T 2–5
201. **Proseminar**—Continuation of Anthropology 200.
   4 units, winter, (D'Andrade, Romney), T 2-5

202. **Proseminar**—Quantitative analysis of anthropological materials. Recent applications of various forms of symbolic analysis to anthropological materials: statistics, mathematical models, set theory, etc. Prerequisites: elementary statistics, graduate standing, or seniors by permission.
   4 units, spring, (Romney, D'Andrade), T 2-5

204. **Phonetics and Phonemics**—Field-oriented training in linguistic analysis as applied to the sound systems of languages. Lecture-discussion and laboratory.
   4 units, winter, (Greenberg), MWF 12-2

205. **Morphology and Syntax**—Field-oriented training in linguistic analysis as applied to grammatical systems. Lecture-discussion and laboratory. Prerequisite: 204, or permission of the instructor.
   4 units, spring, (Greenberg), MWF 12-2

220. **Advanced Ethnology**—Seminar or directed individual work, oriented topically or toward intensive study of chosen areas, e.g., North America, Latin America, India, Southeast Asia, Africa, Soviet Union. Prerequisite: graduate standing or permission of instructor.
   Any quarter, (Staff), by arrangement

225. **Regional Study**—Directed group or individual study in the region chosen as a field for specialization in the doctoral program.
   Any quarter, (Staff), by arrangement

233. **Advanced Social Organization**—Seminar or directed individual work, following up that given in Anthropology 140. Prerequisite: graduate standing or permission of instructor.
   4 units, spring, (Romney), W 2-5

236. **Advanced Cultural Dynamics**—Seminar covering selected problems, especially at the community level. Prerequisite: graduate standing or permission of instructor.
   4 units, autumn, (Siegel), M 2-5

237. **Advanced Culture and Personality**—Seminar following up Anthropology 164. Prerequisite: graduate standing or permission of instructor.
   4 units, winter, (Spindler), M 2-5

247. **Seminar**—Problems in the anthropology of Law.
   4 units, winter, (-----), Th 2-5

253. **Linguistic Field Methods**—Seminar or directed individual work, following up Anthropology 177. Use of one or more informants and selected linguistic materials to demonstrate field methods and procedures for analysis of a language. Prerequisite: graduate standing or permission of instructor.
   4 units, spring, (-----), to be given in 1964-65

257. **Communication Theory and Culture**—Seminar, analyzing selected case materials, testing significant hypotheses. Prerequisite: graduate standing or permission of instructor.
   3 units, winter, (Bateson), W 8 p.m.

259. **Problems of Medical Anthropology**—Seminar, analyzing theories of disease and therapy in selected societies, the relation of medical beliefs to other areas of culture, and similar problems of medical-anthropological interest. Prerequisite: graduate standing, or permission of instructor.
   4 units, winter, (-----), to be given in 1964-65

265. **Cultural Transmission**—The transmission of values, implicit cultural assumptions, and the patterning of education in cross-cultural perspective, with special attention to American culture. (Same as Education 315.)
   3 units, autumn, (Spindler), M 7-10 p.m.

266. **Seminar**—Special topics in cultural transmission. (Same as Education 416.)
   3 units, winter, (Spindler), F 3-6
300. Directed Project Work—Special research projects undertaken for course credit.

Any quarter, (Staff), by arrangement


Any quarter, (Staff), by arrangement


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.

ART and ARCHITECTURE

Emeritus: Victor M. Arnautoff (Assistant Professor)

Acting Executive Head: Daniel Marcus Mendelowitz

Professors: Edward McNeil Farmer, Ray Nelson Faulkner, Daniel Marcus Mendelowitz, Victor King Thompson

Associate Professor: Matthew Seymour Kahn

Assistant Professors: Thomas Thole Williamson. Acting: Keith Boyle, Robert James Mullen, John-David Paul La Plante

Lecturers: Warren Callister, Birge M. Clark, Hervey P. Clark, Aaron Green, Henry Hill, Francis J. McCarthy, Robert C. Peterson, George Rockrise, Eldridge T. Spencer, Walter Stromquist, John C. Worsley (Architecture); Kathryn Imlay Stedman (Landscape Architecture); Myron D. Alexander (Law); Dwight A. Coddington (Mechanical Engineering); Harry L. Sanders (Planning); Isadore Thompson (Structural Engineering)

PROGRAMS OF STUDY

THE ART PROGRAM

The art program is presented in three areas: the courses of instruction, the Art Gallery exhibits, and the Museum with its collections.

The lecture and laboratory courses are open to the general student and afford a means of increasing his appreciation of art and an opportunity to explore his individual art potential.

Bachelor of Arts

A freshman or sophomore student intending to major in art will confer with the art adviser to plan his course of study. A prospective art major should plan to complete about 20 units of art work during his freshman and sophomore years.

Completion of this curriculum with an average grade of not less than B minus is prerequisite to recommendation for graduate or professional work:
1. The Art Curriculum, a four-year program leading to the Bachelor of Arts degree in art, is made up of courses in drawing and painting, design, and history and theory which are basic to any further specialization.

Required courses:

- **Painting:** Art 3, 4, 101, 105, 203, 206 ........................................ 17 units
- **Design:** Art 24, 26, 32, 124, and 3 units of advanced design .............. 16 units
- **History and Theory:** Art 60, 61, 62, 166 ........................................ 17 units
- **Art Electives** (including one History of Art and Architecture Seminar) 20 units

*Special Major Program for Honors Candidates in Humanities*—Students who are planning to take the special Honors Program in Humanities may fulfill the requirements for their major in art by satisfactorily completing the following courses: Art 3, 4, 24, 26, 61, 62, 101, 105, 124, 166, 203, and 206.

**Master of Arts**

Graduate work leading to the Master’s degree may be undertaken by students who wish to engage in advanced 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 70 units of undergraduate work in art.
3. Formal admission to candidacy granted by the University Committee on Graduate Study.

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) 8 units of drawing and painting
   b) 8 units of design
   c) 8 units of history and theory
   d) 6 units of thesis or individual creative project accompanied by written report.

**The Art Education Program**

**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 for the course 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 Degrees, The School of Education in this Bulletin. Complete information concerning these degrees may be secured from the Office of the Dean of the School of Education or the Department of Art and Architecture.
Stanford General Secondary School Credential

Campus Program—Requirements for the Campus Program are: one graduate year at this University of not less than 39 units of graduate courses in education, and 9 units of work in the candidate’s teaching fields; completion of the teaching major in art and of a teaching major or minor in at least one other subject.

Intern Program—Students with high art potential and interest in teaching who hold a bachelor’s degree in art may apply for admission to the Intern Program (15 months of academic work and intern teaching).

(For further information consult the section of this Bulletin on Credentials, listed under the School of Education, and the Credential Secretary of the School of Education.)

THE ARCHITECTURE PROGRAM

The architecture education program is divided into two curricula: the pre-architecture undergraduate curriculum and the professional graduate curriculum.

Bachelor of Arts

A four-year program of study providing the opportunity for a liberal education with pre-professional training in architecture. The program emphasizes understanding architecture, basic design factors, history and theory. At the end of the third year of this program students may enter the professional program if the following requirements are completed:

- Architecture 1, 13, 14, 21, 22, 31, 41, 42, 51 30 units
- Art 3, 24, 26, 101, 124 15 units
- Mathematics 10, 11, 21, 22, 23 15 units
- Physics 21 4 units

Bachelor of Architecture

A three-year graduate program planned for the student who intends to become a practicing architect. Applicants may enter program at end of junior year after completing 135 units of credit including all requirements listed above for the Bachelor of Arts degree. A grade point average of 2.5 must be attained in at least 45 units of these required units.

Requirements for the degree:

- Architecture 101, 121, 141, 151, 201, 211, 213, 221, 242, 251, 252, 253, 262, 264 87 units
- Art 208, 237, 261 10 units
- Civil Engineering 144, 180, 181, 182, 183 16 units
- Electrical Engineering 108a 3 units
- Engineering 11, 15, 161 8 units

Apprentice Training.—In addition to the academic training, the student is required to complete ten weeks of apprentice training. Five weeks of practical experience in actual construction work and five weeks of training in the office of an architect. Letters from employers evidencing this apprentice training must be filed with the Department.

COURSES

Elementary courses of both lecture and laboratory type are numbered below 100. No elementary course may be repeated for credit. Advanced laboratory courses, numbered 100 or above, may be repeated for credit with the permission of the instructor.
#3. Basic Drawing—Drawing with various media to gain facility in objective representation:
2 units, autumn, (Staff), (I) MWF 8-10, (II) MWF 10-12, (III) MWF 1-3, (IV) TThS 10-12
or winter, (I) MWF 8-10, (II) MWF 10-12, (III) MWF 1-3
or spring, (I) MWF 10-12, (II) MWF 1-3

#4. Intermediate Drawing—Problems in the organization of the elements of pictorial expression. Prerequisite: Art 3.
2 units, autumn, (Staff), (I) TTh 1-3, (II), TTh 3-5
or winter, (I) TTh 8-10, (II) TTh 1-3, (III) TTh 3-5
or spring, (I) TTh 8-10, (II) TTh 1-3, (III) TTh 3-5

101. Introduction to Painting—Basic practice in oil and watercolor. Prerequisites: 3 and 26.
3 units, autumn, winter, or spring, (Staff), MWF 10—12

104. Advanced Drawing—Emphasis on individual expression with various drawing media. Prerequisites: 4 and 105.
4 units, winter, (Staff), TTh 8-10

105. Life Drawing—Stressing form, structure, action of human figure. Prerequisite: 3.
2 units, autumn, winter, or spring, (Boyle), MWF 3-5

110. Printmaking—Basic print processes, emphasis upon relief printing. Prerequisite: 24 and 105.
3 or more units, winter, (Staff), MWF 10—12

200. Individual Work: Drawing and Painting—Independent study, weekly criticisms. Prerequisites: Previous related course work with instructor and his permission.
Any quarter, (Staff), by arrangement

4 units, autumn, (Mendelowitz), TTh 2-5
or spring, (Mendelowitz), TTh 2-5

4 units, autumn or spring, (Boyle), MWF 1-3

208. sculpture—Carving, construction in various materials. Prerequisite: 124.
4 units, spring, (Mullen), TTh 1-3

209. Advanced Painting—Study with various media to broaden technical ability and painting vocabulary. Prerequisites: 203 and 206.
4 units, winter, (Boyle), MWF 1-3

212. Creative Research in Painting—Individual problems in painting with emphasis on personal directions. Prerequisites: Advanced work in oil or watercolor painting.
3 or more units, spring, (Staff), M 8-10 p.m. and additional hours by arrangement

DESIGN

#24. Design Fundamentals — Laboratory problems emphasizing basic analysis and creative approach.
3 units, autumn, winter, or spring, (Kahn, Staff), (I) TTh 10-12, (II) TTh 1-3

3 units, autumn, winter, (Faulkner), MW 3
and spring, (Faulkner), TTh 2

32. Graphic Design—Design problems in lettering and layout. Prerequisites: 3 and 24.
3 units, autumn, (Staff), MWF 1-3

4 units, autumn or winter, (Kahn), TTh 3-5
220. Individual Work: Design—Independent study, weekly criticisms. Prerequisites: Previous related course work with instructor and his permission. Any quarter, (Staff), by arrangement

224. Design Projects—Varied comprehensive problems. Prerequisite: 124.
3 or more units, spring, (Kahn), TTh 8-10

4 units, spring, (Faulkner), Th 3-5

230. Advanced Creative Studies—Specialized creative work in various fields.
3 or more units, any quarter, (Kahn), W 8-11 p.m. and additional hours by arrangement

4 units, autumn, (Staff), MW 3-5 and 9 hours by arrangement, to be given in 1964-65

233. Textile Design—Problems in textile design, emphasis on printed cloth. Prerequisite: 125.
5 units, autumn, (Kahn), TTh 8-10

234. Seminar: Design Theory—Prerequisites: senior or graduate standing, experience in design.
3 or more units, spring, (Faulkner), M 3-5

237. Product Design—Designing furniture, other articles for craft and industrial production. Prerequisite: 124.
4 units, spring, (Staff), TTh 1-3, alternate years, to be given in 1964-65

Rapid Visualization—See Mechanical Engineering 112a.
Introduction to Product Design—See Mechanical Engineering 112b.
Philosophy of Design—See Mechanical Engineering 214a.
Human Factors in Design—See Mechanical Engineering 214b.
History of Costume—See Speech and Drama 170.
Costume Design—See Speech and Drama 172.
Costume Construction and Makeup—See Speech and Drama 174b.
Stage Design I—See Speech and Drama 175a.
Stage Design II—See Speech and Drama 175b.
Projects in Stage Costume—See Speech and Drama 260b.

HISTORY OF ART AND ARCHITECTURE

#60. Introduction to Art—Orientation to contemporary and historic art forms and principles. Illustrated lectures.
2 units, winter, (Faulkner), TTh 10

5 units, autumn, (Farmer), MTWThF 9

#62. History of Painting—Painting in the Western world with emphasis on the Renaissance to the end of the nineteenth century. Illustrated lectures.
5 units, winter, (Mendelowitz), MTWThF 9

63. The Modern House—Functional, social, aesthetic problems in house design. Illustrated lectures.
2 units, autumn, (Faulkner), TTh 10

163. Romanesque and Gothic—Architecture, painting, sculpture, and ornament from 1200 through 1500. Illustrated lectures.
3 units, autumn, (Russell), MWF 11

164. Renaissance and Mannerism—Architecture, painting, sculpture, and ornament from 1400 through 1700. Illustrated lectures.
3 units, winter, (Russell), MWF 11
165. Baroque and Neoclassic—Architecture, painting, sculpture, and ornament from 1600 through 1850. Illustrated lectures.
   3 units, spring, (Russell), MWF 11

166. Modern Arts—Architecture, painting, allied arts 1850 to present time. Illustrated lectures.
   5 units, spring, (Farmer), MTWThF 9, to be given in 1964–65

168. History of American Art—American architecture, painting, sculpture, and household arts from pre-Columbian to contemporary times. Illustrated lectures.
   5 units, spring, (Mendelowitz), MTWThF 10

175a. Introduction to the Art of Asia—Major formative periods of art in India, China, and Japan from the Neolithic period through the 6th century A.D. Illustrated lectures.
   3 units, autumn, (La Plante), MWF 1

175b. Introduction to the Art of Asia—Major art developments in India, S.E. Asia, China, and Japan after the 7th century. Illustrated lectures.
   3 units, winter, (La Plante), MWF 1

178. Museum Practice—Practical work in registration and cataloguing procedures; methods of handling art objects; conservation techniques; organization and installation of exhibitions. Opportunity for research in special fields of interest relating to Stanford Museum Collections. Prerequisite: consent of instructor.
   3 units, any quarter, (La Plante), by arrangement

   3 or more units, autumn, (Farmer), by arrangement

262. Seminar: History of Painting—Prerequisite: 62.
   3 or more units, autumn, (Staff), by arrangement, to be given in 1964–65

266. Seminar: Modern Arts—Prerequisite: 166.
   3 or more units, winter, (Faulkner), T 1–3

269. Seminar: Art and Society—Prerequisite: senior or graduate standing.
   3 or more units, spring, (Staff), by arrangement

270. Individual Work: Art History—Independent study, weekly conferences. Prerequisites: Previous related course work with instructor and his permission.
   Any quarter, (Staff), by arrangement

275. Seminar: Art of Asia—Prerequisites: 175a and 175b or permission of instructor.
   2 to 4 units, spring, (La Plante), F 3–5 and additional hours by arrangement

300. Master’s Thesis.
   Any quarter, (Staff), by arrangement

301. Master’s Project.
   Any quarter, (Staff), by arrangement

Prehistoric Archaeology—See Anthropology 170.
Museum Methods—See Anthropology 182.
From Cubism to Surrealism—See French AF175.
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.

ART EDUCATION

180. Art in the Elementary School—(Enroll in Education 180.)
280a. Curriculum and Instruction in Secondary School Art I—(Enroll in Education 280a.)
280b. Curriculum and Instruction in Secondary School Art II—(Enroll in Education 280b.)
ART AND ARCHITECTURE

380. Recent Development in Art Education—(Enroll in Education 380.)
480. Seminar in Art Education—For advanced graduate students or experienced teachers. Exploration of problem areas in art education; application of foundations to art education. Prerequisite: 280a or 380.
   2 to 5 units, (Staff), by arrangement
480i. Individual Study in Curriculum and Instruction in Art—(Enroll in Education 480i.)

ARCHITECTURE

Courses Open to All Students

1. Introduction to Architecture—Illustrated lectures and laboratory work. Investigation of the basic design factors, the architect's role in society and a critical evaluation of contemporary architecture.
   3 units, autumn, (Williamson), MW 10
   or winter, (V. Thompson), WF 3

13. House Design—Laboratory work in design of the house. May be taken concurrently with Art 63.
   2 units, autumn, (Peterson), TTh 2-4

14. Landscape Design—Lectures and laboratory work in design of outdoor spaces and familiarization with plant materials.
   3 units, spring, (Stedman), TTh 2-4

21. Drafting—Laboratory problems in lettering, geometrical solutions, orthographic projection, architectural plans, elevations and sections, conventions and symbols.
   3 units, winter, (V. Thompson), WF 10-12

22. Pictorial Drawing—Laboratory problems in shades and shadows, perspective drawing and axonometric projection.
   3 units, spring, (Williamson), MW 10-12

31. Basic Structures—Lectures and laboratory work, drawings and models introducing student to structural systems.
   4 units, autumn, (V. Thompson), WF 10-12

41. Architecture before 1500—Illustrated lectures and freehand sketching of the architecture from building cultures of the world before the Renaissance Period.
   4 units, winter, (Williamson), MW 9

42. Architecture since 1500—Illustrated lectures and freehand sketching of the architecture of building cultures of the world from the beginning of the Renaissance Period.
   4 units, spring, (V. Thompson), WF 9

51. Basic Materials—Lectures and laboratory problems to familiarize the student with the aesthetic qualities of building materials.
   4 units, winter, (Williamson), MW 1-3

Professional Courses

101. Elementary Design—Laboratory work, lectures, readings and field trips on simple case study problems in architectural design. The student must complete 15 units of Elementary Design prior to beginning Intermediate Design.
   5 units, autumn, (V. Thompson), WF 1-4
   or winter, (Staff), WF 1-4
   or spring, (Williamson), MW 1-4

121. Presentation Techniques—Laboratory work in preparing architectural presentation drawings in opaque and transparent water color, pen and ink and other media.
   3 units, spring, (Staff), F 1-3

141. Significant Buildings—Lectures, readings, critical writing and sketching in detailed study of selected buildings.
   3 units, autumn, (Williamson), M 1-3
151. Construction Methods—Lectures, problems and field trips on the study of the building processes, familiarization with various building trades and their work standards.

4 units, winter, (Worsley), M 1-3

200. Individual Work: Architecture—By permission of the instructor.

Any quarter by arrangement

201. Intermediate Design—Laboratory work, lectures, readings and field trips on case study problems in architectural design. The student must complete 15 units of Intermediate Design prior to beginning Advanced Design.

5 units, autumn, (McCarthy), WF 1-4
or winter, (Callister), WF 1-4
or spring, (H. Clark), WF 1-4

211. Advanced Design—Laboratory work, lectures, readings and field trips on complex case study problems in architectural design. The student must complete 10 units of Advanced Design prior to beginning the terminal project.

5 units, autumn, (Hill), MW 1-4
or winter, (Green), MW 1-4

213. Terminal Project—Individual work in selecting an architectural problem, program preparation and solution in form in report drawings and models in which student evidences his ability to work independently. Work is submitted to a mentor chosen by the student. Readings and seminars on the architect's role in society. Student intending to take terminal project must enroll in 213 autumn quarter for 1 unit credit.

1 unit, autumn, (Williamson), M 11
15 units, spring, (V. Thompson, Staff), F 1-4 and by arrangement

221. Working Drawings and Specifications—Laboratory work in the preparation of contract documents

5 units, spring, (Peterson), TTh 8-10

242. Seminar: City Planning

2 units, autumn, (Sanders), M 7-9 p.m.

251. Seminar: Materials and Their Specification—Lectures, readings and field trips on materials and methods of installation.

2 units, autumn, (B. Clark), M 11, W 10-12

252. Mechanical Equipment I—Plumbing, heating, and air conditioning.

3 units, winter, (Coddington), TTh 4

253. Mechanical Equipment II—Electric wiring, refrigeration, elevators and acoustics.

3 units, spring, (Coddington), TTh 4


2 units, winter, (Alexander), W 7-9 p.m.

264. Practice—Lectures and field trips in supervision, administration and ethics of practice.

3 units, winter, (Peterson), T 1-3

ASIAN LANGUAGES

Emeritus: Frederic Spiegelberg (Professor)

Executive Head: Donald H. Shively
Professors: Shau Wing Chan, Donald H. Shively. Consulting: Sir George Sansom
Assistant Professors: David Y. Chen, Albert E. Dien, William H. McCullough, Chung-Wen Shih
Instructors: Hiroshi Miyagi, Francis Motofuji
CHINESE-JAPANESE LANGUAGE CENTER

Director: Donald H. Shively
Professors: Shau Wing Chan, Donald H. Shively, Kurt Steiner
Assistant Professors: David Y. Chen, Albert E. Dien, William H. McCullough, Chung-Wen Shih
Instructors: Hiroshi Miyaji, Francis Motofuji

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:

A. Concentration in Chinese:
   C103, C151, C152, C153

B. Concentration in Japanese:
   J103, J151, J152, J153

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 of one year, or the requirements for the Ph.D. in the minimum time of three years.

Master of Arts

The degree of Master of Arts is granted both in Chinese and in Japanese. The University’s basic requirements for the Master’s degree are discussed in the section “Degrees” in this Bulletin. The following are Departmental requirements:

The candidate must:

A. Meet the Department’s requirements for the degree of Bachelor of Arts in Chinese (or Japanese) or their equivalent;
B. complete C221 (or J221), C222 (or J222), C299 (or J299), and at least 15 units of courses above the level of 230.

The candidate must be in residence at Stanford in California during the final quarter of registration for the Master’s degree.
A thesis is not required for the degree of Master of Arts in Chinese or Japanese. The candidate will, however, be required in C299 (or J299) to prepare an annotated translation or, under special circumstances, a paper 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. University requirements for the doctorate are given in the section “Degrees” in this Bulletin. The following are Departmental requirements:

I. 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:

A. He must demonstrate a reading knowledge of French or German by passing a written examination administered by the Department. All students presenting themselves for candidacy are strongly urged to acquire a reading knowledge of both these languages.

B. He must complete all of the requirements for the Master of Arts degree in this department or the equivalent courses at another university.

II. Further requirements:

A. The candidate must complete at least 5 additional units of other courses above the level of 230 and, in addition, courses 321 and 361.

B. Supporting language requirement:

1. If the candidate's field is Chinese, he will be examined on his ability to read modern Japanese (on the level of J103) and on his knowledge of and ability to use Japanese reference works of importance in Chinese studies.

2. If the candidate's field is Japanese, he will be examined on his ability to read classical Chinese (on the level of C103) and on his knowledge of and ability to use Chinese reference works of importance in Japanese studies.

C. He must pass examinations demonstrating fluency in the modern spoken language of his field, familiarity with modern and classical literary styles in the language of his field, and a knowledge of the history and structure of that language.

III. Preparation for University oral examination: General regulations governing the oral examination will be found in the section “Degrees” in this Bulletin. In addition, the Department of Asian Languages expects a candidate to be prepared in the following fields:

A. The general field of Chinese or Japanese literature and literary studies;

B. East Asian history and culture;

C. An outside field, to be selected in consultation with the Graduate Adviser. 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.

IV. 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 C221 or J221 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 program of the Stanford Center for Japanese Studies described elsewhere in this Bulletin.

COURSES NOT REQUIRING A KNOWLEDGE OF AN ASIAN LANGUAGE

#C151. Ancient Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, autumn, (Chan), MWF 10

#C152. Medieval Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, winter, (Chan), MWF 10

#C153. Modern Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, spring, (Chan), MWF 10

#J151. 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, autumn, (Seidensticker), MWF 11

#J152. 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, winter, (Seidensticker), MWF 11

#J153. Modern Japanese Literature in Translation — From the eighteenth century to the present. (Freshmen and sophomores may be admitted by permission of instructor.)
4 units, spring, (Seidensticker), MWF 11

See also Senior Colloquia.

I. COURSES IN CHINESE

#C1, C2, C3. First-Year Modern Chinese—Conversation, grammar, reading, elementary composition.
5 units, autumn, winter, and spring, (———), MTWThF 9

C5. Intensive First-Year Modern Chinese—Equivalent to C1, C2, C3 combined. Consent of instructor necessary.
15 units, summer, (———), MTWThF 8–12

#C21, C22, C23. Second-Year Modern Chinese—Further study in grammar, reading, conversation, composition. Prerequisite: C3 or equivalent.
5 units, autumn, winter, and spring, (———), MTWThF 1
C25. Intensive Second-Year Modern Chinese—Equivalent to C21, C22, C23 combined. Prerequisite: C3 or equivalent. Consent of instructor necessary.
15 units, summer, (———), MTWThF 8-12

C31, C32, C33. Intermediate Conversation—Prerequisite: C3 or equivalent.
2 units, autumn, winter, and spring, (———), M 11

C41, C42, C43. 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 C101.
10 units, autumn, winter, and spring, (———), MTWThF 9 and MTWThF 1

ADVANCED

C101, C102, C103. Introduction to Classical Chinese—Reading, syntax, composition. Prerequisite: C23 or equivalent.
5 units, autumn, winter, and spring, (———), MTWThF 9

C105. Intensive Introduction to Classical Chinese—Equivalent to C101, C102, C103 combined. Prerequisite: C23 or equivalent. Consent of instructor necessary.
15 units, summer, (———), MTWThF 8-12

C121, C122, C123. Advanced Conversation—Prerequisite: C33 or equivalent.
2 units, autumn, winter, and spring, (Shih), TTh 11

C131, C132, C133. Nationalist and Communist Materials in the Hoover Institution—Newspapers, documents, pamphlets. Prerequisites: For C131, C23 or equivalent; for C132 and C133, C131 and C101 or equivalent.
3 units, autumn, winter, and spring, (Nivison), MWF 2

C162. History of Chinese Literature: Ancient to T'ang Period—Lectures and discussion. Prerequisite: C23 or equivalent.
4 units, winter, (———), MWF 11

C163. History of Chinese Literature: Sung Period to the Present—Lectures and discussion. Prerequisite: C23 or equivalent.
4 units, spring, (———), MWF 11

C171, C172, C173. Composition—Prerequisite: C23 or equivalent.
3 units, autumn, winter, and spring, (Shih), MWF 1

C181, C182, C183. Chinese Literary and Historical Texts—Representative selections from pre-modern materials. Prerequisite: C103.
3 units, autumn, winter, and spring, (———), TTh 10

GRADUATE

C200. Directed Reading in Chinese—Prerequisite: C103 or equivalent.
1 to 3 units, any quarter, (Staff), by arrangement

C221, C222. Proseminar—Research Methods in Chinese Studies—Prerequisite: C103 or equivalent.
3 units, autumn and winter, (———), M 2-4

C251, C252. Chinese Philosophical Texts.
5 units, autumn and winter, (———), by arrangement

5 units, spring, (———), by arrangement

C254, 255. Chinese Historical Texts.
5 units, autumn and winter, (———), by arrangement

C257. Fiction and Essays in Classical Chinese.
5 units, spring, (———), by arrangement

C261, C262. Chinese Poetry.
5 units, autumn, (———) by arrangement

5 units, winter and spring, (———), by arrangement
C274. Chinese Drama.  
5 units, spring, (——), by arrangement

C281, C282. Modern Chinese Literature.  
5 units, autumn and winter, (——), by arrangement

C291. History of the Chinese Language—Lectures and discussion. Prerequisite: C103 or equivalent.  
5 units, spring, (——), by arrangement

C299. Translation.  
A total of 5 units, which may be taken in one or more quarters, winter or spring, (Staff), by arrangement

C321. Seminar—May be repeated for credit.  
5 units, (Staff), TTh 2-4

C361. Seminar in Chinese Literary Criticism—May be repeated for credit.  
5 units, (Staff), by arrangement

By arrangement, (Staff)

II. COURSES IN JAPANESE

#J1, J2, J3. First-Year Modern Japanese—Conversation, grammar, reading, elementary composition.  
5 units, autumn, winter, and spring, (Motofuji), MTWThF 9

J5. Intensive First-Year Modern Japanese—Equivalent to J1, J2, J3 combined. Consent of instructor necessary.  
15 units, summer, (——), MTWThF 8-12

#J21, J22, J23. Second-Year Modern Japanese—Further instruction and practice in conversation, grammar, reading, and composition. Prerequisite: J3 or equivalent.  
5 units, autumn, winter, and spring, (Motofuji), MTWThF 1

J25. Intensive Second-Year Modern Japanese—Equivalent to J21, J22, J23 combined. Prerequisite: J3 or equivalent. Consent of instructor necessary.  
15 units, summer, (——), MTWThF 8-12

J31, J32, J33. Intermediate Conversation—Prerequisite: J3 or equivalent.  
2 units, autumn, winter, and spring, (Motofuji), TTh 11

J41, J42, J43. 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 J101.  
10 units, autumn, winter, and spring, (Miyaji), MTWThF 9 and MTWThF 1

ADVANCED

J101, J102, J103. Modern Written Japanese—Reading in texts representative of various modern written styles. Prerequisite: J23 or equivalent.  
5 units, autumn, winter, and spring, (McCullough), MTWThF 10

J105. Intensive Modern Written Japanese—Equivalent to J101, J102, J103 combined. Prerequisite: J23 or equivalent. Consent of instructor necessary.  
15 units, summer, (——), MTWThF 8-12

J121, J122, J123. Advanced Conversation—Prerequisite: J33 or equivalent.  
2 units, autumn, winter, and spring, (Miyaji), W 2-4

J131, J132, J133. Readings in the Social Sciences—The reading of modern Japanese writings in history and the social sciences.  
5 units, autumn, winter, and spring, (McCullough, Shively), MWF 1

J171, J172, J173. Composition—Prerequisite: J23 or equivalent.  
3 units, autumn, winter, and spring, (Miyaji), MWF 1
J181, J182, J183. Japanese Literary and Historical Texts—Representative selections from pre-modern materials.
3 units, autumn, winter, and spring, (Shively), TTh 10

GRADUATE

J200. Directed Reading in Japanese—Prerequisite: J103 or equivalent.
1 to 3 units, any quarter, (Staff), by arrangement

J221, J222. Proseminar—Research Methods in Japanese Studies—Prerequisite: J103 or equivalent.
5 units, autumn and winter, (Shively), F 2-4

J231, J232, J233. Modern Japanese Literature—Poetry, prose, and drama after 1868. Prerequisite: J103 or equivalent.
5 units, autumn, winter, and spring, (———), TTh 2-4

J241, J242, J243. Classical Japanese Literature—Poetry, prose, and drama before 1868. Prerequisites: J181, J182, and J183, or equivalent.
5 units, autumn, winter, and spring, (———), MW 2-4

J291. History of the Japanese Language—Prerequisite: J103 or equivalent.
5 units, spring, (———), by arrangement

J299. Translation.
A total of 5 units, which may be taken in one or more quarters, winter, spring, (Staff), by arrangement

J321. Seminar—May be repeated for credit.
5 units, (Staff), by arrangement

J361. Seminar in Japanese Literary Criticism—May be repeated for credit.
5 units, (Staff), by arrangement

By arrangement, (Staff)

ADDITIONAL INFORMATION

For information concerning other opportunities for study in the Asian field, see listings under the following departmental headings: Anthropology, Art and Architecture, 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, James E. Brinton, 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 and Journalism, 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 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.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Units</th>
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<tbody>
<tr>
<td>FIRST YEAR</td>
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<tr>
<td>Mathematics 41, 62, 63. Differential and integral calculus</td>
<td>5, 5, 5</td>
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<td>(The sequences 41, 42, 43, or 10, 11, 21, 22, 23 are also acceptable.)</td>
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<tr>
<td>Philosophy 3. Introduction to Logic</td>
<td>5</td>
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<tr>
<td>SECOND YEAR</td>
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<tr>
<td>Mathematics 64. Partial derivatives, multiple integrals, infinite series</td>
<td>3</td>
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<tr>
<td>Course in Matrix Theory</td>
<td>3</td>
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<tr>
<td>Statistics 50, Psychology 60, or Economics 7</td>
<td>5</td>
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<tr>
<td>THIRD YEAR</td>
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<tr>
<td>Statistics 116. Theory of Probability</td>
<td>4</td>
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<td>Statistics 119. Statistical Inference</td>
<td>3</td>
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<tr>
<td>Statistics 206, 207. Mathematical models in the Behavioral Sciences</td>
<td>6</td>
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<tr>
<td>FOURTH YEAR</td>
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<tr>
<td>Economics 199, Psychology 104, or Behavioral Sciences 199. Senior Thesis in Quantitative Methods</td>
<td>5</td>
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<td>Three of the following:</td>
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<tr>
<td>Economics 272. Statistical Inference in Economics</td>
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<td>Mathematics 115. Fundamental Concepts of Analysis</td>
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<td>Mathematics 116. Fundamental Concepts of Analysis</td>
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<td>Mathematics 120. Modern Algebra</td>
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<td>Mathematics 130. Ordinary Differential Equations</td>
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<td>Mathematics 131. Partial Differential Equations I</td>
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<td>Mathematics 132. Partial Differential Equations II</td>
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<tr>
<td>Mathematics 137. Numerical Analysis</td>
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<tr>
<td>Philosophy 161. Introduction to Set Theory</td>
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<tr>
<td>Statistics 217a. Introduction to Stochastic Processes</td>
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<tr>
<td>Statistics 217b. Introduction to Stochastic Processes</td>
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<td>Statistics 221. Analysis of Variance</td>
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3. The Senior Thesis will be written under supervision of a designated faculty advisor. 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.

COURSE

199. Senior Thesis in Quantitative Methods.
   1 to 5 units, each quarter, (Staff), by arrangement

BIOLOGICAL SCIENCES

Emeriti: Cornelis Bernardus van Niel, Willis Horton Rich, Harry Beal Torrey (Professors)

Executive Head: Victor Chandler Twitty


Professors by Courtesy: Jens Christian Clausen, Charles Stacey French, William McKinley Hiesey

Associate Professors: Winslow Russell Briggs, Paul Ralph Ehrlich, Richard William Holm, Donald Kennedy, Robert Meredith Page (on leave autumn quarter), Donald Eugene Wohlschlag. Visiting: Peter Andrew Peterson (winter quarter)

Assistant Professors: John Howell Phillips, Jr., Peter Hamilton Raven, Norman Keith Wessells, Dow Woodward

Instructor: Charles Harold Baxter

Research Biologists: Isabella A. Abbott, Dorothy Newmeyer, Virginia M. Page

Lecturers: Walter C. Brown, Laurence Monroe Klauber, Alan Edward Leviton, Oswald Hope Robertson, Oscar Elton Sette, John Hunter Thomas

ORGANIZATION

The Department of Biological Sciences comprises the following divisions of teaching and research: (a) General and Experimental Biology, (b) Systematic Biology, and (c) Marine Biology and Oceanography. The laboratories, museum, and libraries of these divisions are housed in Jordan Hall and the Museum Building on the campus, and in the Hopkins Marine Station in Pacific Grove on Monterey Bay.

The Department provides: (1) informative courses for the general student, (2) programs of study leading to the degree of Bachelor of Arts, and (3) programs of graduate study and research leading to the degrees of Master of Arts and Doctor of Philosophy.

A brochure of special interest to prospective candidates for advanced degrees, Graduate Study in the Biological Sciences at Stanford University, is available upon request to the Chairman of the Department. The brochure describes the areas of
specialization represented in the Department, facilities for study and research, and the opportunities for financial aid available to graduate students.

PROGRAMS OF STUDY

Bachelor of Arts

Candidates for the Bachelor of Arts degree must complete: (1) a group of specified courses in biology, or their equivalents, with certain options (see below) in keeping with the intended field of specialization; (2) 24 units of cognate studies in the physical sciences; and (3) 12 units of elective courses in biological sciences. Electives may be courses in biological sciences, anatomy, bacteriology, physiology, or any of the following courses in geology: 112, Elementary Paleontology; 113, Systematic Invertebrate Paleontology. Courses included under 1 and 3 must be completed with an average grade of not less than C.

Required Courses in Biology:

Biology 20. Introduction to Botany .......................... 5 units
Biology 21. Introduction to Invertebrate Zoology ............. 5 units
Biology 22. Comparative Vertebrate Anatomy .................. 5 units
Biology 24. Cellular Physiology ............................... 5 units
Biology 25. Genetics ........................................... 4 units

and one of the following courses:

Biology 23. Introductory Embryology .......................... 5 units
Biology 30. The Plant Kingdom: Algae and Fungi ............... 4 units
Biology 31. The Plant Kingdom: Mosses and Ferns ............. 4 units
Biology 32. The Plant Kingdom: Seed Plants ................... 4 units
Biology 100h. Marine Algae ..................................... 5 units

Biology 1, 2, 3 (General Biology) may be substituted for Biology 20 and 21 (transfer from one sequence to another is not encouraged; students enrolling in Biology 1 will ordinarily complete Biology 2 and 3, and those electing Biology 20 will continue with Biology 21); Biology 111h or 112h (Marine Zoology) for 21; Biology 164h (Physiology of Algae) for 24.

Required Cognate Courses in the Physical Sciences:

Chemistry 1, 2, 3, or equivalent ................................ 14 units
Organic Chemistry 121, 123, or equivalent ..................... 6 units
Physics, geology, or mathematics ............................... 4 units

In all cases the program of study must be approved each quarter by the Department Adviser. The degree is conferred only upon recommendation of the Department.

Students wishing additional training in any of the special fields of botany or zoology in anticipation of attaining professional competence should consult with advisers of the Department regarding the elective units in their programs and additional courses which should be taken. (For botany, see Professor W. R. Briggs.)

Senior Honors Program

(See Biology 200 under Courses.) This program is open to students of superior scholarship (over-all grade average of B or better) or 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 take the following courses:

Biology 20. Introduction to Botany ........................................ 5 units
Biology 21. Introduction to Invertebrate Zoology .................. 5 units

Biology 1, 2, 3 (General Biology), 9 units, may be substituted for Biology 20 and 21

Biology 22. Comparative Vertebrate Anatomy ....................... 5 units
Biology 23. Introductory Embryology ................................. 5 units

These courses fulfill the biology requirements for admission to the Stanford University School of Medicine (see School of Medicine Bulletin) and for most other medical schools. For specific requirements of other medical schools consult the premedical advisers of the Department.

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 20, 21, and 22, or Biology 1, 2, and 3.

The Teacher's Recommendation

Programs are provided for candidates seeking either (a) the General Secondary Credential, 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. Some substitutions may be made for Biology 23, 24, and 25 with the approval of the adviser on teaching credentials of the Department of Biological Sciences. 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.

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 Executive Head of the Department).

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 (apti-
BIOLOGICAL SCIENCES

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tude 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—In addition to the usual basic undergraduate courses in Biology, it is recommended that wherever possible preparation for graduate work include courses in general physics, mathematics through intermediate algebra and if possible 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.

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.

Courses required of all Ph.D. candidates—It is expected that candidates for the Ph.D. degree will have had courses in the following fields prior to entrance to graduate school or will ordinarily complete them during the first year of graduate study: introductory botany and zoology or general biology, microbiology, developmental biology, physiology, and genetics. Additional course requirements are as follows:
(a) 10 units of course work in areas other than the field of specialization and fields closely allied to it, taken in graduate standing; (b) courses in inorganic chemistry (one year) and either one quarter of organic chemistry and one quarter of biochemistry or two quarters of organic chemistry; (c) a minimum of 15 units of advanced biology courses (beyond Biology 25 and exclusive of special problems and research courses), taken in graduate standing. Specific course training beyond this point will be determined in each individual case by the special needs of the student, in consultation with his research adviser and sponsor.

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 Dissertations 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.

Graduate Minor

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

The requirements for the A.M. degree in Biological Sciences are as follows:

A. With thesis—One year (3 quarters) of registration at Stanford in graduate
status, totaling 45 units, with an average grade of B.

Courses Biology 20 through 25 or their equivalents (during either collegiate or
graduate years). These undergraduate courses cover the following fields: introd-
cutory botany, introductory zoology, comparative vertebrate anatomy, embryology,
cellular physiology, and genetics, respectively. Courses from the botany group Biol-
ogy 30, 31, 32, 100h, or 164h may be substituted for comparative anatomy and/or
embryology. These cover algae and fungi, mosses and ferns, and seed plants, re-
spectively. An introductory general biology course such as Biology 1, 2, 3 is ac-
ceptable in lieu of the separate introductory botany and zoology courses (20 and 21).

A minimum of 15 units of advanced biology courses taken in graduate standing,
excluding special-problems courses, seminars and research. Not more than 5 of these
15 units may be elected from courses offered by the departments of Anatomy, Bact-
eriology, Biochemistry, Geology (Paleontology) and Physiology.

A minimum of 10 units each in plant and animal biology (during either collegiate
or graduate years). An introductory botany or zoology course may apply toward one
of these.

A minimum of 22 units in physical sciences (during either collegiate or graduate
years), consisting of a year’s course in general chemistry, and 10 additional units in
chemistry and/or mathematics, physics, or geology.

A written A.M. thesis, based either on the results of an original investigation, or
on a survey of the literature, in a special field agreed upon with the faculty sponsor.

B. Without thesis—Same as A, except that no thesis is required, and the number
of units that must be taken in advanced courses in biology is increased from 15 to 36.

Students originally admitted to the Department as A.M. candidates may subse-
quently transfer to Ph.D. candidacy only by written petition to the Department.

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 require-
ments for the course are outlined in the School of Education section.

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 $2,000 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.

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 a period of approximately one year.

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 applicants 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 Chairman of the Department.

Applications for scholarships or fellowships from candidates who are not applying for teaching assistantships must be received by the Office of Admissions not later than February 8.

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 14, Maryland. 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

Biology 20 and 21 may be superseded during 1963–64 by somewhat modified courses in plant and animal biology, as the first step in instituting a new core curriculum for biology majors.

The letter h following a number indicates that the course is given at the Hopkins Marine Station.

#1, 2, 3. General Biology—Functional mechanisms in microorganisms, plants, and animals; 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 22 and subsequent courses leading to fulfillment of degree or premedical requirements. Lectures, laboratory, demonstrations. Enrollment only by signing class lists.

2. 3 units, winter, (Kennedy, Regnery, Baxter), WF 11; lab. (I) T 9–12, (II) T 2–5, (III) W 8–11, (IV) W 2–5, (V) Th 9–12, (VI) Th 2–5;


#20. Introduction to Botany—Structure, function, relationships of plants.
5 units, winter, (Page), MWF 8; lab. (I) TTh 9–12, (II) Ti 2–5, (III) WF 2–5

#21. Introduction to Invertebrate Zoology—Structure, function, relationships of invertebrate animals.
5 units, autumn, (Olliphant), MWF 9; lab. (I) TTh 9–12, (II) TTh 1–4, (III) WF 1–4

23. Introductory Embryology—An introductory study of development, particularly of amphibians, birds and mammals. Prerequisites: Biology 22 or equivalent.
5 units, autumn, (Grobstein), MWF 9; lab. (Wessells) (I) TTh 9–12, (II) TTh 2–5, (III) WF 2–5

24. Cell Physiology—Fundamental activities of animals, plants, microorganisms. Prerequisites: Biology 1, 2, 3, or 20, 21, or equivalents, and elementary chemistry and physics. Preferred that students take organic chemistry before registering, or concurrently.
5 units, winter, (Giese), MWF 9; lab. (I) TTh 1–4, (II) WF 1–4

25. Genetics—Prerequisites: Biology 1, 2, 3, or 20, 21.
4 units, autumn, (Perkins), MTWTh

26. Introduction to Population Biology—Lectures, laboratories, and readings on the properties of aggregations of organisms. Prerequisites: Biology 1, 2, 3 or 20, 21.
3 units, autumn, (Erlich, Holm), MWF 11

28. Classification of Flowering Plants—Lectures, laboratory, field studies. Prerequisite: Biology 20 or equivalent.
4 units, spring, (Thomas), WF 2–5; field trips on alternate Saturdays, by arrangement

29. Fungi—Prerequisite: Biology 20 or Biology 1, 2, 3, or equivalents.
4 units, winter, (Page), TTh 9; lab. TTh 10–12 and two hours by arrangement, to be given in 1964–65

30. The Plant Kingdom: Algae and Fungi—Structure, development, evolutionary relationships of algae, fungi. Lectures, laboratory, field trips. Prerequisite: Biology 20 or equivalent.
4 units, spring, (Page), TTh 1; lab. TTh 2–5

31. The Plant Kingdom: Mosses and Ferns—Structure, development, evolutionary relationships of liverworts, mosses, the seedless vascular plant. Lectures, laboratory, field trips. Prerequisite: Biology 20 or equivalent.
4 units, winter, (Briggs), TTh 11; lab. TTh 2–5

32. The Plant Kingdom: Seed Plants—Structure, development, evolutionary relationships of seed plants. Lectures, laboratory. Prerequisite: Biology 20 or equivalent.
5 units, autumn, (Raven), MWF 11; lab. TTh 2–5

50. Evolution—A summary of current evolutionary thought, with emphasis on processes. Prerequisite: general biology or equivalent.
3 units, winter, (Ehrlich), MWF 11

53. General Entomology—The morphology, physiology, ecology, behavior, and taxonomy of insects. By permission. Prerequisite: Biology 21 or equivalent.
4 units, autumn, (Ehrlich), by arrangement

55. General Ecology—Environmental-biological interrelationships. Concepts of populations, communities, energy levels, utilization and conservation of resources by man. Prerequisites: Biology 20, 21, or equivalent.
3 units, winter, (Wohlschlag), MWF 8

100h. Marine Algae—Lectures, laboratory, field work on various classes of algae. Open to elementary students.
5 units, summer (first term), (——), MWF
101h. Natural History of Marine Animals—Lectures, laboratory, field work stressing adaptive adjustments of marine animals. Prerequisites: general biology or zoology (or concurrent registration in Course 111h).
5 units, summer (first term), TThS

103. Comparative Histology—Microscopic structure of animal tissues; special reference to vertebrates. Prerequisite: Biology 22 or equivalent.
3 units, winter, (Oliphant), TTh 10; lab. W 1–4

105. Immunobiology—Principles of immunology as related to certain problems in biology.
2 units, winter, (Regnery), TTh, alternate years, to be given in 1964–65

111h. Marine Invertebrates—Structure, classification, biology, and phylogeny of lower marine invertebrates, echinoderms, protochordates. Prerequisite: an elementary zoology course.
5 units, summer (first term), (Abbott), MWF

112h. Marine Invertebrates—Continuation of Course 111h, covering molluscs, annelids, arthropods, allied minor phyla. While the two courses form a continuous sequence, either half may be taken separately. Prerequisite: elementary zoology, preferably also Course 111h.
5 units, summer (second term), (Abbott), MWF

124. Comparative Parasitology: Protozoa, Helminths—Principal attention to forms parasitic in man, animals, plants of importance in human economy.
4 units, spring, (Oliphant), TTh 10; lab. TTh 1–4

136h. General Ichthyology—Fishes, including elements of morphology, taxonomy, embryology, natural history. Prerequisite: Biology 22 or equivalent.
5 units, summer (second term), (Abbott), TThS

139. Herpetology I—Lecture, laboratory and field survey of living amphibians, with a synoptic history of herpetology. By permission.
3 units, winter, (Leviton, Myers), by arrangement

140. Herpetology II—Lecture, laboratory and field survey of living reptiles. By permission.
3 units, spring, (Leviton), by arrangement

141. Cytodifferentiation—Lectures and class discussion of the nature, criteria and mechanisms of differentiation at the cell level. Prerequisites: Biology 23, 24, 25, 142, or equivalents.
3 units, winter, (Grobstein), TTh 10, alternate years, to be given in 1964–65

142. Experimental Embryology—Lectures on experimental analysis of embryonic development by microsurgical methods, related techniques. Prerequisite: Biology 23.
3 units, autumn, (Twitty), MWF 10, to be given in 1964–65

143. Analysis of Development—Lectures and class discussion of the experimental analysis of development, with emphasis on the behavior of cells and tissues and its integration in the development of the whole organism. Prerequisites: Biology 23, 24, 25, 142, or equivalents.
3 units, winter, (Grobstein) TTh 10, alternate years, to be given in 1963–64

144. Plant Growth and Development—Morphological, physiological aspects of plant growth. Prerequisite: Biology 156.
2 units, spring, (Briggs), TTh 9

145. Laboratory Techniques in Embryology—Application of microsurgical, chemical, and tissue culture procedures to developmental problems. Prerequisites: Biology 23 and permission of instructor.
3 units, winter, (Wessells), TTh 2–5

148a. Genetics of Microorganisms I—Genetic mechanisms in microorganisms other than bacteria and viruses. Prerequisite: Biology 25.
2 units, winter, (Perkins), TTh, alternate years, to be given in 1964–65

148b. Genetics of Microorganisms II—Genetic mechanisms in bacteria and viruses. Prerequisite: Biology 25.
2 units, spring, (Yanofsky), TTh, alternate years, to be given in 1964–65
149. **Cytogenetics**—The chromosomal and cellular basis of heredity. Prerequisite: Biology 25.
   3 units, winter, (Peterson), MWF

151. **Evolutionary Genetics**—Application of genetics to study of evolution. Prerequisite: Biology 25.
   2 units, winter, (Regnery), TTh, alternate years, to be given in 1963-64

152. **Gene Action**—The mechanism of action of genetic material will be discussed. Prerequisite: Biology 158 or Biochemistry 101.
   3 units, spring, (Yanofsky), MWF, alternate years

156. **Introductory Plant Physiology**—Principal functions of organs of higher plants; growth, mineral nutrition, water relations, movement of materials, respiration, nitrogen relations, photosynthesis. Prerequisites: Biology 20 or equivalent, inorganic chemistry. Organic chemistry recommended.
   5 units, autumn, (Briggs), MWF 9; lab. WF 2-5

158. **Molecular Biology**—The synthesis, function and interactions of the various cellular components, emphasis on molecular genetics. Prerequisites: Biology 25; Biology 24 (may be taken concurrently).
   3 units, winter, (Woodward), TTh 10

159. **Molecular Biology Laboratory.** By permission. Prerequisite: Biology 158.
   2 units, spring, (Woodward), TTh 2-5

161h. **Comparative Biochemistry of Marine Organisms**—Prerequisites: elementary biology, organic chemistry.
   5 units, summer (first term), (Phillips), MWF

162h. **Comparative Biochemistry of Marine Organisms**—(continuation of Course 161h)
   5 units, summer (second term), (Phillips), MWF

164h. **Physiology of Algae**—Prerequisites: elementary physics, chemistry, biology.
   5 units, summer (second term), (Blinks), TThS

165. **Advanced Plant Physiology**—Selected topics. Reading, conferences, lectures. Prerequisites: Biology 20, 24, and preferably 156.
   2 units, winter, (Blinks), M 2-4, alternate years, to be given in 1963-64

166. **Physiology of the Nervous System and Sense Organs**—The generation of electrical activity in neurons and receptors; neural organization, and its relationship to behavior. Enrollment by permission.
   4 units, autumn, (Kennedy), lec. and lab. WF 2-5

168. **Comparative Animal Physiology**—Response, nutrition, reproduction of animals; special emphasis on invertebrates. Prerequisites: Biology 21, 22, 24, or equivalents. Laboratory work may be undertaken during summer at Hopkins Marine Station.
   3 units, spring, (Giese), MWF 8, alternate years, to be given in 1964-65

169h. **Ecological Physiology**—Physiological responses of animals to variation in environmental factors and to organisms. Most work will deal with marine invertebrates. Prerequisite: general zoology and elementary chemistry.
   5 units, summer (first term), (Giese), TThS

170. **Readings in Paleobotany**—Structure, evolutionary relationships of fossil plants. Prerequisites: Biology 31 and 32, and permission of instructor.
   (Holm), by arrangement

174. **Zoogeography**—Seminar study of geographical distribution, historical migrations of natural populations of animals. By permission.
   2 units, spring, (Leviton, Myers), alternate years, to be given in 1963-64

175h. **Problems in Marine Biology**—Field studies, laboratory, lectures, and individual problems in marine biology. Designed primarily for undergraduates. Prerequisites: Biology 1, 2, 3 or 20, 21; and Chemistry 1, 2, 3, and permission of the instructors. Students will be in residence at the Hopkins Marine Station during the entire quarter.
   15 units, spring, (Abbott, Blinks, Phillips), MTWTThF
4 units, spring, (Wohlschlag), TTh 9; lab. WF 2-5, alternate years, to be given in 1964-65

185. **Problems in Autecology**—Field studies of some aspects of the ecology of a single organism. By permission.
3 units, spring, (Ehrlich), by arrangement

189. **Quantitative Methods in Biology**—Design, analysis, interpretation of biological experiments. Rationale, application of techniques of analysis of variance, regression and correlation, covariance; techniques utilizing chi-square, binomial, and Poisson distributions. Prerequisites: Statistics 50 or equivalent, or permission of instructor.
4 units, spring, (Wohlschlag), TTh 1; lab. TTh 2-5, alternate years, to be given in 1963-64

199. **Special Problems.**
(Staff), by arrangement

199b. **Special Problems.**
(Hopkins Marine Station Staff) by arrangement

200. **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 over-all average grade of B or better. Not more than six units of honors work may be applied toward the 12 units of electives required for graduation in biology.
(Staff), by arrangement

212. **Evolution of the Flowering Plants**—Phylogenetic relationships of angiosperm families. Prerequisite: Biology 28 or equivalent.
5 units, winter, (Raven), MWF 10; lab. WF 2-5, alternate years, to be given in 1963-64

213. **Plant Geography**—Survey of factors controlling distribution of plants. Prerequisite: Biology 20 or equivalent.
3 units, winter, (Raven), MWF 10, alternate years, to be given in 1964-65

214. **Advanced Topics in Evolution**—Some major interrelationships of cytology, genetics, morphology, behavior. Prerequisite: Biology 25 or equivalent.
3 units, spring, (Holm), MWF 11

215. **Biosystematics**—Current methods of approach to systematic problems in higher plants. Prerequisite: Biology 20, and permission of the instructor.
5 units, (Raven), by arrangement

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, autumn, winter, summer, (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, autumn, (Myers), by arrangement, alternate years, to be given in 1963-64

231. **Advanced Systematic Ichthyology II**—Continuation of Biology 230.
4 units, winter, (Myers), by arrangement, alternate years, to be given in 1963-64

245. **Electrobiology**—Electrical phenomena in plants, animals, and membranes.
2 units, winter, (Blinks), M 2-4, alternate years, to be given in 1964-65

247. **Advanced Cellular and Comparative Physiology**—Discussion of a selected topic. Prerequisite: Biology 24 or equivalent. By permission. May be repeated for credit.
2 units, autumn, (Giese), M 1-3
DIVISION OF MARINE BIOLOGY AND OCEANOGRAPHY
HOPKINS MARINE STATION

Emeritus: Cornelis B. van Niel (Hersstein Professor)

Director: Lawrence Rogers Blinks
Associate Director: Rolf Ling Bolin
Assistant Director: Donald Putnam Abbott
Professors: Donald Putnam Abbott, Lawrence Rogers Blinks, Rolf Ling Bolin, Arthur Charles Giese
Assistant Professor: John Howell Phillips
Research Associate: Isabella Aiona 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. 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, spring, (Abbott, Blinks, Phillips), MTWThF

199h. Special Problems—Properly qualified undergraduate students may undertake individual work in fields indicated under 300h. Such studies are intended to introduce the serious student to methods of research. Arrangements must be made by consultation or correspondence.
(Staff), by arrangement
222h. Biological Oceanography.
15 units, autumn, winter, summer, (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)

Physiology—Problems of general and cellular physiology, especially of marine plants. Permeability, photosynthesis, bio-electric phenomena emphasized.
(Blinks)

Marine Fishes—Morphology, taxonomy, embryology, ecology of marine fishes.
(Bolin)

Physiology—Problems on physiology of invertebrate animals; photobiology, especially effects of ultra-violet light.
(Giese)

Comparative Biochemistry and Immunology—As exemplified in marine animals.
(Phillips)

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, (——), MWF

101h. Natural History of Marine Animals.
5 units, (——), TThS

111h. Marine Invertebrates.
5 units, (Abbott), MWF

161h. Comparative Biochemistry of Marine Organisms.
5 units, (Phillips), MWF

169h. Ecological Physiology.
5 units, (Giese), TThS

199h. Special Problems—(See autumn, winter, spring quarters, above.)
(Staff), by arrangement

222h. Biological Oceanography—(See above.)
300h. Research—(See autumn, winter, spring quarters, above.)
(Staff), by arrangement

Second Term

112h. Marine Invertebrates (continued).
5 units, (Abbott), MWF

136h. General Ichthyology.
5 units, (——), TThS

162h. Comparative Biochemistry of Marine Organisms (continued).
5 units, (Phillips), 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 Stinchfield Ferris (Curator), Willis Horton Rich (Professor)

Director: Richard William Holm
Professors: George Sprague Myers, Ira Loren Wiggins
Associate Professors: Paul Ralph Ehrlich, Richard William Holm
Assistant Professor: Peter Hamilton Raven
Curators: Paul Ralph Ehrlich (Entomological Collections), Alan Edward Leviton
   (Zoological Collections), John Hunter Thomas (Dudley Herbarium)
Research Associates: Samuel Stillman Berry (Malacology), Walter Creighton
   Brown (Herpetology), Warren Curtis Freihofer (Ichthyology)
Lecturers: Laurence Monroe Klauber, Alan Edward Leviton, John Hunter Thomas

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, geo-
 graphical 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 in-
 vestigators to carry forward research programs.

Advanced courses and research leading to the degrees of Master of Arts and
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) entomology (morphology, ecol-
ogy, and systematics of insects); (c) zoology (fisheries biology, ichthyology, and
herpetology, including taxonomy, morphology, ecology, and distribution).

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 facili-
ties 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, fre-
cently cited specimens and are of great value to investigators studying plants re-
cently introduced into North America or those closely related to Old World species.
The collections of cryptogamic and phanerogamic plants in the Dudley Herbarium
now number about 700,000 sheets.

Entomological Collections

The collection of Lepidoptera preserved in fluid is probably the finest in the world,
and is growing rapidly. In addition, much material of other insect orders is available.

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
CHEMISTRY

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. The Division also has a fine representation of the birds and mammals of the western states. The collection of marine invertebrates is rich in echinoderms, crustaceans, and cephalopods, and contains good working nuclei in other groups. The series of deep-sea forms is especially good.

CHEMISTRY*

Emeriti: John Pearce Mitchell, George Sutton Parks, Philip Albert Leighton (Professors)

Executive Head: William Summer Johnson
Associate Executive Head: Douglas Arvid Skoog
Associate Professor: Frank Ephraim Harris
Assistant Professor: Victor William Laurie
Lecturers: Frank R. Mayo, Pierre Van Rysselberghe
Laboratory Director and Research Associate: Boris Weinstein

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 trigonometry and solid geometry). 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 Examinations in chemistry may petition the Department to waive the requirement of Chemistry 1, 2, and 3. The Department, however, does not allow unit credit toward graduation nor unit credit for meeting the University requirement in science for courses from which the student has been excused.

PROGRAMS OF STUDY

Minimum Requirements for the B.S. 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

* The curriculum leading to the B.S. degree in Chemical Engineering is described elsewhere in this Bulletin.
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 2.0 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, 180, and at least three units from one of the following: Chemistry 138, 142; 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 3.0 in all course work in the University and of 3.5 in courses in chemistry, physics, and mathematics. In addition to the minimum requirements for the B.S. degree, the student must complete nine units of Chemistry 190 to be taken three units per quarter for three quarters; seven units from Chemistry 126, 180, 212, 216, 221, 223, 225, 233, 235, 246, 247, 271, 273, 275, 289a, 289b, 289c; 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**

### First Year

<table>
<thead>
<tr>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 1, 2, 3. General Chemistry</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>German G1, G2, G3. First-Year German</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Math. 10, 11, 21. Analytic Geometry and Calculus</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Group Activities</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>14</strong></td>
<td><strong>14</strong></td>
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</tbody>
</table>

### Second Year

<table>
<thead>
<tr>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 121, 123, 125. Organic Chemistry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 122, 124. Organic Preparations</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>German G22, G23. Second-Year Reading</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Math. 22, 23. Analytic Geometry and Calculus</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54. Mechanics, Sound, Electricity</td>
<td>—</td>
<td>5</td>
</tr>
<tr>
<td>Social Science</td>
<td>5</td>
<td>—</td>
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<tr>
<td>Electives (Note 1)</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>Group Activities</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>14</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>
Third Year

Chem. 112, 113. Quantitative Analysis .................. 5
Chem. 116. Instrumental Analysis .................. —
Chem. 171, 173, 175. Physical Chemistry ............. 3
Chem. 176. Physical Chemistry Laboratory ........... —
Hist. 1, 2, 3. Western Civilization .................. 4
Physics 55, 56, 57. Light, Heat, Atomic Physics .... 5
Social Science ......................................... —
Electives (Note 1) .................................... —
Totals .................................................... 17

Fourth Year

Humanities .............................................. 4
Electives (Note 1) .................................... 11
Totals .................................................... 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: Chem. Engr. 10, 130, 150; Economics 1; English 102; Mathematics 24, 130, 131, 132; Physics 61, 110, 111, 140; Statistics 110; Geology 1, 25, 123; Engr. 50; Min. E. 105; Mat. Sci. 107; Microbiology 101; Biology 20, 21, 22, 23, 25; 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 during 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. Students who fail to pass these examinations in the autumn may be permitted to repeat them during the first week of the winter quarter. 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.

Graduate students must begin their course work with Chemistry 221 if majoring in organic chemistry, with Chemistry 271 if majoring in chemical physics, or in analytical, inorganic, or physical chemistry, or with either course if majoring in biochemistry. Candidates for advanced degrees must have a minimum grade point average of 3.0 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 require-
ments, 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. Students majoring in chemical physics are required to take two of the four examinations, namely that in physical chemistry and either that in inorganic or that in organic chemistry, and in addition thereto, a four-hour written examination in chemical physics. The examinations will be given during the period September 25-28 in 1963 and all examinations must be taken at this time. For those students who fail to pass one or more of the examinations and are permitted to repeat them, the examinations will be held again during the period January 7-10 in 1964.

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, 271, 273, or 275.

Doctor of Philosophy

The graduate student does not become a formal candidate for the Ph.D. degree until he has passed the Department qualifying 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. However, proposals to substitute for French or Russian another language or a program of course work will be considered by the Department on petition of the candidate. The Department requires that the foreign language requirement or the approved substitute program be fulfilled completely before the candidate may apply for admission to candidacy. 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 analytical chemistry are required to take (1) Chemistry 271, 212, 216, and 233 or 235. Three of these courses must be completed during the first year irrespective of background; those who fail to make a grade point average of 3.0 in the three courses may not become candidates for the Ph.D. degree in analytical chemistry. In addition, students are required to complete (2) three units of Chemistry 221, 223, or 225, and (3) six additional units of advanced lecture courses.

All students majoring in inorganic chemistry are required to take (1) Chemistry 271 and Chemistry 180; (2) Chemistry 273 or 275; and (3) 233 or 235. Requirements (1) and either (2) or (3) must be completed during the first year irrespective of background; those who fail to make a grade point average of 3.0 in the three courses may not become candidates for the Ph.D. degree in inorganic chemistry. In addition they are required to complete (4) three units of Chemistry 221, 223, or 225, and (5) six additional units of advanced lecture courses of which at most three may be choset from physical or inorganic chemistry.
All students majoring in organic chemistry are required to take (1) basic training in certain spectroscopic and chromatographic techniques, and a proficiency test in qualitative organic analysis; those failing to pass the test will be required to take Chemistry 126; (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 3.0 in these three courses may not become candidates for the Ph.D. degree in organic chemistry; (3) three units of Chemistry 227; (4) nine units of advanced lecture courses outside of the field of organic chemistry of which at least three units must be from Chemistry 271, 273, or 275. Beginning with the second year of graduate work at Stanford, organic majors are required to participate in a series of advanced problem sessions.

All students majoring in physical chemistry are required to take (1) Chemistry 271, 273, and 275 during the first year, irrespective of background; those who fail to make a grade point average of at least 3.0 in these three courses may not become candidates for the Ph.D. degree in physical chemistry; (2) three additional units of advanced analytical, physical or inorganic chemistry; (3) nine units of advanced lecture courses outside of the fields of analytical, physical, and inorganic chemistry of which at least three units must be from Chemistry 221, 223, or 225.

Students majoring in biochemistry must complete (1) a course in general biochemistry such as Biochemistry 101 and 102 (7 units or equivalent); (2) the advanced organic chemistry series, Chemistry 221, 223, and 225, or the advanced physical chemistry series, Chemistry 271, 273, and 275; and (3) five units of advanced courses in biochemistry such as Chemistry 246, Chemistry 247, Biochemistry 211, or allied courses in Medical Microbiology, Biology, or Physiology as approved by the Department of Chemistry.

In 1963 the Department will institute a new program leading to the Ph.D. in chemistry, to be called the program in chemical physics. This is directed toward a stronger integration of physics and chemistry than that achieved under the traditional program of physical chemistry. Typical current areas of study include quantum mechanical studies of molecular structure, microwave, spectroscopy, electronic and nuclear magnetic resonance, molecular structure of biological systems and their analogs, the solid state, low temperature chemistry, and chemical effects of high energy radiation. Students majoring in chemical physics will be required to demonstrate a satisfactory level of competence in selected advanced fields of physics and chemistry, by obtaining appropriate grades either in the courses devoted to these fields, or in suitable special examinations.

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 3.0 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, 271, 273, or 275.
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, Edward Curtis Franklin Fellowship, James W. McBain Memorial Fellowship, Dow Chemical Company 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 Gard 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

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 A.
4 units, autumn, (Staff), lec. (I) MWF 8, (II) MWF 9, (III) TThS 9; lab. (I) T 9-12, (II) T 2-5, (III) W 2-5, (IV) Th 9-12, (V) Th 2-5, (VI) F 2-5

#2. General Chemistry—Continuation of Chemistry 1.
4 units, winter, (Staff), lec. and lab. sections same as under Chemistry 1.

#3. General Chemistry—Continuation of Chemistry 2.
5 units, spring, (Staff), lec. (I) MWF 8, (II) MWF 9; lab. (I) TTh 9-12, (II) TTh 2-5, (III) WF 2-5

110. Elementary Quantitative Analysis—For other than Chemistry or Chemical Engineering majors. Concurrent registration in 111 required. Prerequisite: 3.
2 units, spring, (Loring), TTh 11

111. Elementary Quantitative Analysis Laboratory—Concurrent registration in 110 required.
3 units, spring, (Loring), MWF 1-4

112. Quantitative Analysis—For Chemistry or Chemical Engineering majors. Concurrent registration in 113 required. Prerequisite: 3.
3 units, autumn, (Skoog), MWF 10

113. Quantitative Analysis Laboratory—Concurrent registration in 112 required.
2 units, autumn, (Skoog), MW 1-4 or TTh 1-4

116. Instrumental Analysis—Techniques and instrumentation theory of electrochemical titrations, polarography, spectrophotometry, chromatography, and refractometry. Prerequisites: 112, 113, 171, and previous or concurrent enrollment in both 173 and Physics 29 or 57.
4 units, winter, (--), lec. TTh 10; lab. TTh 1-4 or WF 1-4

120. Organic Chemistry—Aliphatic, aromatic compounds. For students other than Chemistry, or Chemical Engineering majors. Prerequisite: 3.
5 units, summer, (Staff), MTWThFS 9

121. Organic Chemistry—Carbon compounds. Prerequisite: 3.
3 units, autumn, (Noller), MWF 11

122. Organic Preparations—Laboratory course. Prerequisite: 120, or previous or concurrent enrollment in 123.
3 units, winter, (Mosher), MT 1-5 or WTh 1-5
123. Organic Chemistry—Continuation of Chemistry 121.
3 units, winter, (Noller), MWF 11

124. Organic Preparations—Continuation of Chemistry 122.
3 units, spring, (Mosher), MWF 1-4

125. Organic Chemistry—Continuation of Chemistry 123.
3 units, spring, (Noller), MWF 11

126. Qualitative Organic Analysis—Prerequisites: 124 and 125.
4 units, autumn, (Bonner), MWF 1-5

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, Mathematics 23, and Physics 57, or equivalent.
3 units, autumn, (Krugcr), TTh 9

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. Prerequisites: 138 or consent of instructor.
3 units, winter, spring, (Krugcr), Th 1 and one lab. by arrangement

142. Nonmedical Biochemistry Laboratory—An introductory course to acquaint the student with some of the newer biochemical techniques, preparations, reactions, and methods of analysis. Prerequisites: 112, 113 (or 110, 111); 122, 123; Biochemistry 101.
2 or 3 units, winter, (Loring), TTh 1-5

171. Physical Chemistry—Introduction to chemical thermodynamics. The properties of gases, liquids and solutions. The phase rule and some applications. Prerequisites: 3; Mathematics 10, 11, 21 (or equivalent); Physics 51, 52, 53, 54, and previous or concurrent registration in Physics 55 and 56 (or Physics 21, 23, 29 on petition).
3 units, autumn, (Hutchinson), MWF 8

173. Physical Chemistry—Electrochemistry, including conductance phenomena and galvanic cells. Chemical kinetics, colloid and surface chemistry. Prerequisite: 171.
3 units, winter, (Hutchinson), MWF 8

3 units, spring, (Hutchinson), MWF 8

176. Physical Chemistry Laboratory—Vacuum, temperature control, electronic, and optical techniques used in the measurement of enthalpy changes, viscosity, surface tension, 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, spring, (——–), lec. T 10, lab. TTh 1-4 or WF 1-4

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, winter, (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.

212. Advanced Analytical Chemistry—Selected topics in quantitative analysis. Prerequisites: 116 and 123.
3 units, spring, (Skoog), MWF 10, alternate years, to be given in 1963–64
216. Instrumental Analysis—Theory, application. Prerequisites: 116, 123, and concurrent or previous registration in 175.
   3 units, spring, (Skoog), MWF 10, alternate years, to be given in 1964–65

219. Analytical Chemistry Seminar—Attendance is required of all graduate students majoring in analytical chemistry.
   autumn, winter, and spring, (Staff), by arrangement

221. Advanced Organic Chemistry—Lectures. Prerequisites: 125, 175.
   3 units, autumn, (Eastman), MWF 9

223. Advanced Organic Chemistry—Continuation of Chemistry 221. Prerequisite: 221, or permission of instructor.
   3 units, winter, (Johnson), MWF 9

225. Advanced Organic Chemistry—Continuation of Chemistry 223. Prerequisite: 223, or permission of instructor.
   3 units, spring, (van Tamelen), MWF 9

227. Selected Topics in Organic Chemistry—Prerequisite: 225, or permission of the instructor. May be repeated for credit.
   3 units, autumn, (Djerassi), M Th 8–10, W 8

230. 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, physical chemistry, and related fields. (Enroll in Chemical Engineering 230.) Prerequisites: physical chemistry with elementary thermodynamics.
   5 units, autumn, (Van Rysselberghe), by arrangement

   2 units, spring, (———), TTTh 10

235. Advanced Inorganic Chemistry—Selected topics. Prerequisite: 175.
   2 units, autumn, (———), TTTh 10

240. Organic Chemistry Seminar—Attendance is required of all graduate students majoring in organic chemistry.
   No credit, autumn, winter, and spring, (Staff), F 4

   2 units, autumn, (Loring), TTTh 9, alternate years, to be given in 1964–65

   2 units, autumn, (Loring), TTTh 9, alternate years, to be given in 1963–64

271. Advanced Physical Chemistry—Quantum Mechanics. Prerequisite: 175 or its equivalent.
   3 units, autumn, (Harris), MWF 11

273. Advanced Physical Chemistry—Molecular Structure. Prerequisite: 271, or permission of the instructor.
   3 units, winter, (Laurie), MWF 11

275. Advanced Physical Chemistry—Statistical Mechanics. Prerequisite: 271 or permission of the instructor.
   3 units, spring, (Flory), MWF 11

276. Electrochemical Concepts and Conventions—A survey of the fundamentals of electrochemistry, sign conventions, etc. Prerequisite: 175.
   1 unit, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1963–64

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, etc.; electrochemical procedures in physical, analytical chemistry. Prerequisite: 175.
   2 units, winter, (Van Rysselberghe), TTTh 9, alternate years, to be given in 1964–65
277b. Electrochemical Thermodynamics and Kinetics—Continuation of Chemistry 277a. Prerequisite: 276 or 277a.
   2 units, spring, (Van Rysselberghae), TTh 9, alternate years, to be given in 1964-6.

278. Selected Topics on Macromolecules—Lectures. May be repeated for credit.
   2 units, autumn, (Flory), by arrangement

289a. Chemical Thermodynamics—Systematic exposition of thermodynamics from the Gibbsonian point of view. Principal topics are: fundamental concepts, Gibbsonian equations, general conditions for chemical equilibrium, phase rule, systematic deduction of thermodynamic formulas, monovariant systems, azeotropic systems, perfect gases, absolute temperature, imperfect gases, ideal solutions, law of mass action. Lectures, problems.
   3 units, autumn, (Koenig), T 8, Th 8-10

289b. Chemical Thermodynamics — Continuation of 289a. Nonideal solutions, systematic deduction of the thermodynamic solution laws, chemical affinity and standard free energy, charged components, electrochemical potential, electric potential, electromotive force, galvanic cells, without liquid junction.
   3 units, winter, (Koenig), T 8, Th 8-10

289c. Chemical Thermodynamics—Continuation of 289b. Galvanic cells with liquid junction, pH, gravitational field, radiation, irreversible processes.
   3 units, spring, (Koenig), T 8, Th 8-10

297. Physical and Inorganic Chemistry Seminar—Attendance is required of all graduate students majoring in physical or inorganic chemistry.
   No credit, autumn, winter, and spring, (Staff), T 4

300. Department Seminar—Attendance is required of all graduate students, and all undergraduates registered for Chemistry 190.
   No credit, autumn, winter, and spring, (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 Ferdinand Fränkel, Raymond Davis Harriman (Professors)

Executive Head: Brooks Otis
Professors: Brooks Otis, Lionel Pearson, Antony E. Raubitschek
Associate Professor: Edwin Marshall Good (Religion and Hebrew)
Assistant Professors: Charles R. Beye (on leave 1963-64), Andrew Thomas Cole, Edwin Joseph Doyle
Instructor: Michael Wigodsky
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.

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 (L23, G23) or have reached an equivalent standard through work done in high school before they can be admitted to courses on the 100 level. Students interested in Greek should start at least in the winter quarter of their Sophomore year and if possible in their Freshman year.

Students interested in a Combined Major (Classics, Greek or Latin and English, Philosophy, Modern European Languages) should consult the Heads of the Departments concerned. (See below under: Programs of Study, Bachelor of Arts.) A combined major is designed to meet the needs of students with an equal interest in the two fields or in an area of study that overlaps the two fields.

GENERAL STUDIES REQUIREMENTS

The General Studies Foreign Language requirements can be fulfilled by courses in Greek, Latin, or Hebrew, the Basic requirement (for all students) by the series 1 to 23, 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).

PROGRAMS OF STUDY

Bachelor of Arts

The Degree of Bachelor of Arts in Classics may be taken either in A: Classics (Latin and Greek), or B: Latin or Greek.

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.

A: Major in Classics: Latin and Greek. Twenty-eight units in Latin courses and 28 units in Greek courses which must include: the four composition courses G105, 155, L105, 155); two further courses (in each language) at the 100 level; two courses (in each language) at the 150 level; and the two series, G171, 172, 173 and L171, 172, 173 (Histories of Greek and Latin Literature). This major is especially designed 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.

B: Major in Classics: Latin or Greek.

1. There are two types of Latin Major: the Latin Major, and the Latin Major with a related minor.

a) The Latin Major: 40 units distributed as follows: two composition courses (L105 and 155); two further Latin courses on the 100 level (L101-104):
two courses on the 150 level (L151–158); L171, 172, 173 (History of Latin Literature); H102–103 (Roman History); Humanities 61.

b) The Latin Major with a Related Minor.
The above program for the Latin Major plus a minor of 20–21 units in either Greek, French, German, Italian, Philosophy, English, or History.

2. There are two types of Greek Major: the Greek Major and the Greek Major with a related minor.

a) The Greek Major: 40 units distributed as follows: two composition courses (G105 and 155); at least two further Greek courses on the 100 level; two courses on the 150 level; G171, 172, 173 (History of Greek Literature); H102–103 (Greek History); Humanities 61.

b) The Greek Major with a Related Minor:
The above program for the Greek Major plus a minor of 20–21 units in either Latin, French, German, Italian, Philosophy, English, 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. (See preceding page.)

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)."

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 or essay.
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 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.

**Master of Arts (Three-Year Program)**

In addition to the regular major programs, the Department of Modern European Languages offers, with the support of the Ford Foundation, a special three-year Master of Arts program especially designed to prepare college teachers of Classics (Latin or Greek) and Classical civilization. Highly qualified students begin this program at the beginning of their junior year and continue for eleven consecutive quarters. One of these quarters is spent abroad in Italy and Greece. For information regarding eligibility, admission to the program, and special scholarships write to Professor Daniel D. McCluney, Jr., Program Director, Three-Year Master's Degree Program, Office of the Dean, Graduate Division, Stanford University, Stanford, California.

**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 of 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) A reading examination in French and German. Candidates should prepare themselves to take this examination by the end of their first year of graduate study if possible.
   b) An examination in translation into English from Latin and Greek authors included in an approved list (drawn up by the Department and obtainable from the department secretary). This examination will be set in each autumn quarter, and is expected to be taken after one full year of graduate study.
   c) An examination in Latin and Greek composition to be taken in the candidate's second year or earlier.
   d) An examination in four classical authors (two Latin, two Greek), selected by the Department each year. (The authors for 1963–64 will be: Cicero, Virgil, Thucydides, Sophocles.) This examination will be set each spring quarter and candidates are expected to be prepared for it in their second year of study unless special arrangements are made to take it later.
   e) An oral examination on his Dissertation and on one or more special topics (approved by the Department) such as selected periods of Greek or Roman History, Archaeology, Philosophy, Epigraphy, or Palaeography. Candidates should be ready for the examination in the spring quarter of their third year.

3. Each candidate (not later than the end of the quarter in which he takes his Examination in the Four Authors) 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 or knowledge and should be written in an acceptable style. All theses must be written in English.

Graduate Minors

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. G or L171–173 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.

I. COURSES IN GREEK

FIRST- AND SECOND-YEAR COURSES

The General Studies language requirement may be met by completing G23 or G101. Students may complete the work of the first year by taking either G1, 2 and 3, or 1a and 1b. Students must complete G23 or the equivalent before enrolling for G101.

The following table shows the sequence of first- and second-year courses offered each year:

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<tr>
<th>Autumn</th>
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<td>G22</td>
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#G1. First-Year Greek—For beginners.
4 units, autumn, (Doyle), TWThF 10

#G2. First-Year Greek—Continuation of G1.
4 units, winter, (Doyle), TWThF 10

#G3. First-Year Greek—Continuation of G2.
4 units, spring, (Doyle), TWThF 10

#G1a. First-Year Greek.
5 units, winter, (———), MTWThF 1:15

#G1b. First-Year Greek—Continuation of G1a.
5 units, spring, (———), MTWThF 1:15

#G22. Second-Year Greek—Attic Prose.
4 units, autumn, (Pearson, Otis), TWThF 10 or 1:15

4 units, winter, (———), MTWTh 1:15

1 or 2 units, by arrangement

G100. Homer: Odyssey.
4 units, spring, (Otis), MTWF 10

#G101. Tragedy—One play of Euripides.
3 to 4 units, autumn, (———), MWF 9 or by arrangement
#G102. Tragedy—One play of Sophocles.
3 to 4 units, winter, (———), MWF 9 or by arrangement

#G103. Plato: Phaedo.
3 to 4 units, spring, (———), MWF 9 or by arrangement

G104. Tragedy—One play of Aeschylus.
3 to 4 units, spring, (———), MWF 9 or by arrangement

G105. Composition (elementary).
2 units, autumn, (———), by arrangement

Third-Year Courses

3 to 4 units, autumn, (———), by arrangement, to be given in 1964–65

G152. Plato: the Republic.
3 to 4 units, winter, (———), by arrangement

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

G155. Composition (advanced)
2 units, winter and spring, (Pearson), by arrangement

G156. Aristophanes.
3 to 4 units, autumn, (———), by arrangement, to be given in 1964–65

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

G158. Thucydides.
3 to 4 units, spring, (———), by arrangement, to be given in 1964–65

G160. Individual Work.
By arrangement

Courses for Undergraduate and Graduate Students

G171. History of Greek Literature (Epic and Lyric).
5 to 7 units, autumn, (Otis)

G172. History of Greek Literature (Comedy, Tragedy).
5 to 7 units, winter, (———)

G173. History of Greek Literature (Fifth and Fourth Century Prose).
5 to 7 units, spring, (———)

See also Classical Courses (Latin and Greek) listed after Hebrew (III)

Graduate Courses

G201. Pindar.
By arrangement, to be given in 1964–65

G203. Aristotle (Politics or Ethics).
3 to 4 units, spring, (Pearson), by arrangement

G205. Composition for Graduates.
By arrangement

G208. Sophocles.
3 to 4 units, autumn

G213. Individual Work.
By arrangement

G215. Thucydides.
3 to 4 units, winter, (Pearson), by arrangement

G216–217. Seminar—Subject to be announced.
3 to 4 units, winter and spring, (———), by arrangement

II. COURSES IN LATIN

The General Studies language requirement may be met by completing L23 or L101. A placement test will be given to determine with which course a student should begin. It is generally expected that students who have taken two years of high school Latin will be able to start with L3 or L22; those with three years, with L22 or L23; students with four years of high school Latin may complete requirements by taking L23 or one more advanced course.

The following table shows the sequence of first- and second-year courses offered each year:

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FIRST- AND SECOND-YEAR COURSES

#L1. First-Year Latin—For beginners (see also L5).
4 units, autumn, (———), TWThF 8

#L2. First-Year Latin—Continuation of L1.
4 units, winter, (———), TWThF 8

#L3. First-Year Latin—Continuation of L2 or equivalent.
4 units, spring, (———), TWThF 8 or by arrangement

L5. Accelerated Course in Elementary Latin—Intended especially for Graduate students in other departments or Juniors and Seniors with consent of instructor.
5 units, winter, (———), MTWThF 1

L6. Accelerated Course in Elementary Latin—Continuation of L5.
5 units, spring, (———), MTWThF 1

#L22. Second-Year Latin—Continuation of L3 or equivalent.
3 units, autumn, (———), MWF 1

#L23. Second-Year Latin—Continuation of L22 or equivalent. Virgil: Selections from the Aeneid VII–XII.
3 units, autumn and winter, (———), MWF 1

#101. Introduction to Latin Prose Literature.
3 to 4 units, autumn, winter, and spring, (——— ————), MWF 9 or by arrangement

#L102. Horace, Odes.
3 to 4 units, winter, (———), MWF 9 or by arrangement

#L103. Ovid.
3 to 4 units, spring, (———), MWF 9 or by arrangement

L104. Livy.
3 to 4 units, (———), by arrangement

L105. Composition.
2 units, autumn, (Pearson), by arrangement

#L106. Catullus.
3 to 4 units, spring, (Otis), MWF 11 or by arrangement

THIRD-YEAR COURSES

#L151. Lucretius.
3 to 4 units, autumn, (———), by arrangement, to be given in 1964–65

L152. Virgil, Eclogues.
3 to 4 units, autumn, (———) MWF 11 or by arrangement

L153. Virgil, Georgics.
3 to 4 units, winter, (———) MWF 11 or by arrangement
3 to 4 units, spring, (———), MWF 11 or by arrangement

L155. Composition, Advanced.
2 units, winter and spring, (———), by arrangement

L156. Satire.
3 to 4 units, spring, (———), to be given in 1964-65

3 to 4 units, winter and spring, (———), by arrangement, to be given in 1964-65

L160. Individual Work.
By arrangement

L170. Teachers’ Course.
3 units, by arrangement, to be given in 1964-65

Courses for Undergraduate and Graduate Students

L171. History of Latin Literature (Republican).
5 to 7 units, autumn, (———), by arrangement

5 to 7 units, winter, (———), by arrangement

L173. History of Latin Literature (Silver Age).
5 to 7 units, spring, (———), by arrangement

Graduate Courses

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

L202. Ovid.
3 to 4 units, autumn, (Otis), by arrangement, to be given in 1964-65

L205. Latin—Prose composition for graduates.
3 units, autumn, (———), by arrangement

L213. Individual Work.
By arrangement

Winter and spring, (Pearson), by arrangement

Autumn and winter, (Otis), by arrangement


III. COURSES IN HEBREW

#HE1. First-Year Hebrew—Introduction to classical Hebrew language, emphasizing reading ability in various styles as found in the Hebrew Bible.
4 units, autumn, (Good), TWThF 11

#HE2. First-Year Hebrew—Continuation of HE1
3 units, winter, (Good), MWF 11

#HE3. First-Year Hebrew—Continuation of HE2.
3 units, spring, (Good), MWF 11

#HE22. 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, autumn, (Staff), by arrangement

4 units, winter, (Staff), by arrangement

4 units, spring, (Good), by arrangement
IV. COURSES IN GREEK AND ROMAN AUTHORS IN TRANSLATION

*T160. The Classical Epic (in Translation)—A study of the epic in respect to structure, character, theme, and imagery.
  3 units, spring, (———), MWF 2

*T170. Tragedy (in Translation)
  3 units, spring, (———), MWF 2, to be given in 1964–65.

See also Senior Colloquia and Humanities 61.

V. COURSES IN ANCIENT HISTORY

The following courses form a sequence, as a general survey of the Greek and Roman world, but they may be taken separately. Prerequisite: History 1, or equivalent.

H100. Greek History: The City States.
  4 to 5 units, autumn, (———), MTWTh 2, to be given in 1964–65

  4 to 5 units, winter, (———), MTWTh 2, to be given in 1964–65

H102. The Roman Republic.
  4 units, autumn, (———), MTWTh 2

H103. The Roman Empire.
  4 units, winter, (———), MTWTh 2

  4 to 5 units, spring, (———), MTWTh 2

For more advanced students—especially majors and graduate students in Classics or History—work will be offered on an individual basis:

H200. Independent Reading in Greek History.
  3 or more units, spring, (———), by arrangement

H205. Independent Reading in Roman History.
  3 or more units, spring, (Pearson), by arrangement

VI. COURSES IN GREEK ARCHAEOLOGY

These will be announced in autumn, 1963.

COMMUNICATION

Emeritus: Chilton R. Bush (Professor)

Executive Head: Clifford Francis Weigle
Associate Executive Head, Broadcasting and Film: Stanley T. Donner
Director, Institute for Communication Research: Wilbur Schramm
Professors: Stanley T. Donner, Nathan Maccoby, Wilbur Schramm, Clifford Francis Weigle. Consulting: Grant Fairbanks
Associate Professor: James Everett Brinton. Visiting: William L. Rivers
Assistant Professor and Research Associate in the Institute for Communication Research: Richard F. Carter
Assistant Professors: Richard Rees Fagen, Edwin B. Parker. Acting: John David Lewis
Instructor: Henry S. Breitrose
Lecturers: 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, film, and communication research.
The main objectives of the curriculum are to equip the student with an adequate set of professional values; to provide a broad program in the social and humanistic studies; and to present courses in the processes and effects of communication.

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 while he is in college 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 graduate students should write to: Executive Head, Department of Communication, Stanford University, Stanford, California.

Prospective undergraduate students should write the Office of Admissions.

PROGRAMS OF STUDY

Bachelor of Arts

Two Bachelor of Arts degree programs are available, 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.
2a. Broadcasting and Film Division: Communication 100a, b, and c, 105a, b, and c, and 110a or b or c, 112, 113, 114, 141 or 142, 180.
2b. Journalism Division: Twenty-five to thirty units in communication of which the following courses are required: 50, 51, 103, 107, 112, and 140. In addition, the student preparing for newspaper or press association editorial work will take Communication 109, 169 and 175; 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 109, 150 and 169.
3. 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.

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 "3" above.

Majors in Communication may elect one of the following interdisciplinary honors programs:

- Behavioral Sciences (Honors Program 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 communications 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: Journalism Division

The Department will recommend to the University Committee on the Graduate Division for the degree of Master of Arts students who have completed the following:

1. A unified program of not less than 30 units, selected from one or more of the departments listed above under requirements for the degree of Bachelor of Arts.
2. Approximately 40 units in communication, of which three shall be graduate courses, and shall include Courses 211 or 220; courses taken at the undergraduate level count toward these requirements.
3. Either an acceptable thesis or the methodological courses (217, 218, and 219, and Psychology 60). The Department decides this option after evaluating the student's preparation. Most students will be held for the thesis requirement.

The candidate must complete approximately 45 units in graduate residence at Stanford and must earn an average grade of B on his entire program of study during the graduate year.

Candidates for the degree of Master of Arts entering the Department from another institution, or from Stanford with the Bachelor's degree in a subject other than communication, will follow individually arranged programs of study. In planning such programs the following factors will be taken into account: (1) previous training in the social sciences; (2) previous academic training in communication and journalism; and (3) professional journalistic experience. Where the student's previous work in the social sciences and in journalism has been limited, the requirements for the degree cannot be met in three quarters of residence.

Master of Arts: Broadcasting and Film Division

Admission to graduate study is granted by a faculty committee on the basis of undergraduate academic record, recommendations and test scores on the Graduate Record Examination or the Miller Analogies Test.

Admission to candidacy is granted by the University Committee on the Graduate Division on the basis of a formal application approved in writing by the Department. Upon securing from the Department the approval of his program and thesis subject, the student should file an application for admission to candidacy with the University Committee. This application must be filed not later than the fourth week of the quarter preceding that in which the candidate expects to receive his degree.

Requirements for the Degree—Candidates for the degree of Master of Arts must present a minimum of 50 units of graduate work and must spend at least one year
in full-time residence study. Of these units, not less than 4 nor more than 6 may be
devoted to a thesis or project. This program may include course work offered in
other departments of the University. Students are required to maintain a satisfactory
scholastic rating in all course work. Candidates are normally required to include a
minor program consisting of at least 12 units. These 12 units are included in the 50
required units of graduate work. Courses required of a candidate because of defi-
cencies in undergraduate preparation may not be used in satisfying the requirement
of 50 units of advanced work.

Thesis or Project—The thesis or research project must be carried on under the
direction of a member of the faculty of the Department of Communication. The final
draft must be submitted three weeks prior to the end of the quarter in which the de-
gree is expected. After acceptance by the Department, four copies of the thesis or
project must be presented for acceptance by the University Committee on the Grad-
uate Division.

Internship—Upon completion of the academic requirements for the degree, each
candidate is required to spend an internship of approximately three months in a
professional radio or television station, film production unit, or a related organization
approved by the Department.

The Ph.D. Degree in Mass Communications Research

Unusually well-qualified students who wish to become candidates for the Ph.D.
degree in Mass Communications Research may present, through the Department of
Communication in co-operation with appropriate other departments, a well-defined
program to the University Committee on the Graduate Division and petition to be-
come candidates for the degree. (See “Graduate Division Special Programs.”)

This program, which is designed to train students for research in communication,
includes sequential courses in communication theory and communication research
methods; courses in the media, as well as courses in several of the departments which
offer work in statistics, learning, perception, social psychology, personality theory,
social organization, social structure, and the methodology of the behavioral sciences.

The Department of Communication sponsors for this degree only those applicants
who present a superior academic record and who have demonstrated that they have
the motivation for completing a program of this nature. The applicant is first ac-
cepted for admission to the University by the Department. In his first two quarters
of residence he must achieve a superior record in the courses taken with sponsoring
professors in the several departments. After he has done this he may request those
professors to recommend him to the University Committee on the Graduate Division,
first for permission to pursue study toward such a degree, and later for admission to
candidacy for the degree.

Other programs leading toward the Ph.D. and involving communication may be
pursued in the Graduate Division Special Program. This program is designed for
students whose plans for the Ph.D. degree do not fall within the province of any one
department. Such programs are individually planned for unusually well-qualified
students.

The Institute for Communication Research

The Institute for Communication Research operates as an office of project re-
search for the faculties of the Department of Communication and other departments
on grants from foundations, communication media, and other agencies, on govern-
ment 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 psy-
chology and sociology, including training in statistics and research methodology),
and training for or experience with the mass media.
COURSES OPEN TO UNDERGRADUATES AND GRADUATES

I. General

112. Communication and Society — An introductory survey of the structure, functions, philosophy, process, and effects of mass and interpersonal communication in modern society. Taught from a behavioral science perspective. Open to non-majors. (Graduate students must register for Communication 220.)

5 units, autumn, (Donner, Parker), MTW 10 and section

156. Media Management—Principles of business operation of newspapers, magazines, radio-TV; emphasis on revenue factors. Nonmajor students require consent of instructor.

3 units, spring, (Brinton), by arrangement

199. Individual Work—Major students with high academic standing are permitted to undertake individual work.

1 to 2 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 nonmajors.

3 units, autumn or spring, (Rivers), 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 nonmajors. Prerequisite: Typing skill of 35 words per minute (may be met by taking Typing 1).

1 unit, autumn or spring, (Rivers), by arrangement


3 units, winter, (Brinton), TTh 9; lab. by arrangement


3 units, winter, (Weigle), MW 9; lab. by arrangement

109. Editorial Techniques III—Advanced news writing for newspapers, radio-TV. Prerequisites: 50-51, junior standing. Majors only. Conducted in co-operation with the Palo Alto Times.

2 units, spring, (Brinton), by arrangement

115. Advertising I—Fundamentals of marketing, consumer research, media, copy, layout. Open to nonmajors.

3 units, autumn, (Brinton), MWF 11


3 units, winter, (Brinton), MWF 11

140. History of Anglo-American Journalism—Open to nonmajors.

3 units, autumn, (Weigle), TTh 9

4 units, summer, (———), by arrangement

150. Forms of Journalistic Writing—Practice in writing magazine articles, with emphasis on marketing manuscripts. Conferences. Prerequisites: senior standing and 50-51 or consent of instructor.

3 units, autumn, (Rivers), TTh 11

or 4 units, summer, (———), TTh 10

152. Magazine Editorial Techniques — Planning, writing, production studied
with local magazine editors, correspondents; industrial editing. Prerequisite: 150, consent of instructor.

3 units, spring, (Rivers), by arrangement

169. Legal Aspects of Journalism—Libel, contempt, constitutional guaranties, privacy, copyright, inspection of public records.

3 units, winter, (Fagen), TTh 9

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, winter, (Rivers), MWF 10

Practice Courses

121. Advanced Practice — Practice work in executive positions on editorial or business staff of The Stanford Daily; 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, spring, (Weigle), by arrangement


III. Broadcasting and Film

100. Theory of Broadcasting and Film — Approaches to radio, television, and film as media of communication, art, and commerce. Background and nature of the organization and processes of broadcasting and film.

100a. Broadcasting I.

3 units, winter, (Lewis), MWF 9

100b. Broadcasting II.

3 units, spring, (Lewis), MWF 10

100c. Film.

4 units, autumn, (Breitrose), MWF 9

105. Practice in Broadcasting and Film—Actual production and direction of various forms in radio, television, and film, respectively. Complete production facilities are used in each medium.

105a. Radio.

4 units, autumn, (Lewis), TTh 1-3

105b. Television.

4 units, winter, (Lewis), TTh 1-3

105c. Film.

4 units, autumn, (Breitrose), MW 2-4

110. Experiment in Broadcasting and Film—Experimental approaches to content, forms, methods, and techniques in these constantly evolving media. Complete production facilities are used in each medium. Prerequisite: the appropriate course from the 105 series, or equivalent.

110a. Radio.

3 units, winter, (Lewis), T 10-11 and Th 10-12

110b. Television.

3 units, spring, (Lewis), T 1-2 and Th 1-3

110c. Film.

3 units, winter, (Breitrose), T 10-11 and Th 10-12
113. Writing for Broadcasting—Writing of nondramatic forms for broadcast, including news, educational programs, music continuity, and documentary. To be taken concurrently with Communication 114.

2 units, autumn, (Lewis), MWF 11

114. Broadcast Journalism Laboratory—Procedures of the broadcast newsroom. Use of radio and film techniques for features and documentaries. Practice in KZSU newsroom. To be taken concurrently with Communication 113.

1 unit, autumn, (Lewis), by arrangement

123. Advanced Writing for Broadcasting—Study and analysis of dramatic, documentary, and informational programs for television. Practice and criticism in the writing of these forms.

4 units, spring, (Lewis), MW 2-4

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 to be announced in class.

4 units, spring, (Breitrose), MWF 9; lab. by arrangement

142. History of Broadcasting—Studies in the development of broadcasting as communication.

4 units, winter, (Donner), 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. Pre-requisite: consent of instructor.

3 units, spring, (Donner), MWF 11

Summer Radio-Television-Film Institute

R200. Mass Communications in the United States—A survey lecture course on the nature and social responsibilities of the media, the structure of the industry, problems of regulation, management, educational and commercial interests, and social effects of the mass media. Guest speakers from the industry and related fields. Required of all students. (Same as Communication 220.)

4 units, summer, (Staff and Guest Lecturers), by arrangement

R201. Educational Television Station Operation—A course taught in the studios of KQED for advanced students who wish to learn the philosophy, the origination, the planning, the coordination, and finally the production of noncommercial television programs. The course work will include on-the-air telecasts. Limited to 20 students. (Same as Education 341s; see Summer Session Bulletin.)

3 units, summer, (KQED Staff), by arrangement

R203. Teaching by Television—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, with emphasis upon programs prepared for in-school viewing. (Same as Education 342s; see Summer Session Bulletin.)

3 units, summer, (Staff), by arrangement

R204. Modern Broadcasting—The resurgence in radio broadcasting demonstrated through current programming in AM and FM, the influence of electronic developments, integration of sales and programming, studio techniques and the world-wide influence of international broadcasting. Career opportunities will be presented and a student-developed program will be broadcast over KNBR. Must be taken concurrently with R204a.

2 units, summer, (Staff), by arrangement

R204a. 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. Required
for students enrolled in R204. Recommended for all students. (May be taken separately from R204 for 1 to 2 units.)

1 unit, summer, (Staff), by arrangement

R205. Film Production—A course in the theory and techniques of film production. Individual student productions from script to release print. Cameras, lighting, sound editing. Limited to 20 students. (Students with prior work in film production may register for Communication 299, Advanced Individual Work, 1 to 4 units, with the consent of the instructor.)

4 units, summer, (Staff), by arrangement

R207. Radio and Television Writing—Theory and practice in writing for radio and television. Special emphasis is on documentaries, variety, educational, informational, and similar non-dramatic forms. Student scripts may be used for broadcast on KZSU and KNBR as well as providing material for television productions in R214.

3 units, summer, (Staff), by arrangement

R209. Radio and Television News—A practical course to train students for work in the radio and television newsroom; the selection, rewriting, editing and reporting of news for broadcast and TV newsfilm; production of feature material and special events broadcasts.

3 units, summer, (KNBR Staff), by arrangement

R211. Commercial Programming and Station Management—All aspects of organization, management, sales, and programming are combined to provide a thorough understanding of the problems facing management. Special consideration is given to program planning and scheduling. Lecture and demonstration including remote pickups. Limited to advanced students.

3 units, (KPIX Staff), by arrangement

R214. Television Production—Practice in directing, production and performance of selected commercials, interviews, public affairs programs in KPIX studios. Student productions will be video taped for evaluation and criticism. Consideration of design as it relates to all things that come before the cameras.

3 units, summer, (KPIX Staff), by arrangement

COURSES PRIMARILY FOR GRADUATES

211. Theory of Communication I—Theory, structure, and effects of mass communication. Analysis of the literature.

5 units, autumn, (Schramm), M 2-4 and additional meetings by arrangement


5 units, winter, (Maccoby), MW 2-4


5 units, spring, (Parker), M 2-4 and additional meetings by arrangement

215. Behavioral Science in Broadcasting and Film—A comprehensive survey of the contribution of behavioral science theory and research to radio, television, and film. Methods and findings of behavioral science research on effects of forms and contents of audio-visual communication on audience learning of skills, information, and attitudes. For A.M. candidates primarily.

3 to 5 units, autumn, (Maccoby, Donner), Th 7-10 p.m.

217, 218, 219. Communication Research Methods I, II, III—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 prep-
aration. Prerequisite: previous or concurrent registration in elementary statistics.

4 units, autumn, winter, and spring, (Maccoby, Carter, Parker, Brinton), TTh 2-4

220. Communication and Society—See Communication 112.

5 units, autumn, (Parker), MTW 10 and section

222. Introduction to Media Research—Substantive aspects of recent investigations of audiences, communicators, content, and control; some attention to method. Open to advanced undergraduates.

4 units, autumn, (Brinton), TTh 10

230. Advertising and Media Research—Procedures for advertising and media research, audience measurement, and consumer analysis. Prerequisite: consent of instructor.

3 units, spring, (Brinton), F 2-4

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, spring, (Schramm, Fagen), M 2-4

260. Content Analysis—The method of frequency, contingency, and qualitative analysis of texts.

3 units, autumn, (Carter), W 2-4

275. Attitude Measurement.

3 units, winter, (Carter), by arrangement

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.

(Staff), by arrangement

309. Directed Graduate Research—Research in connection with a staff project, in lieu of Master's thesis.

(Staff), by arrangement

310. Proseminar in Broadcasting and Film—Introduction to various types of bibliographical research and research methods in radio, television, and film, through study of selected problems. Required of all graduate students in broadcasting and film.

4 units, winter, (Donner), by arrangement

311. Seminar in Broadcasting and Film—Directed studies in areas of bibliographical research and program analysis, production problems, and effects of these media on society. Required of all graduate students in broadcasting and film.

4 units, spring, (Donner), by arrangement

312. Seminar in Film History and Criticism—Studies in the theory, history, and criticism of film, with emphasis on significant film makers and movements, as well as on recently developed research methodologies in these areas.

4 units, winter, (Breitrose), by arrangement

ECONOMICS


Executive Head: ———

Professors: Moses Abramovitz, Kenneth Joseph Arrow (on leave 1963-64), Paul Alexander Baran, Hollis Burnley Chenery, Emile Despres, John Grey Gurley,
Marc Nerlove (on leave 1963–64), Melvin Warren Reder, Edward Stone Shaw, Lorie Tarshis

**Professors, Food Research Institute:** Karl Brandt, Helen Cherington Farnsworth, Roger W. Gray, Richard J. Hammond, Bruce F. Johnston, William Orville Jones, S. Daniel Neumark, E. Louise Peffer, Vernon D. Wickizer

**Professor, Graduate School of Business:** Alan S. Manne (on leave 1963–64)

**Associate Professor:** Hirofumi Uzawa

**Assistant Professors:** Richard Eugene Attiyeh, Paul Allan David, Paul Theodore Hartman, Ronald Ian McKinnon, Roy Emerson Murphy, Jr., Earl Albert Thompson

**Director of Undergraduate Study:** Paul Theodore Hartman

**Director of Graduate Study:** Paul Alexander Baran

**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 sound 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.

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 the curriculum of the Food Research Institute.
   a) Economics 1, 5, 10, 111 and 120 or their equivalent shall be included in the 45 units. All of these should be completed by the end of the junior year except for Economics 120.
   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 re-
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 25 units of courses numbered 100 or above, of which 20 must be taken at Stanford, shall be included in the 45 units.

2. An average grade of C or better shall have been received for all course units completed at Stanford in economics and the curriculum of the Food Research Institute, 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 not more than two of the following subjects: law courses open to undergraduates, cultural anthropology, history, industrial engineering, mathematics (including courses in differential and integral calculus numbered below 100 for which partial credit is given) and statistics, 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 3.0 in all courses at the University, excluding the last quarter.
2. The student must have received a grade-point average of at least 3.0 in all economics courses at Stanford.
3. The student must present a minimum of 55 units in economics and the curriculum of the Food Research Institute, including.
   a) The Junior Honors Seminar in Economics
   b) Two Senior Seminars in Economics
4. Candidates for admission to the Honors Program should apply to the Director of Undergraduate Study during the first or second quarter of their junior year. In any case, such application must be made by the beginning of the third quarter of the junior year. (In exceptional cases, the Director of Undergraduate Study for the Economics Department may admit students to the Honors Program at the beginning of the senior year.)

Quantitative Methods—Students who are preparing for professional careers as economists, statisticians, or accountants are advised to register for courses in mathematics through elementary differential and integral calculus. Among the courses of instruction which make use of mathematics are Economics 6, 9, 108, and 172, and Statistics 116 and 119 (which may be taken for economics credit).

Qualified students are urged to enter the Honors Program in Quantitative Methods in the Behavioral Sciences, the details of which are given elsewhere in this Bulletin, under the heading Behavioral Sciences (Honors Program). Among the requirements are three courses designated by the Economics Department; these are 6, 9, and 108. Completion of this Honors Program automatically implies satisfaction of the degree requirements of 25 units in two outside fields.

A student may, of course, qualify for both departmental honors and honors in Quantitative Methods in the Behavioral Sciences.

Advanced Degrees

The members of the Department of Economics, with the assistance of certain members of allied departments, undertake to supervise a wide range of individual
advanced study and research to supplement instruction that is offered in courses listed below. All candidates for advanced degrees are urged to schedule their entire program of study with the Director of Graduate Study as early as possible.

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:

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 discussed 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 comprehensive written examinations, given at the close of spring quarter, for the two course sequences Economics 203, 204 and Economics 210, 211, 212.

2. The student must have completed the University foreign language requirement for the degree by:

   a) Passing satisfactorily, during either undergraduate or graduate training, a second-year reading course equivalent to French 23, German 23, etc., or by
   b) Passing a special reading examination to be scheduled once annually by the Department of Economics.

The student's selection of a foreign language must be approved by the departmental Director of Graduate Study. The minimum language requirement may be increased for students whose Ph.D. dissertations are concerned with foreign economic systems or involve a familiarity with literature in a foreign language.
3. The student must have completed a course in the calculus equivalent to Mathematics 63, with grade of C or better.

Recommendation for the Degree—Before being recommended for the degree of Doctor of Philosophy in economics, the student must have completed the following stages of preparation:

1. Qualification in six fields of study (if no minor subject is offered) or in three fields of study (with a minor subject). In either case, Price and Allocation Theory (203, 204) and Money, Income, and Employment (210, 211, 212) will constitute two of the fields. The remaining fields will be chosen according to the following options:

   Option A—Without a minor subject
   a) Economic Development and Comparative Systems (215, 216, 217) is required.
   b) Three other fields of economics are to be chosen from the following: Public Finance, Labor Problems, Economics of Industry, International Economics, Economic Statistics, Econometrics, and any two of the fields in Food Research. The preparation required will be determined by the professor in charge of each field and will consist of two courses at the 200 level or their equivalent. (In case of scheduling difficulties, a reading course may be substituted for one of the courses.) An approved program of 20 units in subjects other than economics may be substituted for one field.

   Option B—With a minor subject
   a) Economic Development and Comparative Systems (215, 216, 217) or Economic Statistics (270, 271, 272) is required, except that students minoring in statistics must select Economic History and Development.
   b) A minor subject, the requirements for which are determined by the department concerned.

   For students who elect either option, there will be comprehensive Departmental written examinations in all elected fields of study in economics. The examinations for sequences in Price and Allocation Theory (203, 204) and Money, Income and Employment (210, 211, 212) will be given at the close of spring quarter in each academic year. During the spring quarter, dates will be announced for comprehensive examinations during the succeeding academic year for all other fields in economics. Normally the comprehensive examination in any field will be offered once annually. The examination will be based on the sequence of courses, at the 200 level, that is specified for the field. The standard of qualification in each field will be minimally a grade of B in the comprehensive examination.

2. Qualification in background subjects:
   a) Economic Statistics and Quantitative Analysis equivalent to 170 and 171 (for those who do not elect Economic Statistics as a field).
   b) The History of Economic Thought (201), except for students electing Option B.
   c) Accountancy (equivalent to 290).

   Each of these requirements may be satisfied by passing, with minimal grade of B, the final examination in each course cited above.

3. Training in independent research. Participation in three seminars (at the 300 level) in at least two fields, and preparation of satisfactory papers in each. Workshop fellows may satisfy this requirement by successful participation in a Workshop for one year and taking one seminar but in another field.

4. Satisfactory performance in the University oral examination. Except in special cases, the first three 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.

5. Completion of the dissertation in form satisfactory both to the Departmental committee and to a committee appointed by the University. Students are urged to complete the first three stages of preparation in a maximum of two years, with no comprehensive examinations scheduled later than the first quarter of the third year, so that the dissertation may be virtually finished during graduate residence.

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 Money, Income, and Employment. 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 in their amounts from about $1200 to $3000. Completed application forms for graduate fellowships should be filed before February 8 at the Office of Financial Aids, at the same time as completed application forms for admission are filed with the Admissions Office.

For students in their second and third year of study a limited number of appointments as Workshop Fellows in selected fields are available. Workshops now in operation focus on Economic Development, Topics in Macro-economics, Quantitative Methods in Resource Allocation. In each workshop a small group of selected second- and third-year graduate students pursue independent research, closely supervised by professors expert in the field. This research normally culminates in a doctoral dissertation.

Opportunities for employment as research assistants are also available to competent graduate students. 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 $2000 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.

Applicants for workshop fellowships, research assistantships and teaching assistantships should, besides their applications to the Office of Financial Awards, address a specific request to the Executive Head of the Department not later than February 8.

COURSES

Note—Food Research Institute courses which count as economics are shown below. For details see the section on the Institute.

Courses: 103,105,160,170,203,205,212,232,250,275
Seminars: 260,261,270,303,305,350
Directed Reading and Research: 371,372,373,374
Advanced Directed Reading and Research: 401,402,403,404

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 1963-64.

#1. **Elementary Economics**—Introduction to, survey of economics. Prerequisite: sophomore standing, or third-semester freshmen with B average.

- 5 units, autumn, winter, or spring, (Staff), MTWThF
- or 4 units, summer, (Staff), MTWThF

5. **Price Theory and Policy**—Function of price system; determination of prices, outputs in different market structures; public policy. Prerequisite: 1 or equivalent. (May be taken as 105 by graduate students.)

- 5 units autumn or winter, (Staff), MTWThF
- or 4 units, summer, (Staff), MTWThF

6. **Price Theory and Policy**—Content same as Economics 5 but use will be made of mathematical tools in presentation. Prerequisites: 1 or equivalent and Mathematics 62 or equivalent. (May be taken as 106 by graduate students.)

- 5 units, spring, (Staff), MTWThF

7. **Introduction to Statistics**—Especially designed for students of economics, sociology and other social sciences. (Same as Statistics 7.)

- 5 units, autumn, (Olkin), MTWThF

9. **Income and Employment**—Content same as Economics 10 but use will be made of mathematical tools in presentation. Prerequisite: 1 or equivalent and Mathematics 41 or equivalent. (May be taken as 109 by graduate students.)

- 5 units, winter, (Staff), MTWThF

10. **Income and Employment**—National income accounts; the determination of income, employment, prices. Prerequisite: 1 or equivalent. (May be taken as 110 by graduate students.)

- 5 units, autumn or winter, (Staff), MTWThF

90, 91. **Elements of Accounts**—Theory, practice of enterprise accounting, including an introduction to both financial and cost accounting. Students who have taken or are taking a university course in elementary accounting may not take these courses for credit. 90 is prerequisite for 91. Freshmen may enroll.

- 90. 5 units, autumn or winter, (Staff), MTWThF
- 91. 5 units, spring, (Staff), MTWThF

100. **Early Economic Doctrine**—The development of early economic thought, with particular attention to English classical economics, and its counterpart in other Western countries, in the period 1776-1850. Prerequisites: 5 and 10. (Same as 200.)

- 5 units, winter, (Baran, Usawa), MTWThF

102. **Price and Allocation Theory I**—Same as 202. Open to advanced undergraduates with consent of instructor.

105. **Price Theory and Policy**—See Economics 5.


108. **Intermediate Mathematical Economics**—The special topic for 1963-64 will be capital allocation and investment, mathematical analysis of the factors determining the optimum allocation of capital in financial and productive enterprises. Applications to specific problems concerning optimum portfolios, liquidity, and product diversification in the firm. Prerequisites: 6, 9.

- 5 units, (Murphy), MTWThF


111. **Income, Employment, and Money**—National income analysis; emphasis on role of financial institutions. Prerequisites: 5 and 10.

- 5 units, autumn or winter, (Staff), MTWThF


- 5 units, spring, (Staff), MTWThF
115. Economic History of Europe—Forces involved in emergence of modern capitalism. General economic development of Europe from sixteenth century to present. Prerequisite: 1 or equivalent.

5 units, spring, (Staff), MTWThF

117. Economic History of the United States—Economic development of United States in nineteenth, twentieth centuries. Prerequisite: 1 or equivalent.

5 units, winter, (Staff), MTWThF


5 units, autumn, (Staff), MTWThF

119. Underdeveloped Economies: Case Studies—Examination and analysis of recent experience and problems of selected underdeveloped economies and of the role of foreign aid. Prerequisite: 118.

5 units, winter, (Staff), MTWThF

120. Comparative Economic Systems—Working principles, institutions of different capitalist, noncapitalist national economies. Prerequisites: 5 and 10 or consent of instructor. (It is recommended that majors take this course in their senior year.)

5 units, winter or spring, (Staff), MTWThF

122. Socialist Economics—Survey of origins, development of socialist thought; particular reference to early French, British socialists; Marx and followers; Fabians. Prerequisites: 5 and 10 or consent of instructor. (It is recommended that majors take this course in their senior year.)

5 units, winter, (Staff), MTWThF


5 units, spring, (Staff), MTWThF

141. Public Finance—Effects of government expenditure, borrowing, taxation upon allocation of resources, levels of national income, employment, prices. Prerequisites: 5 and 10.

5 units, autumn, (Staff), MTWThF

142. Taxation—Further study of taxation; particular reference to ethical aspects of taxation, concepts of taxable income, shifting and incidence of taxation. Prerequisite: 141.

5 units, winter, (Staff), MTWThF

145. Labor Economics—Analysis, description of labor force, labor markets. Impact of legislative measures, productivity changes, labor organizations upon wages, distribution of income. Prerequisite: 1 or equivalent.

5 units, autumn, (Staff), MTWThF

147. Collective Bargaining—Discussion of collective bargaining; legislation curbing collective bargaining practices; unions as social organizations; strikes and the control thereof; schemes for increasing labor participation in management.

5 units, winter, (Staff), MTWThF

154. 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: 6 and a knowledge of differential equations.

5 units, (Murphy), MTWThF

157. Economics of Industry—Factors determining structure, economic behavior of plants, firms, industries. Prerequisite: 1 or equivalent, or consent of instructor.

5 units, autumn, (Staff), MTWThF

158. Social Control of Industry—Effects of various types of business behavior
and various types of market structures; attempts to preserve competition through the enforcement of anti-trust laws; public regulation of noncompetitive sectors of the economy. Prerequisite: 5, or consent of the instructor.

5 units, spring, (Staff), MTWThF

159. Economics of Public Works—Particular emphasis on the criteria for investment and pricing decisions in public expenditure programs for natural resource development (e.g., water), public facilities (e.g., highways), and national defense. Course will include a survey of those parts of economic theory of special relevance and review some of the important attempts to apply economic analysis to particular problems in the above areas. May be taken by advanced undergraduates and graduate students.

3 to 5 units, autumn, (———), MWF


5 units, autumn or spring, (Staff), MTWThF


5 units, winter, (Staff), MTWThF

171. Introduction to Quantitative Analysis—Major problems of quantitative research in economics; relevant sources of statistical information, including national economic accounting, input-output analysis, cost and demand studies, family budget surveys. Prerequisite: 170.

5 units, spring, (Staff), MTWThF

172. Statistical Inference in Economics—(Same as 272.) Prerequisite: Statistics 119.


5 units, winter, (Staff), MTWThF

198. Junior Seminar in Economics—(Required of all Honors students.) Prerequisites: Admission to Honors Program; completion of Economics 1, 5, and 10.

5 units, winter or spring, (Staff), MTWThF

199. Senior Seminar in Economics—(Required of all Honors students.) Prerequisites: major in economics, completion of 130 units of credit, Stanford grade average of at least 3.0, or grade average of 2.5 and consent of instructor.

5 units, autumn, winter, or spring, (Staff), MTWThF

COURSES PRIMARILY FOR GRADUATE STUDENTS


401. Workshop: Topics in Macro-economics.

3 to 10 units


3 to 10 units


3 to 10 units

(For each workshop, prerequisites are one year of graduate work and consent of the instructors.)

In each group below, courses marked (*) constitute continuous courses. Registration will be accepted and grades given only for the entire sequence.

A. Price and Allocation Theory

[Professors Baran, McKinnon, Reder, Uzawa]

200. Early Economic Doctrine—The development of early economic thought,
with particular attention to English classical economics, and its counterpart in other Western countries.

5 units, winter, (Baran, Uzawa)

201. **Economic Thought since 1850**—Development of economic doctrine, principally in Western Europe, United States, in modern times.
5 units, spring or autumn, (Baran, Uzawa)

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, autumn, (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, winter, (Staff)

*204. **Price and Allocation Theory III**—Pricing of factors of production. Income distribution by size and by relative shares. Prerequisite: 203.
5 units, spring, (Staff)

205. **Advanced Topics in Price and Allocation Theory**—Reading and discussion of recent work in economic theory with special attention to periodical literature. Recommended for Ph.D. candidates. Prerequisites: 204 and Statistics 63 (or equivalent).
5 units, winter, (McKinnon)

301. **Seminar in Price and Allocation Theory**—Prerequisite: 204, and consent of instructor.
5 units, (Staff), by arrangement, to be given in 1964-65

### B. Money, Income and Employment

[Professors Abramovitz, Gurley, Shaw, Tarshis]

*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, autumn, (Tarshis)
211. 5 units, winter, (Shaw)
212. 5 units, spring, (Abramovitz)

310. **Seminar in Money, Income and Employment**—Prerequisites: 212 and consent of instructor.
5 units, (Staff), by arrangement, to be given in 1964-65

### C. Economic Development and Comparative Systems

[Professors Abramovitz, Baran, Chenery, Despres, David]

*215. **Economic Development I**—Outline of origins and development of modern capitalism. Historical study of the growth of advanced economies. Prerequisite: 10 or consent of instructor.
5 units, autumn, (Staff)

*216. **Economic Development II**—Comparative analysis of presently underdeveloped economies, the process of development, alternative theories of growth.
5 units, winter, (Staff)

*217. **Economic Development III**—Major problems of development policy. Planning, prices and market processes. Investment criteria and resource allocation, tech-
nological choices, agricultural problems, investment in social overheads, foreign trade, population and manpower.

5 units, spring, (Staff)

218. Underdeveloped Economies: Structure and Policy—Same as Economics 118, with additional reading and written paper. Designed for graduate students who are not Ph.D. candidates in economics.

219. Underdeveloped Economies: Case Studies—Same as Economics 119, with additional reading and written paper. Designed for graduate students who are not Ph.D. candidates in economics.

315. Seminar in Economic Growth of Western Europe and the United States—Prerequisite: consent of instructor.

5 units, winter (Staff), by arrangement

316. Seminar in Economic Organization and Growth of the Soviet Union and Eastern Europe—Prerequisite: consent of instructor.

5 units, spring (Baran), by arrangement

317. Seminar in Economic Development Problems of Latin America—Prerequisite: consent of instructor.

5 units, (Staff), by arrangement

318. Seminar in Economic Development Problems of South and East Asia—Prerequisite: consent of instructor.

5 units, spring, (Staff), by arrangement

319a, 319b. Seminar in Problems in American Economic History—Prerequisite: consent of instructor.

5 units, autumn or spring, (David), by arrangement

D. PUBLIC FINANCE

[Professors Arrow, Gurley]

*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. Credit will be given only for completion of both 241 and 242. Prerequisites: 204, 212.

5 units, (Gurley)

341. Seminar in Public Finance—Prerequisites: 241, consent of instructor.

5 units, spring, (Gurley)

E. ECONOMICS OF LABOR

[Professors Reder, Hartman]

*245. History of the American Labor Movement—Analytical topics from historical viewpoint. Special attention to growth patterns of specific unions, changes in leadership, and objectives of American labor. Prerequisite: consent of instructor.

5 units, spring, (Hartman), MTWThF

*246. Comparative Labor Movements—Labor forces, labor markets, trade union restrictions of Western European countries, British Commonwealth. Political behavior of unions. Prerequisite: consent of instructor.

5 units, (———)

248. Wages and Income Distribution—Wage levels, structure; income distribution, effects of education on earnings, special reference to empirical data. Prerequisite: consent of instructor.

5 units, autumn, (Reder)

249. Economics of the Professions—Study of occupational choice; incomes and costs of training in various professions; restrictions on entry and professional monopolies; social need vs. market demand for personnel as it affects occupational shortages. Special attention to medical profession. Prerequisite: consent of instructor.

5 units, spring, (Staff)
345. Seminar in Wage Theory—Prerequisite: consent of instructor.
   5 units, (Staff)

F. ECONOMICS OF INDUSTRY
[Professors Chenery, Manne]

249. Economics of the Professions—See E. Economics of Labor.

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. Prerequi-
sites: 106 and a knowledge of differential equations.
   5 units, (Murphy), MTWThF

*255, 256. The Structure of Industry—Empirical production, cost, and input-
output relationships for individual plans, firms, and interrelated sectors of the econ-
omy. Application of statistical methods, input-output analysis, and linear program-
ing. Measurement and effects of technological change. Investment and plant lo-
ocation decisions. Combination of engineering data with economic analysis.

   5 units

257. Economics of Industry—Factors determining structure, economic behavior of
plants, firms, industries. Prerequisite: 1 or equivalent, or consent of instructor.
   5 units, (Staff)

258. Social Control of Industry—Effects of various types of business behavior
and various types of market structures; attempts to preserve competition through the
enforcement of anti-trust laws; public regulation of noncompetitive sectors of the econ-
omy. Prerequisite: consent of the instructor.
   5 units, (Staff)

355. Seminar in Economics of Industry—Prerequisite: consent of in-
structor.
   5 units, (Staff), by arrangement

G. INTERNATIONAL ECONOMICS
[Professors Despres, Tarshis, McKinnon]

*265, 266. International Economics—Factors that underlie trade, policies for reg-
ulating it. Significance of international transactions for the national income; related
questions.
   5 units, winter, (Despres)
   or spring, (Tarshis)

365. Seminar in International Trade and Resource Allocation—Prerequi-
site: consent of instructor.
   5 units, spring, (McKinnon)

H. ECONOMIC STATISTICS
[Professors Arrow, Nerlove, and Statistics Department]

*270. Theory of Probability—Elementary probability theory, sampling,
   distributions. (Same as Statistics 116.) Prerequisite: working knowledge of the calculus.
   4 units, autumn, (Parzen), MTWThF 11; (———), MTWF 2:15
   or winter, (Stein), MTWF 11
   or spring, (———), MTWF 11
   or summer, (———), MTWThF 1:15

*271. Elementary Statistical Inference—Review of probability; distribution
   theory; sampling, sampling distributions; univariate, bivariate normal distribution;
correlation, regression. (Same as Statistics 119.) Prerequisite: 270.
   3 units, winter, (Lieberman), MWF 9

*272. Statistical Inference in Economics—Multiple correlation, special empha-
sis on economic applications; correlation of time series; introduction to simultaneous
equations estimation. Prerequisite: 271, Statistics 64.
   5 units, spring, (Staff), MWTh
ENGLISH

I. Econometrics
[Professors Arrow, Chenery, Nerlove, Uzawa]


*280. Quantitative Analysis in Economics—Economic interdependence in relation to statistical analysis; problems of aggregation, use of cross-section data. Prerequisites: 5, 10, 272.

5 units, (______)

285. Special Topics in Mathematical Economics—The topics for 1963-64 will be economic growth and planning. Various theories of economic growth and technical change will be discussed, together with technical aspects of economic planning. May be repeated for credit. Prerequisite: consent of instructor, working knowledge in differential calculus is required.

5 units, autumn, (Uzawa)

286. Linear Programming—Fundamentals Theorems; variations of the simplex methods; parametric programming; standard model formulations; quadratic programming; discussion of current developments. (Same as Statistics 255.)

380. Seminar in Econometrics—Prerequisite: consent of instructor.

5 units, winter, (______), to be given in 1964-65

J. Accountancy

290. Accounting and Economic Theory—Analysis of relationship of accounting theory, practice to economic theory. Prerequisite: consent of instructor.

5 units, (Staff)

ENGLISH

Emeriti: Margery Bailey, Hardin Craig, Richard Foster Jones, (Professors); Margaret Dille Hudson (Instructor)

Executive Head: Virgil Keeble Whitaker
Associate Executive Head: John Loftis


Associate Professors: Charles N. Fifer, David Levin, Thomas C. Moser, Lawrence V. Ryan, W. Wesley Trimpi, Jr.

Assistant Professors: Alfred Appel, Jr., Walter Bliss Carnochan, Howard B. Franklin, Verdel A. Kolve, Robert M. Polhemus, Fred Colson Robinson, Lucio P. Ruotolo

Instructors: S. Dale Harris, Ronald A. Rebholz

Lecturers: Blair Fuller, Edward McClanahan

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.
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.

I. Prospective English majors may profitably elect one or more of the following courses: English 25 and 76; Humanities 61.

II. All students majoring in English are required to take the following Departmental courses:

- English 102. Introduction to the English Language.
- English 141. Chaucer.
- English 143. Shakespeare.
- English 182. English Literature of the Renaissance.
- English 184. English Literature of the Nineteenth Century.

The last three courses should be taken in sequence during the junior year.

In addition to the courses listed above, the student must complete one of the following programs:

A. English Literature

The student should take a course in English history, such as History 105, before the end of his junior year.

1. One course from each of the following groups:
   a) English 142, 144, 145, 146, 147, 148, 149, 151, 152, 153, 155.
   b) English 100, 237, 238, 241, 242, 251.

2. One of the following seniors seminars: English 192, 193, 194, 195.

B. American Literature

The undergraduate major in American Literature should plan to take English 177 and 178 in sequence during the junior year, and he 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 1850.
3. English 266. Chief American Poets from 1630 to the present.
4. Two additional courses from the following list: English 155, 172, 196, 255, 264, 265, 267, 268, 269, 270; Speech and Drama 292.

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) English 142, 144, 145, 146, 147, 148, 149, 151, 152, 153, 155.
   b) English 171, 172, 173, 265, 266, 269, 270; Speech and Drama 292.

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 eight 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.
III. In addition to the English major requirements, 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 unusual interest in literary studies may apply for admission to the Honors Program in English literature, preferably by the start of their sophomore year and not later than the start of their junior year. Admission is selective.

The Program offers the chance for more intensive and more independent work in the field. Course requirements are as follows: English 102, 141, 143, 182, 183, and 184, and a single author or genre course, and one of the following options:

American Emphasis: English 177, 178, 266.

American Emphasis: One course in American literature, and two elective advanced courses in English literature. With the approval of the adviser, three advanced courses in the appropriate period may be substituted for 177, 178, 182, 183, or 184. Not more than two such substitutions will be permitted.

Honors students will be placed in special seminar sections of English 182, 183, and 184. They will take a comprehensive examination early in the fall of their senior year, and those who pass with at least a B will write a senior essay of 10,000-15,000 words. In the autumn quarter of the senior year honors students will normally be free of course obligations; they will take instead a program of directed reading as background for the senior essay. In this quarter they will meet weekly as a group to discuss major works outside English and American literature.

Since admission to the Creative Writing Program is limited to students having a special aptitude for writing, it is regarded as itself a kind of 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 Stanford General Secondary Credential 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.
A. 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>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Major</td>
<td></td>
</tr>
<tr>
<td>English 1, 2, and 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 of the Renaissance</td>
<td>5</td>
</tr>
<tr>
<td>English 183. English Literature of the Restoration and Eighteenth Century</td>
<td>5</td>
</tr>
<tr>
<td>English 184. English Literature of the Nineteenth Century</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>4</td>
</tr>
<tr>
<td>Speech and Drama 120a. Exposition</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 164a. Principles of Directing or Journalism 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>71</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, and 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 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 of the 19th Century</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>Education 284a, b. Curriculum and Instruction in Secondary English</td>
<td>6</td>
</tr>
<tr>
<td>Education 247c. Student Teaching in the Minor</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>47</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.
B. Stanford Junior College Credential

Candidates for the Stanford Junior College Credential must meet the following requirements:

1. Completion of the Master's degree in English.
2. Completion of 24 quarter units in a teaching minor, 12 units of which are advanced undergraduate or graduate units.
3. Completion of the following professional courses in education:
   a) Education 347, The Junior College (3 units), offered in the winter quarter by the School of Education.
   b) Education 248, Student Teaching in Junior College (9 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 the School of Education and the Department of English.
   c) Education 284a, Curriculum and Instruction in Secondary School English (4 units), offered only during summer and autumn quarters.
   d) Education 241, Introduction to Audio-Visual Education (3 or 4 units), offered by the School of Education in the spring and summer quarters, is required by the California State Code.

C. 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 admission to advanced standing 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 from any college or university of accredited standing, and if his record is acceptable. (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 re-evaluated or rejected.

In general, only applicants who seem fully qualified, both in aptitude and in motivation, to attempt the Ph.D. will be admitted to graduate standing in the Department (except, of course, for candidates interested in Creative Writing or the Master of Arts in Teaching). The A.M. is not prerequisite to the Ph.D., but A.M. programs will be maintained for graduate students who wish the experience of writing an A.M. thesis or who for some reason decide not to continue to the Ph.D.

Master of Arts

The following Departmental requirements are in addition to the University's basic requirements for the Master's degree, dealing with such matters as residence, thesis, etc.:
Time of Residence—A candidate for the degree of Master of Arts must take three quarters of full-time work (or the equivalent) at Stanford. He must complete a minimum of 36 units of course or seminar work in this Department and submit an acceptable thesis.

Program of Study—A candidate for the Master's degree may concentrate in English literature, in American and English literature, in English philology, or, with permission upon demonstration of special aptitude, in creative writing. A candidate in English literature must offer a course or seminar at the most advanced level for which he is actually prepared, in each of the following areas: Old English (310), Middle English, the Renaissance, English literature of the Restoration and eighteenth century, English literature of the nineteenth century, and American literature. He must offer at least one seminar in the period of his thesis. Any of these requirements may be waived upon demonstration that the candidate has had unusually intensive undergraduate work in the particular area (e.g., a concentration of courses or an undergraduate honors thesis). A candidate in English literature must offer a course or seminar at the most advanced level for which he is actually prepared, in each of the following areas: Old English (310), Middle English, the Renaissance, English literature of the Restoration and eighteenth century, English literature of the nineteenth century, and American literature. He must offer at least one seminar in the period of his thesis. Any of these requirements may be waived upon demonstration that the candidate has had unusually intensive undergraduate work in the particular area (e.g., a concentration of courses or an undergraduate honors thesis). A candidate in English literature must offer a course or seminar at the most advanced level for which he is actually prepared, in each of the following areas: Old English (310), Middle English, the Renaissance, English literature of the Restoration and eighteenth century, English literature of the nineteenth century, and American literature. He must offer at least one seminar in the period of his thesis. Any of these requirements may be waived upon demonstration that the candidate has had unusually intensive undergraduate work in the particular area (e.g., a concentration of courses or an undergraduate honors thesis). A candidate in English literature must offer a course or seminar at the most advanced level for which he is actually prepared, in each of the following areas: Old English (310), Middle English, the Renaissance, English literature of the Restoration and eighteenth century, English literature of the nineteenth century, and American literature. He must offer at least one seminar in the period of his thesis. Any of these requirements may be waived upon demonstration that the candidate has had unusually intensive undergraduate work in the particular area (e.g., a concentration of courses or an undergraduate honors thesis). A candidate in English and American literature may omit one of the areas in English literature (but not old English) and offer instead two additional courses or seminars in American literature (a total of three). His thesis and at least one seminar will be in American literature.

A candidate in creative writing will follow the programs prescribed for English, or English and American literature, except that he may include 8 units of advanced work in creative writing in the 36 required for the degree, and these will be regarded as fulfilling the seminar requirements.

Applicants interested in a Master's degree in English philology should correspond with Professors Meritt or Ackerman to determine the requirements.

Candidates for the Ph.D. will be granted the A.M. upon special application, if they have passed the written comprehensives for the Ph.D.

Language Requirements—In addition to Old English, a candidate for the degree of Master of Arts must demonstrate, within two quarters of residence, a reading knowledge of one foreign language approximately equal to that acquired by two years of college work in the language. He will demonstrate this knowledge by passing a two-hour written examination consisting of three passages: (1) poetry, (2) criticism, (3) fiction. He will be expected to read a relatively easy piece of literature accurately without excessive use of the dictionary. Examinations will be given by the Department in the eighth week of each quarter except the summer at an hour and date to be announced.

Thesis—The Master's thesis may not be counted for more than 9 units of credit in addition to the required 36 units of course work. Candidates in creative writing will offer a piece or pieces of imaginative writing as the thesis. A preliminary proposal for the thesis supported by adequate samples of the student's writing must be approved by the Creative Writing Committee. For this reason it is usually impossible for any student to be admitted as a candidate for the A.M. in creative writing until he has been in residence for a quarter. The Master's thesis must be presented in its finished form to the professor under whose direction it is written at least four weeks before the close of the quarter in which the degree is to be granted.

Examinations—Since the distribution of courses required is intended to insure a reasonable familiarity with English or American literature, no comprehensive examination is required for the Master's degree.

Doctor of Philosophy

University regulations regarding admission and application for candidacy are discussed in the section "Degrees" in this Bulletin. The following Departmental requirements are in addition to the University's basic requirements for the doctorate, dealing with such matters as residence, dissertation, and examination:

A candidate for the Ph.D. degree must complete three years (nine quarters) of full-time work, or their equivalent, in graduate study beyond the Bachelor's degree. He will be expected to offer at least 72 units of graduate courses or seminars in addi-
tion to his doctoral dissertation. At least three consecutive quarters of graduate work and also the last courses or seminars in the program must be taken at Stanford.

A candidate for the Ph.D. degree may concentrate in English literature or English philology, or may take the Ph.D. in English and American literature, or in English and comparative literature. Applicants interested in a Ph.D. in English philology should correspond with Professors Meritt or Ackerman to determine the requirements of the program.

The program in English literature is as follows:

1. English 301, Bibliography and Methods of Graduate Study, or an equivalent course elsewhere.
2. English 310, 311, 312, the sequence in Old and Middle English, or equivalent work elsewhere.
3. A seminar in each of the six following categories (at least four of these seminars must be taken at Stanford):
   a) Old or Middle English, or principles and structure of the English language (English 314, 316, 318, 320, 322).
   b) English Renaissance (English 325, 331, 334b).
   c) Restoration and Eighteenth Century (English 341).
   d) Nineteenth and Twentieth Centuries (English 351, 358).
   f) One additional seminar related to the period or genre of the student’s dissertation. The two seminars in the field of the student’s dissertation must be taken at Stanford.

With the Department’s permission, an A.M. thesis may be substituted for one seminar in the same period or genre. Any genre seminar may also count for a period, if the student’s research centers in that period—i.e., literary criticism in the 16th, 18th, or 19th; the novel in the 18th or 19th—but the same seminar cannot fulfill both requirements.

Each student will be expected to satisfy his adviser and the professor giving the seminar that he has a sound general knowledge of the background or to take preparatory courses or proseminars. The background expected is indicated under each listing. (N.B. In the interest of clarity, prerequisites will ordinarily be listed in terms of Stanford courses, and the syllabus for each of these courses will be available in the Briggs Room. But the notation “equivalent” indicates that a comparable course elsewhere or independent study is equally acceptable.)

4. Graduate electives (courses numbered 200 or 300) amounting to at least 8 units. Graduate courses taken in preparation for seminars may be counted toward this requirement.

5. One of the following minor programs, amounting to at least 24 units taken in graduate standing either at Stanford or elsewhere: (1) 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; (2) a supplementary program in American literature or English philology (candidates concentrating in English philology may offer English literature through the Renaissance); (3) 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 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.

The Ph.D. program in English and American literature will have the following course and seminar requirements:
(1) English 301 or the equivalent.

(2) 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 writers studied in Middle English.

(3) A minimum of 28 units of graduate courses (200 or 300) in American literature, including at least three graduate seminars taken at Stanford.

(4) A minimum of 28 units of graduate courses in English literature, including at least two seminars.

(5) 4 or more units of electives, including one additional seminar, to be distributed between English and American literature according to the adviser's judgment of the candidate's background.

The written comprehensive examination will consist of five papers, two in American literature and any three of the four given in English literature. But the candidate must offer one graduate course in the period of English literature covered by the examination paper that he elects to omit. Hereafter, any candidate must complete this program before undertaking a dissertation in American literature, unless he began graduate work at Stanford before the end of the academic year 1958-59.

The Ph.D. program in English and comparative literature will have the following requirements:

1. A knowledge of English literature since 1350 comparable to that demanded of candidates for the Ph.D. in English literature;

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 28 further units of graduate work in courses given by the English Department;

5. 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;

6. A knowledge, tested by a written or oral examination, of the period. This examination will be based on a reading list established by the candidate in consultation with his adviser;

7. A minimum of six seminars, of which at least five must be in the English Department.

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, which will be given by the Department on the following dates: August 2, 1963; November 15, 1963; February 28, 1964; May 22, 1964; July 31, 1964; November 20, 1964; February 26, 1965; May 21, 1965; July 30, 1965; November 19, 1965; February 25, 1966; May 20, 1966; July 29, 1966. Another foreign language may be substituted for German or French if it is required for the student's projected research. Italian may be substituted for either language if the candidate's dissertation is concerned with the English Renaissance.

The following schedule for meeting foreign language requirements will apply to all candidates, whether for the A.M. or the Ph.D. degree:
No graduate student will be allowed to register for his third quarter of work until one foreign language examination has been passed. No Ph.D. candidate will be allowed to register for the fifth quarter of work until a second foreign language examination has been passed. No Ph.D. candidate will be allowed to take the written comprehensives until all language requirements (two modern and Latin) have been satisfied.

Examination—In addition to the foreign language examinations, a Ph.D. candidate must take a comprehensive written examination at least one year before he anticipates receiving the degree. This examination will be given September 16–21, 1963; September 21–26, 1964; September 20–25, 1965. Candidates will also take an oral examination over the period and background of the dissertation after approval of the dissertation by the Departmental Committee.

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 senior member of the Department as his adviser. The adviser will request the Executive Head to appoint a committee to supervise the dissertation. The candidate will then submit to this committee a brief statement of his dissertation project and meet with the committee to confer about his program of study and preparation for the dissertation. A copy of the statement, revised if necessary, and bearing signatures of the three committee members in approval of the topic, will become a part of the Department records. It must be transmitted to the Department not later than the quarter before the candidate takes his written comprehensives. N.B. The candidate should take this crucial step as early in his graduate career as possible, and the deadline stated is to be regarded as the last possible, not the normal or desirable, time. The committee may well advise extra preparation within or outside the Department, and time should be allowed for such work.

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. N.B. Dissertations may not be submitted to the adviser or committee during the summer quarter.

Immediately after passing the written comprehensive examination, the candidate will be expected to 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 comprehensives once again.

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 classes, or by special instructors, according to individual needs.  

#1, 2, 3. Freshman English—Expository writing, emphasizing the control of meaning through critical thinking and mastery of style; introduction to the forms of literature.

1. A course in writing, reading, and thinking designed to help the student to write lucid, orderly and logical prose.

3 units, autumn, (Staff)
2. Continuation of 1; emphasis on elements of style; introduction to research, introduction to short story and the novel. Prerequisite: 1.
   3 units, winter, (Staff)
3. Continuation of 2; emphasis on introduction to drama and poetry; the writing of literary criticism. Prerequisite: 2.
   3 units, spring, (Staff)

1F, 2F. Freshman English—For foreign students.
   3 units, winter and spring, (Staff)

#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 readings and more rigorous training. Open only to students selected by the Department.
   3 units each course, autumn, winter, and spring, (Staff)

5. Narration—Basic problems of narrative and imaginative writing. Prerequisite: 3.
   3 units, autumn, (Fuller), (I) MWF 1; (McClanahan), (II) MWF 1
   or winter, (Harris), (I) MWF 1; (McClanahan), (II) MWF 1
   or spring, (Fuller), MWF 1

#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, winter, (Rebholz), MTWF 9
   or spring, (Polhemus), MTWF 9

#9. Masterpieces of American Literature—Intensive study of a few masterpieces of American literature, including poetry, drama, the essay, the novel.
   4 units, autumn, (Appel), TWThF 9
   or winter, (———), TWThF 11

#25. Shakespeare—Rapid reading of about half the plays and poems in chronological sequence.
   4 units, winter, (Ford), MTWF 10
   or spring, (Rebholz), MTWF 1
   or summer, (Whitaker), MTWFThF 9

#73. Modern British Humorists—Detailed study of Oscar Wilde, Max Beerbohm, G. B. Shaw, G. K. Chesterton, Aldous Huxley; inquiry into the nature, and brief history, of humor, wit, comedy.
   3 units, winter, (Irvine), MWF 1

Introduction to the Chief Types of Literature—Open to all undergraduate students. 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, autumn, (Harris), MWF 10
   or spring, (Ruotolo), MWF 10

#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, autumn, (Stone), TWThF 10

#77. Introduction to the Drama—Principal dramatic forms; development of dramatic art; masterpieces of the theater from various periods, countries.
   4 units, winter, (Kolve), MTWF 10

England—See History 105.


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; 177-9, an introductory survey of American literature; and 182-4, 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 history of the English Bible and use made of Biblical themes in English literature.

4 units, autumn, (Ford), TWThF 11

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, winter, (Meritt), TWThF 11

or spring, (Ackerman), 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, autumn, ( ), MWF 9, 10, 11

or winter, ( ), MWF 9, 10, 11

or spring, ( ), MWF 9, 10, 11

or summer, ( ), 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. Prerequisite: 5. May be repeated for credit.

3 to 5 units, autumn, (Scowcroft), (I) TTh 2-4; (Fuller), (II) MW 2-4

or winter, (Fuller), (I) TTh 2-4; ( ), (II) MW 2-4

or spring, (Harris), (I) MW 2-4; (McClanahan), (II) TTh 2-4

or summer, ( ), TTh 2-4

134. Directed Writing: Poetry—Intermediate course in writing various types of verse. May be repeated for credit.

4 units, to be given in 1964-65

141. Chaucer.

4 units, autumn, (Cassidy), TWThF 8

or spring, (Ackerman), TWThF 8

142. Spenser.

4 units, to be given in 1964-65

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, winter, (Whitaker), MTWTh 8

144. Milton.

4 units, winter, (Sensabaugh), TWThF 9

145. Donne and Jonson.

4 units, to be given in 1964-65

146. Swift and Pope.

4 units, to be given in 1964-65

147. Johnson and His Circle.

4 units, spring, (Fifer), TWThF 11


4 units, autumn, (Ford), MTWF 9

149. Byron, Shelley, and Keats.

4 units, to be given in 1964-65

151. Matthew Arnold.

4 units, to be given in 1964-65

152. Browning and Tennyson.

4 units, to be given in 1964-65

153. George Bernard Shaw.

4 units, autumn, (Irvine), TWThF 10
4 units, to be given in 1964-65

#171. Contemporary Drama—Ibsen, subsequent dramatists—English, Continental, American. Lectures, discussions; critical papers.
4 units, spring, (Dodds), TWThF 9

#172. Forms of the Modern Novel—Studies in major English, American, and Continental novelists from 1850 to the present.
4 units, to be given in 1964-65

173. Twentieth Century English Fiction.
4 units, autumn, (Scowcroft), MTWTh 1

177. American Literature to 1850.
4 units, winter, (Levin), TWThF 9

4 units, spring, (Moser), MTWTh 9

181. Medieval Literature—A survey of the literature of medieval England. Attention is centered on several important works in Old and Middle English and also in Latin and Old French.
4 units, autumn, (Ackerman), TWThF 11

182, 183, 184—A basic survey of English literature 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, autumn, (Whitaker), MWF 10; seminars by arrangement

183. English Literature: Neoclassicism and Romanticism—Prerequisite: 182.
5 units, winter, (Lojtis), MWF 10; seminars by arrangement

184. English Literature: Victorian and Modern—Prerequisite: 183.
5 units, spring, (Irvine), 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, 193, 194, 195, and 196 are open only to seniors and Honors students in the Department of English. They are strictly limited in enrollment. Each student must sign up for a senior seminar in the last quarter of his junior year during the preregistration period.

192. Senior Seminar: Selected Topics in Renaissance Literature—Prerequisite: 182.
4 units, autumn, (Kolve), MW 2-4
or winter, (Sensabaugh), TTh 2-4

193. Senior Seminar: Selected Topics in Eighteenth Century Literature—Prerequisite: 183.
4 units, spring, (Fifer), TTh 4-6

194. Senior Seminar: Selected Topics in Nineteenth Century Literature—Prerequisite: 184.
4 units, winter, (Ruotolo), MW 4-6
or spring, (Ford), TTh 4-6

195. Senior Seminar in Twentieth Century Literature—Prerequisite: 184.
4 units, winter, (Moser), TTh 4-6

196. Senior Seminar in American Literature—Prerequisites: 177 and 178.
4 units, winter, (Grommon), MW 2-4
or spring, (Franklin), MW 2-4
199. Senior Essay, Department Honors Program.
   Any quarter, by arrangement

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.
May be repeated for credit.
   2 units, autumn, (Winters), TF1
   or winter, (Winters), TTh1
   or spring, (Winters), TTh1

203. Advanced Fiction Writing—A workshop group open by permission to gradu-
ates 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, autumn, (Stegner), MW 2-4
   or winter, (Stegner), MW 2-4
   or spring, (Scowcroft), MW 2-4

204. Advanced Exposition—Advanced course dealing with problems of writing
for professional purposes. Prerequisite: 3, or equivalent.
   3 units, winter, (Harris), 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, winter, (Cassidy), TWThF 11

209. Principles of Standard English—Phonetics, syntax, derivation, etymology,
meanings; consideration of recent developments in study of language.
   To be given in 1964–65

237. The English Drama to 1642.
   4 units, summer, (Sensabaugh), TWThF 10

238. Drama of the Restoration and Eighteenth Century.
   4 units, autumn, (Loftis), TWThF 11

241. The English Novel through the Eighteenth Century—Study of the most
significant novels, with emphasis on development of the form.
   4 units, winter, (Scowcroft), MTWTh 1

242. The English Novel in the Nineteenth Century—Study of the most signifi-
cant novels, with emphasis on development of the form.
   4 units, spring, (Stone), TWThF 1

251. The English Lyric—Historical examination of lyric poetry considered in re-
spect to distinctions and historical relationships of schools and movements.
   4 units, autumn, (Winters), TWThF 11

255. The Development of the Short Story.
   4 units, winter, (Stegner), MTWTh 1

265. Hawthorne and Melville.
   4 units, autumn, (Franklin), MTWF 1

266. Chief American Poets, from 1630 to the Present.
   4 units, winter, (Winters), TWThF 11

267. Emerson and Thoreau.
   4 units, spring, (Grommon), MTWF 2-4
268. Narrative Prose in America—A study of most significant nonfictional narrative works, with emphasis on history and biography, including autobiography.
   4 units, to be given in 1964–65
   4 units, autumn, (Moser), TWThF 9
299. Advanced Work in Writing and Criticism.
   Any quarter, by arrangement

Curriculum and Instruction in Secondary School English I—See Education 284a.

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
301. Bibliography and Methods of Graduate Study—This, or equivalent course, required of all candidates for Ph.D.
   4 units, winter, (Fifer), TTh 4–6
303. Seminar in Tragedy—Theory, practice of tragedy in various literatures from Aeschylus to O’Neill. Lectures, reports. Prerequisite: some introductory reading of drama.
   4 units, winter, (Dodds), MW 2–4
   4 units, winter, (Winters), TTh 4–6
307. Seminar in the Novel—Prerequisite: The equivalent of English 241, 242, 265, or 270.
   4 units, spring, (Scowcroft), TTh 2–4
310. Old English—Elements of Old English grammar; reading exercises.
   4 units, autumn, (Meritt), (I) TWThF 9; (Cassidy), (II) TWThF 10
311. Beowulf—Prerequisite: English 310 or equivalent.
   4 units, winter, (Meritt), TWThF 9
312. Middle English—History, dialects of Middle English; readings of representative selections from the literature. Prerequisite: English 310 or equivalent.
   4 units, spring, (Ackerman), TWThF 10
   4 units, winter (Cassidy), TTh 4–6
316. Seminar in Elizabethan Language—Vocabulary, pronunciation, grammar, orthography of the period. Prerequisite: English 312 or equivalent.
   4 units, alternate years, to be given in 1964–65
318. Seminar in Middle English Literature—Prerequisite: English 312 or equivalent.
   4 units, winter, (Ackerman), MW 2–4
320. Seminar in Chaucer—Troilus and Criseyde in some years, selected short poems in others; structure, history of the works, their literary significance. Prerequisite: English 141 or equivalent.
   4 units, alternate years, to be given in 1964–65
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
<th>Term</th>
<th>Instructor</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>322</td>
<td>Seminar in Medieval Drama.</td>
<td>4</td>
<td>spring</td>
<td>(Kolve)</td>
<td>MW 4-6</td>
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<tr>
<td>325</td>
<td>Shakespeare Seminar—Prerequisites: The equivalent of English 25 or 143, 182 or 330, and 237.</td>
<td>4</td>
<td>summer</td>
<td>(Whitaker)</td>
<td>MW 4-6</td>
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<tr>
<td>330</td>
<td>Proseminar: English Literature of the Sixteenth Century—Special arrangements will be made to accommodate students who need this proseminar in English 182.</td>
<td>4</td>
<td>to be given in 1964-65</td>
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<tr>
<td>331a, b, c.</td>
<td>Seminar in Literary Problems of the English Renaissance—Prerequisite: English 182 or 330, or equivalent.</td>
<td>4</td>
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<tr>
<td>331a</td>
<td>Jacobean Drama—Additional prerequisite: English 237 or equivalent.</td>
<td>4</td>
<td>summer</td>
<td>(Sensabaugh)</td>
<td>TTh 4-6</td>
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<tr>
<td>331b</td>
<td>Seminar in Marlowe.</td>
<td>4</td>
<td></td>
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<td>TTh 2-4</td>
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<tr>
<td>331c</td>
<td>Natural and Moral Philosophy: Bacon.</td>
<td>4</td>
<td></td>
<td>(Kocher)</td>
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<tr>
<td>334a, b</td>
<td>The Age of Milton.</td>
<td>4</td>
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<tr>
<td>334a</td>
<td>Proseminar: Seventeenth Century Backgrounds.</td>
<td>4</td>
<td>winter</td>
<td>(Sensabaugh)</td>
<td>TWHF 10</td>
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<tr>
<td>334b</td>
<td>Seminar: Problems in Seventeenth Century Literature—Prerequisite: English 330 or 334a, or equivalent.</td>
<td>4</td>
<td>to be given in 1964-65</td>
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<tr>
<td>340</td>
<td>Proseminar: Eighteenth Century Backgrounds.</td>
<td>4</td>
<td>autumn</td>
<td>(Loftis)</td>
<td>TTh 2-4</td>
</tr>
<tr>
<td>341b, c</td>
<td>Literary Problems of the Restoration and Eighteenth Century—Prerequisite: English 183 or 340, or equivalent.</td>
<td>4</td>
<td></td>
<td>(Loftis)</td>
<td>MW 4-6</td>
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<tr>
<td>341b</td>
<td>Studies in Dryden, Swift, and Pope.</td>
<td>4</td>
<td></td>
<td>(Loftis)</td>
<td>TTh 4-6</td>
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<tr>
<td>341c</td>
<td>Johnson and His Circle.</td>
<td>4</td>
<td></td>
<td>(Irvine)</td>
<td>MW 4-6</td>
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<tr>
<td>350</td>
<td>Proseminar: Nineteenth Century Backgrounds.</td>
<td>4</td>
<td>winter</td>
<td>(Ford)</td>
<td>MW 2-4</td>
</tr>
<tr>
<td>351b</td>
<td>Literary Problems of the Romantic Period—Prerequisite: English 184 or 350, or equivalent treatment of Romantic period.</td>
<td>4</td>
<td>spring</td>
<td>(Ford)</td>
<td>MW 4-6</td>
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<tr>
<td>354</td>
<td>Victoriam Prose: Carlyle and Arnold.</td>
<td>4</td>
<td></td>
<td>(Irvine)</td>
<td>TTh 2-4</td>
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<tr>
<td>358</td>
<td>Seminar: Literary Problems of the Nineteenth Century—Prerequisite: English 184 or 350, or equivalent.</td>
<td>4</td>
<td></td>
<td>(Irvine)</td>
<td>TTh 2-4</td>
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<tr>
<td>358a</td>
<td>Impressionism in English Poetry and Prose.</td>
<td>4</td>
<td>autumn</td>
<td>(Irvine)</td>
<td>TTh 2-4</td>
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<td>358b</td>
<td>Browning.</td>
<td>4</td>
<td>spring</td>
<td>(Irvine)</td>
<td>MW 4-6</td>
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<td>358d</td>
<td>The Bloomsbury Group.</td>
<td>4</td>
<td>spring</td>
<td>(Stone)</td>
<td>TTh 2-4</td>
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<tr>
<td>361</td>
<td>Seminar in American Critics—Prerequisite: English 266 or equivalent.</td>
<td>4</td>
<td></td>
<td>(Winters)</td>
<td>TTh 4-6</td>
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<tr>
<td>370</td>
<td>Seminar in Twentieth Century American Fiction.</td>
<td>4</td>
<td>autumn</td>
<td>(Stegner)</td>
<td>TTh 2-4</td>
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<tr>
<td>371</td>
<td>Seminar in American Historians as Men of Letters—Prerequisite: English 268 or equivalent.</td>
<td>4</td>
<td></td>
<td>(Winters)</td>
<td>TTh 4-6</td>
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<tr>
<td>376</td>
<td>Proseminar: American Literature of the Colonial Period.</td>
<td>4</td>
<td>autumn</td>
<td>(Levin)</td>
<td>MW 2-4</td>
</tr>
</tbody>
</table>
377. Seminar in American Literature of the Colonial Period—Prerequisite: English 177 or equivalent.
4 units, winter, (Levin), TTh 2-4
381. Seminar in Problems in American Literature of the Nineteenth Century.
4 units, winter, ( ), MW 2-4 or spring, ( ), TTh 2-4
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
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: Frederick Anderson, Stanley Astredo Smith (Professors); Earl Kendall Carter, Jessie E Smith (Assistant Professors)

Executive Head: John Clarke Lapp
Professors: Raymond Giraud, Alphonse Georges Juilland, John Clarke Lapp, Georges Edouard Lemaitre
Professor of Education and Romance Linguistics: Robert Louis Politzer
Associate Professors: Robert G. Cohn, Alexander E. A. Naughton, Pauline Newman-Gordon, Roberto B. Sangiorgi, Leo Weinstein
Assistant Professors: Samuel E. Stokes, Jr., Vincenzo Paolo Traversa
Lecturer: Ileana A. Juilland

The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, 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 35 units, selected with the approval of their adviser, from courses numbered 100 and higher. These 35 units must include:
For French majors: Fr110, Fr111, Fr112, Fr113, Fr125, and French sections of Fr130, Fr131, and Fr132.
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.
General Secondary Teaching Credential in French

State of California minimum requirements:

For the major in any subject field: 36 semester hours or 54 quarter units.
For the minor in the subject field: 20 semester hours or 30 quarter units.

Stanford requirements:

For professional education requirements, see requirements set forth by the School of Education.

All students eligible for the General Secondary Credential Program with either a teaching major or a teaching minor in a foreign language must have at least a B average in that language in courses which follow the first-year series (or their equivalent). After admission to the program, a B average must be maintained.

The following requirements must be met for certification by Stanford for teaching French in a California high school. Students who have received the A.B. degree in French will have fulfilled most of the requirements listed below.

Teaching minor in French

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. First-Year sequence (Fr1-3)</td>
<td>12</td>
</tr>
<tr>
<td>2. Second-Year sequence (Fr52-54, or equivalent)</td>
<td>15</td>
</tr>
<tr>
<td>3. Advanced Conversation (Fr100) or 4 units of literature selected from French sections of 130-132.</td>
<td>3-4</td>
</tr>
<tr>
<td>4. Pronunciation (Fr110)</td>
<td>3</td>
</tr>
<tr>
<td>5. Third-Year Composition (Fr111-113)</td>
<td>6</td>
</tr>
<tr>
<td>6. Introduction to the Study of Language and Applied Linguistics L180 and L260</td>
<td>4*</td>
</tr>
<tr>
<td>7. Qualifying language examination</td>
<td></td>
</tr>
</tbody>
</table>

Total minimum for language teaching minor: 43-44

* Not included in ordinary A.B. program in language; prerequisite to Ed282a and should therefore be completed before embarking on formal fifth-year Credential Program.

Teaching major in French

Ordinarily, an A.B. degree in French is considered a standard condition for acceptance into the program for a major teaching credential. In exceptional cases, however, where a non-language major has completed a significant amount of work in the language at an acceptable level of scholarship, the Department will waive the formal degree requirement. Regardless of the undergraduate major, the minimum requirements for a teaching major are as stated below. Most of the courses listed are supplementary to the ordinary A.B. sequence, except for the elective literature courses.

French teaching major:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Completion of French teaching minor (above)</td>
<td>43-44</td>
</tr>
<tr>
<td>2. Fr201-202 or Fr204. Advanced Composition and Grammar, or Etudes de style</td>
<td>4</td>
</tr>
<tr>
<td>3. Fr205. Modern French</td>
<td>3</td>
</tr>
<tr>
<td>4. Fr125. History of the French Language</td>
<td>2</td>
</tr>
<tr>
<td>5. Elective: Upper division or graduate courses in French Literature</td>
<td>7-8</td>
</tr>
</tbody>
</table>

Total minimum for French teaching major: 60

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.

**Master of Arts: French**

No student is accepted for candidacy unless he has completed the equivalent of the training represented by the requirements for the A.B. degree.

Requirements:

I. A working knowledge of Latin as established by departmental examination or certification.

II. 30 units of graduate work, to be distributed approximately as follows:

   a) Advanced composition or stylistics ........................................... 4 units
   b) Philology or linguistics ......................................................... 9 units
   c) Three graduate courses in literature ......................................13-14 units
   d) Thesis research ......................................................................... 4 units

III. Electives chosen with the approval of the student's adviser.............13-14 units

Total .................................................................................................. 44 units

**Doctor of Philosophy: French**

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. Candidates must have completed the equivalent of the course requirements for the Master of Arts degree in French.

General Requirements:

All candidates, regardless of their field of specialization, are expected to fulfill these requirements:

I. Language requirements:

   a) Have a reading knowledge of Latin and German.
   b) Have a knowledge of a second Romance language equivalent to 18 units of advanced work.

All candidates are urged to complete these requirements as early as possible.

II. Pass a written and oral examination on the following:

   a) The principles of general and descriptive linguistics and the outlines of the history of the French language.
   b) The history of French literature.

III. Write a thesis that embodies such results of research as would merit publication.

IV. Teaching experience is required of all candidates. This requirement may be waived in special cases.

Specialization:

Requirements of specialization in linguistics or literature are as follows:

I. In linguistics:

   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., 13-14 units), including at least one course in medieval literature.

II. In literature:
a) Candidates must complete a minimum of 12 units in linguistics and philology, including Fr310.
b) The second Romance language should be Italian or Spanish. Another Romance language may be chosen with special permission only.

Graduate Program in Humanities

The Department of French and Italian also participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in French and Humanities. For a description of that program, and fellowships offered in connection with it, see the section "Humanities (Special Programs)."

Intensive Language Work in European Study Centers

Each student accepted by the Committee on General Studies for work at a Stanford center in France or 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 Fr, or It80, 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.

COURSES OPEN TO ALL STUDENTS

The courses in this section (with the exception of AF154) do not require a knowledge of any language other than English. Students desiring French or Italian language credit for these courses must secure the permission of the Department and do the assigned readings in French or Italian.

A. General Course

A101. 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, autumn, (Juilland), MWF1

AF. French

AF151. French Civilization I—Origin; Roman Gaul; cultural, religious, artistic background of French life during Middle Ages until Hundred Years' War. Lectures, outside readings.

3 units, autumn, (Lemaitre), MWF 9

AF152. French Civilization II—End of Middle Ages; Renaissance and Reform; formation of ideals of Classical Age. Lectures, outside readings.

3 units, winter, (Lemaitre), MWF 9


3 units, spring, (Lemaitre), MWF 9

AF154. Civilisation Française IV—Problèmes politiques et sociaux; évolution culturelle et religieuse depuis la Révolution Française jusqu'à la Première Guerre Mondiale.

3 units, (Lemaitre), to be given in 1964–65
AF155. Political Problems of Contemporary France I.  
3 units, autumn, (Lemaitre), MWF 10

AF156. Political Problems of Contemporary France II.  
3 units, winter, (Lemaitre), MWF 10

AF157. Political Problems of Contemporary France III.  
3 units, (Lemaitre), to be given in 1964–65

#AF160. Molière—Representative comedies of Molière in English translation.  
3 units, (Weinstein), to be given in 1964–65

#AF170. Modern French Novels in Translation.  
3 units, autumn, (Naughton), MWF 11

AF171. Contemporary French Novelists—Significant authors of contemporary France: Proust, Gide, Malraux. Lectures, readings in English.  
3 units, spring, (Lemaitre), MWF 2

AF172. Sartre—Introduction to French Existentialism—Lectures, readings in English.  
4 units, winter (Lemaitre), MTWTh 2

AF175. From Cubism to Surrealism—Modern French art, literature against background of French ideas, French social life. Lectures, readings in English.  
4 units, (Lemaitre), to be given in 1964–65

AI. ITALIAN

#AI75. Dante in English—Reading, interpretation of Vita Nuova and The Divine Comedy in translation.  
3 units, autumn, (Drew), MWF 10

A180. The High Renaissance—Given only at Stanford in Italy.  
2 units, autumn, (Frulla)

AI140. The Contemporary Italian Novel in Translation—Reading, discussion of significant novels of such authors as Silone, Berto, Moravia, Verga, Pratolini.  
3 units, spring, (Traversa), MWF 10

FR. FRENCH COURSES

FIRST- AND SECOND-YEAR

[Under the direction of Samuel E. Stokes, Jr.]

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.

#Fr1. First-Year French.  
4 units, autumn, winter, or spring, (Staff)

#Fr2. First-Year French—Continuation of Fr1.  
4 units, autumn, winter, or spring, (Staff)

#Fr3. First-Year French—Continuation of Fr2.  
4 units, autumn, winter, or spring, (Staff)

Fr10. Elementary French—Accelerated course for beginners, particularly for those seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to seniors and graduate students only.  
4 units, autumn, (Staff), MTWTh 8  
or summer, (Staff), MTWThF 8

Note: Students wishing to stress speaking and writing in addition to reading are advised to take Fr52, Fr53, and Fr54.
#Fr22. Second-Year Reading—Prerequisite: Fr3.
3 units, autumn, winter, or spring, (Staff)

#Fr23. Second-Year Reading—Continuation of Fr22. Reading material assigned will vary from section to section.
3 units, autumn, winter, or spring, (Staff)

Fr24. Second-Year Grammar and Conversation—Prerequisite: Fr3 or equivalent.
3 units, autumn or winter, (Staff)

3 units, winter or spring, (Staff)

#Fr52. Second-Year French—Emphasizes speaking, writing in addition to reading. Reading material corresponds to that of Fr22. A grade of B in Fr3 (or equivalent) required for admission. Students electing this course may not take Fr22 and Fr24. Enrollment limited to 15.
5 units, autumn or winter, (Staff)

#Fr53. Second-Year French—Continuation of Fr52. Level of reading material corresponds to that of Fr23. Students electing this course may not take Fr23 and Fr25. Prerequisite: Fr52 (or Fr22 plus Fr24). Enrollment limited to 15.
5 units, autumn, winter, or spring, (Staff)

#Fr54. Second-Year French—Continuation of Fr53. Prerequisite: Fr53 (or Fr23 plus Fr25). Enrollment limited to 15. Satisfies General Studies requirement under “C.”
5 units, autumn, winter or spring, (Staff)

Fr82–86. Intensive French—Given only at Stanford in France.
6 units for each of two quarters, autumn–winter or spring–summer, (Staff), MTWTh two hours daily

**THIRD- AND FOURTH-YEAR**

Fr100. Advanced French Conversation—Prerequisite: Fr54 or equivalent.
3 units, winter, (Gosselin), MWF 12

Fr110. French Pronunciation—Prerequisite: Fr23 or equivalent.
3 units, autumn, (———), MWF 11
or winter, (———), MWF 11

Fr111. Third-Year French Grammar and Composition—Prerequisite: Fr54 or equivalent.
2 units, autumn, (Jonas), TTh 10, or (Gosselin), TTh 11

Fr112. Third-Year French Grammar and Composition—Continuation of Fr111.
2 units, winter, (Jonas), TTh 10, or (Gosselin), TTh 11

Fr113. Third-Year French Grammar and Composition—Continuation of Fr112.
2 units, spring, (Jonas), TTh 10, or (Gosselin), TTh 11

#Fr120. French Cultural Readings—Training in careful reading of books with a significant cultural content. Prerequisite: Fr23.
4 units, autumn, winter, or spring, (Staff)

Fr125. History of the French Language.
2 units, winter, (———), TTh 2

#Fr130. Introduction to French Literature I—From the Middle Ages through the 17th century. Prerequisite: Fr23 or equivalent.
4 units, autumn, (Newman-Gordon), (I) lecs. in English, MWF 10; (Giraud), (II) lecs. in French, MWF 10; (Stokes), (III) lecs. in French, MWF 10

#Fr131. Introduction to French Literature II—From the 18th century through the early 19th century. Prerequisite: Fr23 or equivalent.
4 units, winter, (Newman-Gordon), (I) lecs. in English, MWF 10; (Giraud), (II) lecs. in French, MWF 10; (Stokes), (III) lecs. in French, MWF 10
#Fr132. Introduction to French Literature III—from the late 19th century to
the present time. Prerequisite: Fr23 or equivalent.
4 units, spring, (Newman-Gordon), (I) lecs. in English, MWF 10; (Giraud), (II)
lecs. in French, MWF 10; (Stokes), (III) lecs. in French, MWF 10

#Fr140. French Literature of the Renaissance—Reading, interpretation of rep-
resentative texts.
3 units, autumn, (———), MWF 11

#Fr141. La Littérature française au XVIIe siècle—Lectures in French.
3 units, (Naughton), to be given in 1964–65

#Fr151. French Literature in the Eighteenth Century—Prerequisite: Fr131
or equivalent.
3 units, (———), to be given in 1964–65

#Fr160. Le Théâtre français au XIXe siècle—Lectures, readings, reports: in-
terpretation, discussion of plays by Dumas père, Hugo, Vigny, Musset, Dumas fils,
Augier, Becque. Lectures in French.
3 or 4 units, (Weinstein), every third year, to be given in 1965–66

#Fr161. Le Roman français au XIXe siècle I—Lectures, readings, reports; in-
terpretation, discussion of representative novels of Chateaubriand, Constant, Hugo,
Balzac, Stendhal, Mérimée. Lectures in French.
3 units, spring, (Weinstein), MTTh 1

#Fr162. Le Roman français au XIXe siècle II—Lectures, readings, reports; in-
terpretation, discussion of representative novels of Flaubert, Fromentin, Maupas-
sant, Zola. Lectures in French.
3 units, (Weinstein), every third year, to be given in 1965–66

#Fr180. La Littérature française au vingtième siècle I—Outstanding writers
of prewar period: Maeterlinck, Rostand, Anatole France, Loti, Romain Rolland.
Lectures in French.
3 units, (Lemaitre), every third year, to be given in 1964–65

#Fr181. La Littérature française au vingtième siècle II—Contemporary
French dramatists: Giraudoux, Lenormand, Claudel, Montherlant, Anouilh, Sala-
crou. Lectures in French.
3 units, (Lemaitre), every third year, to be given in 1965–66

#Fr182. La Littérature française au vingtième siècle III—Modern French
novelists: Jules Romains, Mauriac, Duhamel, Colette, Maurois, Saint-Exupéry.
Lectures in French.
3 units, autumn, (Lemaitre), MWF 2

#Fr190. French Poetry—French lyrical poetry, Villon to Valéry.
3 units, spring, (Naughton), MWF 11

Fr199. Individual Work—Thirty-six hours of reading per unit, weekly confer-
ence with instructor. Open only to majors in French. May be repeated for credit.
1 to 3 units, each quarter, (Staff), by arrangement

Advanced Undergraduate and Graduate Courses

Fr201. Advanced Composition and Grammar—Prerequisite: qualifying exami-
nation.
2 units, autumn, (Naughton), TTh 11

Fr202. Advanced Composition and Grammar—Continuation of Fr201.
2 units, winter, (Naughton), TTh 11

Fr204. Études de style.
4 units, spring, (A. Juilland), MWF 3

Fr205. Modern French—Phonology; morphology, and syntax.
3 units, autumn, (A. Juilland), MWF 2

Fr263. Le Théâtre classique français—Representative plays of Corneille, Mo-
lière, Racine. Lectures in French.
4 units, autumn, (Weinstein), MWF 3
Fr273. Le Roman au XVIII\textsuperscript{e} siècle—Rousseau, Prévost, Laclos, and others.
4 units, (———), to be given in 1965–66

Fr274. La Pensée philosophique au XVIII\textsuperscript{e} siècle.
4 units, (———), to be given in 1964–65

Fr285. The Development of the Regional Novel—Selected readings from Restif de la Bretonne, Mistral, George Sand, Balzac, and Eugène LeRoy.
3 units, (Newman-Gordon), to be given in 1964–65

4 units, winter, (Weinstein), MTh 1

Fr288. Baudelaire.
4 units, autumn, (Cohn), MWF 10

Fr289. The Symbolist Poets—Baudelaire, Verlaine, Rimbaud, Mallarmé, Laforgue, etc. Lectures in English.
4 units, winter, (Cohn), MWF 12

Fr290. La Littérature du XX\textsuperscript{e} siècle—Le roman français depuis le Naturalisme, avec explications de textes et commentaires.
4 units, spring, (Newman-Gordon), MWF 12

Fr291. La Poésie d'Apollinaire à Char.
3 units, (Giraud), to be given in 1964–65

Fr293. Le Roman depuis Malraux.
4 units, autumn, (Giraud), MWF 9

GRADUATE COURSES IN FRENCH AND FRENCH LITERATURE

Fr310. Old French—Elements of phonology, morphology; reading of Chanson de Roland. Prerequisite: L203.
3 units, winter, (———), MWF 3

Fr311. Old French Texts—Reading and philological interpretation of selected Old French Texts. Prerequisite: Fr310.
3 units, (———), to be given in 1964–65

Fr320. Old and Middle French Literature—An introduction to Medieval scholarship. Prerequisite: Fr310.
4 units, spring, (———), MWF 2

Fr350. Graduate Seminar.
Du Bellay.
2 units, autumn, (Lapp), T 2–4

Molière.
2 units, autumn, (Naughton), T 4–6

Valéry.
2 units, winter, (Cohn), T 2–4

Stendhal.
2 units, winter, (Weinstein), Th 2–4

Fr352. Literature of the Renaissance—Reading and discussion of Renaissance verse and prose.
4 units, winter, (———), MWF 11

Fr353. Montaigne—Lectures in French.
3 units, spring, (Lapp), MWF 10

Fr363. Pascal—Lectures in French.
3 units, winter, (Naughton), MWF 9

Fr364. Racine—Lectures in French.
3 units, spring, (Naughton), MWF 9

Fr372. Rousseau—Lectures in English.
3 units, (———), to be given in 1964–65

Fr382. Flaubert—Lectures in French.
2 units, (Giraud), to be given in 1964–65
Fr384. La Critique littéraire au XIXe siècle—Sainte-Beuve, Taine, Brunetière, and others. Lectures in French.
3 units, (Weinstein), to be given in 1965-66
Fr390. Proust—Lectures in French.
3 units, autumn, (Newman-Gordon), MWF 1
Fr391. Gide—Lectures in French.
3 units, spring, (Giraud), MWF 11
Fr392. Le Théâtre contemporain.
4 units, (Giraud), to be given in 1964-65
Fr399. 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

IT. ITALIAN COURSES

Note: Students registering for the first time in a first- or second-year course must take a placement test if they have had any training in Italian before entering Stanford.

#It6. Intensive Italian—A course intended for beginners. Designed especially for those students who desire to enroll at “Stanford in Italy.”
6 units, autumn, winter, or spring, (Staff), MTWThF 1 and one hour by arrange-ment

#It7. Intensive Italian—A continuation of It6.
6 units, winter and spring, (Staff), MTWThF 1 and one hour by arrangement

It10. Basic Italian—Accelerated course for beginners, particularly for those seeking to fulfill University requirement for Ph.D. degree. Open to senior, graduate students only.
4 units, autumn, (Staff), MTWTh 10

#It22. Second-Year Reading—Prerequisite: It7 or equivalent.
3 units, autumn or spring, (Staff)

#It23. Second-Year Reading—Continuation of It22.
3 units, autumn, winter, or spring, (Staff)

#It82-86. Intensive Italian—Given only at Stanford in Italy.
6 units for each of two quarters, autumn–winter or spring–summer, (Staff), MTWTh two hours daily

It111. Italian Composition and Conversation.
2 units, autumn, (Traversa), TTh 10

It112. Italian Composition and Conversation—Continuation of It111.
2 units, winter, (Sangiorgi), TTh 12

It113. Composition, Grammar, and Conversation—Continuation of It112.
2 units, spring, (Sangiorgi), TTh 12

#It131. Introduction to Italian Literature I—From its origin through the 15th century. Prerequisite: It23 or equivalent.
3 units, autumn, (Traversa), MWF 1

#It132. Introduction to Italian Literature II—From the 16th century through the late 18th century. A continuation of It131, but may be taken independently. Prerequisite: It23 or equivalent.
3 units, winter, (Traversa), MWF 1

#It133. Introduction to Italian Literature III—From the late 18th century to the present time. A continuation of It132, but may be taken independently. Prerequisite: It23 or equivalent.
3 units, spring, (Traversa), MWF 1

#It151. Dante, La Divina Commedia—Study, interpretation.
4 units, winter, (Sangiorgi), MW 4-6

#It152. Dante, La Divina Commedia—Continuation of It151.
4 units, spring, (Sangiorgi), MW 4-6
It161. Italian Literature of the Middle Ages—Exclusive of La Divina Commedia. Lectures, readings, reports.
3 units, autumn, (Sangiorgi), TTh 3:00-4:30

#It162. Humanism and Renaissance—History of Italian literature, civilization during fifteenth and sixteenth centuries. Lectures, readings, reports.
3 units, winter, (Sangiorgi), TTh 3:00-4:30

#It163. Classicism and Romanticism—Various aspects of Italian classicism, romanticism in the nineteenth century. Lectures, readings, reports.
3 units, (Sangiorgi), alternate years, to be given in 1964-65

#It165. Modern Italian Drama—Study of representative works of Italian dramatists from Goldoni to Pirandello.
3 units, spring, (Sangiorgi), TTh 3:00-4:30

#It199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit.
1 to 3 units, each quarter, (Staff), by arrangement

L. LINGUISTICS AND PHILOLOGY COURSES

L203. 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, autumn, (A. Juilland), MWF 4

L204. Introduction to Romance Linguistics—Development of Romance languages from Vulgar Latin; phonology, morphology, syntax. Prerequisite: working knowledge of Latin.
3 units, winter, (A. Juilland), MWF 2

L205. Old Provençal—Reading of selected poems of the troubadours, with study of Old Provençal morphology, phonology.
3 units, (———), to be given in 1964-65

L207. Old Italian—Phonology, morphology of Old Italian; preliterary linguistic monuments, Sicilian School, pre-Dantean literature.
3 units, (———), to be given in 1965-66

L208. Anglo-Norman—Phonology, morphology of Anglo-Norman; special attention to paleographic difficulties involved; readings in eleventh-, twelfth-, thirteenth-century texts.
3 units, (———), to be given in 1964-65

L250. Seminar in Romance Linguistics—Prerequisite: L204.
2 units, spring, (———), TTh 2

L270. Topics in Structural Linguistics.
2 units, autumn, winter, (———), TTh 9

ROU. ROUMANIAN COURSES

Rou221. Intensive Roumanian—for first-year students.
5 units, autumn, (I. Juilland), MTWThF 11

Rou222. Intensive Roumanian—Continuation of Rou221.
5 units, winter, (I. Juilland), MTWThF 11

Rou223. Intensive Roumanian—Continuation of Rou222.
5 units, spring, (I. Juilland), MTWThF 11

3 units, autumn, (I. Juilland), MWF 10

Rou232. Advanced Roumanian Grammar and Composition, and Literature Survey II—Continuation of Rou231.
3 units, winter, (I. Juilland), MWF 10
3 units, spring, (I. Juilland), MWF 10

Rou241. Structure of Roumanian I—Phonology.
2-3 units, autumn, (A. Juilland), by arrangement

Rou242. Structure of Roumanian II—Morphology.
2-3 units, winter, (A. Juilland), by arrangement

2-3 units, spring, (A. Juilland), by arrangement

T. TEACHER TRAINING COURSE

TF199. Practice Teaching in French in the Elementary Schools—May be taken for six quarters. Prerequisite: Fr54 or equivalent.
1 unit, any quarter, (———), by arrangement

See also Senior Colloquia.

GEOGRAPHY

Emeritus: C. Langdon White (Professor)

Lecturer: Joseph E. Terry (Lieutenant Colonel, USAF)

Courses in Geography are offered by the School of Humanities and Sciences to students who wish to supplement their work in other fields. Geography may not be selected as a major or minor subject.

COURSES

5 units, autumn, (White), MTWThF 8
or winter, (White), MTWThF 8
or summer, (White), MTWThF 8

4. Economic Geography—Relation from the world point of view, of man's industries—agriculture, lumbering, mining and quarrying, fishing, manufacturing, transportation, commerce—to the natural environment.
5 units, winter, (Terry), MTWThF 9
or summer, (White), MTWThF 9

8. Regional Geography—A survey of the regions of the world to describe the physical environment in each major area, the unique conditions thus imposed upon mankind, and the pattern of activity which man has evolved under these circumstances. Prerequisite: Geography 1.
5 units, spring, (White), MTWThF 8

175. Individual Study in Geography—This course may be taken to do reading and work in Geography. Prerequisite: Geography 1 or 4. Geography 175 may not be repeated.
2 to 5 units, by arrangement

191. Political Geography—Geographical pattern of major nations; territorial structure, resources, industry, communications, national aspirations, special consideration to role of United States in world. Establishment of base for analyzing current international trends.
4 or 5 units, spring, (Terry), MTWTh 9
HISPANIC AMERICAN and LUSO-BRAZILIAN STUDIES

Director: Ronald Hilton
Assistant to the Director: ———
Lecturers: Luis Bertonasco, Burnett Bolloten, William Kemnitzer, Sir Harold Mitchell, James L. Taylor, ———

The Program of the Institute of Hispanic American and Luso-Brazilian Studies is an area or regional program in that it concerns itself with a definite area—Spain, Portugal, and Latin America—but this is a cultural rather than a geographical region.

The program emphasizes the use of the Spanish and Portuguese languages; the study of a foreign area without a mastery of the language of that area is comparable to engineering without mathematics. Authorities from Spain and Latin America regularly address in Spanish or Portuguese the core faculty-student seminar which prepares the Hispanic American Report (see below) and engage in discussion with members of the seminar. The Hispanic American Studies program strives to bridge the dangerous gap between the humanities and the social sciences.

Every program must have a focus, depending on the idiosyncrasies of the civilization studied and on the peculiar interests which have developed at any given institution. The predominant obsession of the Hispanic world today is politics—not the abstract variety which flourishes in more metaphysical lands, but a peculiarly personalistic brand, involving a day-to-day struggle in which revolution and unrest are often accompanied in a paradoxical way by economic and social growth. This focus is provided through the Hispanic American Report, a monthly publication founded in 1948, which has as its theme the political, social and economic development of the area. The Report is prepared by the Seminar (HAS 248) which provides a continuing thread through the advanced student's work, while the basic area analyses are taught in the Hispanic World series of courses (HAS 142-148). Hispanic American Studies awards a certificate to those students who have worked on the Hispanic American Report for at least a year.

The Institute of Hispanic American and Luso-Brazilian Studies cooperates closely with the Department of Modern European Languages. Other disciplines such as geography, government, history, economics, sociology, and anthropology contribute to the symposium which constitutes Hispanic American Studies. The Schools of Education and Mineral Sciences likewise cooperate with this program.

The Institute has its own building, Bolivar House; this is a sufficient mailing address. Within the Institute there is a Luso-Brazilian Center which coordinates teaching and research in the Portuguese and Brazilian fields.

PROGRAMS OF STUDY

The requirements for the Bachelor of Arts, Master of Arts, and Doctor of Philosophy are as follows:

Bachelor of Arts

Language—The sequence of reading and composition courses, terminating with Third-Year Spanish Grammar and Composition (Modern European Languages Sp113)

Civilization—The Hispanic World (HAS 142-148) ................. 10 units

Literature—Two courses of Spanish or Spanish American literature... 6 units
History—Two courses on Latin American History .................. 8 units
Inter-American Relations—Latin America and the United States (Political Science 138, 5 units), or one course on advice of director .... 5 units
Anthropology or Economics—one course on advice of director .... 4 units
Students who wish to minor in any special field of interest may do so by completing 16 units of work in that field.

Master of Arts

Candidates for the Master's degree in Hispanic American and Luso-Brazilian Studies must fulfill satisfactorily the following requirements:
1. A reading, writing, and oral knowledge of Spanish or Portuguese, and a reading knowledge of the other of these two languages.
2. A satisfactory completion of courses followed. A minimum of 36 units is required with a grade of A or B, not including credit for the thesis.
3. A thesis for which 9 units of credit are granted. Nine units of additional course work may be substituted for thesis with the permission of the Director.
4. The student's program will stress the language, civilization, literature, geography, history, and political affairs of modern Spain and Latin America, with special reference to one of the following areas: Spain and Portugal, Mexico, Central America, the Caribbean Islands, Gran Colombia (Colombia, Ecuador, Venezuela, West Coast countries (Bolivia, Chile, Peru), River Plate countries (Argentina, Paraguay, Uruguay), or Brazil. Students are assigned to the section of the Hispanic American Report covering the area in which they are specializing. Students wishing to work exclusively in Spanish language and literature and Hispanic American Studies may also take an A.M. in Spanish with a specialization in Hispanic American Studies. See under Modern European Languages. Students may begin their A.M. program in any quarter. Those planning to begin in the summer will receive special consideration, and those planning to begin in the autumn quarter should arrive if possible early in September to familiarize themselves with the operation of the Institute.
5. All students must take a general examination in the field. A preliminary test will be given at the end of the first quarter.

Doctor of Philosophy

There are two Ph.D. programs in Hispanic American Studies. The first is general in character, the courses being selected from the offerings of various departments according to the aims and interests of the candidate. It is administered under Graduate Division Special Programs. There is a core program consisting of the Seminar on Contemporary Latin America, Spain, and Portugal, and the study of the Spanish and Portuguese languages. Students for the Ph.D. will study three of the areas listed under the A.M. program, it being permissible to count Brazil as two areas. Students specializing in Brazil will be expected to achieve a higher degree of competency in Portuguese than those specializing in the Spanish-speaking countries. Candidates for the Ph.D. will take two examinations, the one on the departmental level covering the general field of study of the candidate; it will normally be taken before the candidate has made substantial progress on his dissertation. The university examination will consist of a defense of the completed dissertation.

Those planning to teach in a language department may obtain a Ph.D. in Spanish with a specialization in Hispanic American Studies. The Hispanic American Institute cooperates in this program with the Department of Modern European Languages, which has a number of teaching assistantships for prospective language teachers. In this program, all candidates for a Ph.D. in Spanish must take a program lasting about a year and consisting of equal parts of language and linguistics, literature and Hispanic American Studies. They may then specialize in any of the three fields mentioned. Since the work on the Hispanic American Report is organized as far as possible in the autumn for the academic year, students entering this program
are strongly urged if possible to enter HAS 248 in the autumn quarter. Candidates who do not propose to specialize in Hispanic American Studies should consider the advisability of remaining in the seminar for three quarters in order to qualify for the certificate mentioned above. Students specializing in literature or linguistics are welcome to continue work in Hispanic American Studies if they wish to present this as an area of study on their final examination. A minimum of two quarters of HAS 248 is required of all students working for a Ph.D. in Spanish.

Teaching Credentials

The Hispanic American Studies program was developed with the assistance and encouragement of the School of Education, since the subject matter meets the professional needs of high school teachers among others. An A.B. in Hispanic American Studies is a logical point of departure for students who wish to obtain a teaching credential with a major in Spanish and a minor in Social Studies or one of the social sciences. Consult the Credential Secretary of the School of Education for further information. Students preparing for an A.M. in the Teaching of Spanish are also urged to consider the advisability of working in Hispanic American Studies.

COURSES

HAS 142. The Hispanic World—Spain and Portugal.
2, 3, or 4 units, any quarter, (Hilton), by arrangement

HAS 143. The Hispanic World—Mexico and Central America.
2, 3, or 4 units, winter, (Hilton), TTh 8

HAS 144. The Hispanic World—The Caribbean.
2, 3, or 4 units, spring, (Hilton), TTh 8

HAS 145. The Hispanic World—The Pacific Coast Republics.
2, 3, or 4 units, autumn, (Hilton), alternate years, to be given in 1964–65

HAS 146. The Hispanic World—The River Plate Republics.
2, 3, or 4 units, winter, (Hilton), alternate years, to be given in 1964–65

HAS 147. The Hispanic World—Brazil.
2, 3, or 4 units, spring, (Hilton), alternate years, to be given in 1964–65

HAS 148. The Hispanic World—Problems of Spain, Latin America. May be repeated for credit.
2, 3, or 4 units, autumn, (Hilton), TTh 8

The Hispanic World courses (HAS 142–HAS 148), given in English, provide, with convenient regional subdivisions, a general picture of Spain, Portugal, and Latin America (geography, history, social organization, culture). These courses are the basic requirement for the Hispanic American major, and provide a valuable background for students of Spanish and Latin American literature. They are also intended to give non-specialists basic information about the Spanish- and Portuguese-speaking world.

HAS 161. La economía de Latinoamérica—Conferencias en español sobre la economía de los países latinoamericanos.
2 to 3 units, autumn, (Bertonasco), Th 2–4

HAS 170. Development in Latin America—With special reference to the development of resources in certain countries.
2 to 3 units, summer, (Kemnitzer), MWF 10 and one hour by arrangement

HAS 171. Development in Latin America. Mexico and the West Coast Countries of South America—A study based on first-hand analysis of change in these countries.
2 to 3 units, (Mitchell)

HAS 172. Development in Latin America, The Caribbean, including Central America and Venezuela—A study based on first-hand analysis of change in these countries.
2 to 3 units, (Mitchell)
HAS173. Development in Latin America, Brazil, and the River Plate Countries—A study based on first-hand analysis of change in these countries.
   2 to 3 units, (Mitchell), to be given in 1964-65

HAS174. Contemporary Brazil—An introduction to the various aspects of Brazilian civilization.
   2 to 3 units, summer, (Taylor), by arrangement

HAS175. Modern Spain—Spain before the Civil War.
   2 to 4 units, autumn, (Bolloten), Th 11-1

HAS176. Modern Spain—The Civil War.
   2 to 4 units, winter, (Bolloten), Th 11-1

HAS177. Modern Spain—Spain since the Civil War.
   2 to 4 units, spring, (Bolloten), Th 11-1

HAS191. Area Analysis of Contemporary Latin America—A cooperative seminar with the participation of specialists from commercial, academic, and governmental organizations.
   2 to 3 units, (Hilton and Hispanic American Studies Staff), by arrangement

HAS199. Directed Reading (Undergraduate).
   Any quarter, by arrangement

   2 to 3 units, autumn, (——), M 2-4

   2 to 3 units, winter, (——), M 2-4

HAS233. Civilização Brasileira: A literatura e a vida intelectual.
   2 to 3 units, spring, (——), M 2-4

Courses 231-3 are reserved for advanced students in Hispanic American Studies, and are especially appropriate for those students who are working for an A.M. or Ph.D. in Hispanic American Studies with a specialization in Luso-Brazilian studies. For instruction in the Portuguese language, see under Modern European Languages.

HAS234. História Econômica do Brasil I.
   2 to 3 units, autumn, (——), W 2-4

HAS235. História Econômica do Brasil II.
   2 to 3 units, winter, (——), W 2-4

HAS236. História Econômica do Brasil III.
   2 to 3 units, spring, (——), W 2-4

HAS237. A Economia Brasileira.
   2 to 3 units, summer, (——), by arrangement

HAS238. Seminário Especial sobre Portugal e o Brasil.
   2 to 3 units, each quarter, (Hilton and ——), by arrangement

HAS239. Social and Linguistic Developments in Brazil—A study of the expanding vocabulary of Brazilian Portuguese under the influence of social and technical developments. A seminar for students trained in Portuguese.
   2 to 4 units, any quarter, (Taylor), by arrangement

HAS242-247. The Hispanic World—Directed Reading.
   Any quarter, by arrangement

HAS248. Seminar on Contemporary Latin America, Spain, and Portugal—Special attention is paid to political, social, economic, and cultural developments. This seminar produces the monthly Hispanic American Report. Given on a continuing basis, it is the core of the HAS graduate program.
   3 to 5 units, each quarter (Hilton, Hispanic American Report Committee), TTh 10

   2 to 4 units, any quarter, by arrangement

HAS299. Directed Reading (Graduate).
   Any quarter, by arrangement

HAS300. Thesis.
   Any quarter, by arrangement

HAS375. Individual Work (Graduate)
   Any quarter, by arrangement
COURSES IN ADVANCED PORTUGUESE

Note: For courses in elementary Portuguese, see under Modern European Languages.

P199. Individual Work—Thirty-six hours of reading per unit; weekly conference with instructor. May be repeated for credit.
   1 to 3 units, each quarter, (Hilton), by arrangement

P211. Advanced Portuguese—Prerequisite: P7 or equivalent.
   4 units, autumn, (———), MTWTh 1

P212. Advanced Portuguese—Continuation of P211.
   4 units, winter, (———), MTWTh 1

P213. Advanced Portuguese—Continuation of P212.
   4 units, spring, (———), MTWTh 1

P299. Individual Work—Exclusively for graduate students working on thesis or engaged in special work.
   1 to 12 units, each quarter, (Hilton), by arrangement

For other courses relevant to Hispanic American Studies see below:

Anthropology
Peoples of South America—See Anthropology 158.
Peoples of Middle America—See Anthropology 161.

History
Latin America to 1825—See History 176.
Modern Latin America—See History 177.
Latin America Since 1939—See History 178.
Historical Evolution of Mexico—See History 179.
Directed Reading in Latin American History—See History 184.
Senior Research in Latin American History—See History 185.

Modern European Languages
Second-Year Reading: (The Development of Latin America)—See Modern European Languages Sp23a.
Reading in Current Periodicals—See Modern European Languages Sp120.
Hispanic American Cultural Readings: (The Life of Simón Bolívar)—See Modern European Languages Sp121.
Hispanic American Cultural Readings: (The life of José Vasconcelos)—See Modern European Languages Sp122.
Modern and Contemporary Spanish Literature—See Modern European Languages Sp134, 135.
Literatura hispanoamericana—See Modern European Languages Sp186, 187, 188 189.
Historia de la literatura española—See Modern European Languages Sp211, 212, 213, 214, 215.
La novela española moderna—See Modern European Languages Sp223.
La novela hispanoamericana—See Modern European Languages Sp224.

See also under Modern European Languages for courses in the Portuguese language.
HISTORY

Emeriti: Carl Fremont Brand, Harold Henry Fisher, Yamato Ichihashi, Ralph Haswell Lutz, Edgar Eugene Robinson, Payson Jackson Treat (Professors)

Executive Head: Gordon Wright


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 year; earlier only if the student's background seems adequate to his adviser; not later than the junior year, save with the approval of his adviser. Admission to a basic seminar requires the approval of the instructor.

Each undergraduate major in history shall, in consultation with his adviser, select a minor to consist of a coherent group of courses totaling at least 25 units, to fall within one of the following categories: (1) A social science minor of at least 15 units in one subject, plus 10 elective units. Of the 15 units in one subject, at least one (but preferably two) of the courses should be advanced courses. The subjects acceptable for a social science minor are anthropology, economics (except accounting), geography, political science, psychology (except courses primarily laboratory in nature), and sociology. (2) A minor in humanities of at least 15 units in one subject (including some advanced courses) plus 10 elective units. The subjects acceptable under this requirement are classics, literature (including foreign language courses
above 23), philosophy, religion, the history of science, and the history of the visual arts and of music. (3) The Honors Program in Humanities.

The Cory and Riotte scholarships are available for undergraduate women students in the Department.

In order to provide for students with special 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 students the Department will offer a special program leading to a Bachelor's degree with Honors in History. To be eligible a student must have at least a B average in History and normally the same standing in the University. The candidate must fulfill the basic seminar requirement, be sponsored by a member of the Department, and have Department approval for his program. Normally students will begin this work in the winter or spring quarter of the third year and after completion of the basic seminar. Students electing the Honors Program will (1) take a minimum of 60 units in history, (2) meet the usual requirements for distribution and a minor, (3) complete a course on Interpretations of History, (4) take an independent study program of 12 units extending over a period of three quarters, and (5) write a senior thesis. A comprehensive examination, mainly upon the independent study work, will be given upon the completion of this program. The Department will recommend that recipients of the James Birdsall Weter scholarships be selected from among honors candidates and that special weight for University honors at graduation be given for the quality of work done under this Department program.

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, Room 43, School of Education.

Graduate Study

Graduate students who are candidates for advanced degrees will be given personal guidance, but the purposeless graduate student will not be accepted by the Department. For the degree of Master of Arts, the University Library contains adequate material in all of the conventional areas of historical study. There are certain special fields, or substantial portions thereof, in which the Department, by virtue of the specialized interests of its staff and the unusual resources of the Library, is prepared to offer graduate work leading to the Ph.D. degree.

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 Belgium 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 revolutions and political ideologies of international importance; colonial and minority problems; propaganda and public opinion; military occupation; peace plans and movements; international relations; international organization and administration, including the publications of the League of Nations, the World Court, the International Labor Office, and the United Nations, as well as the principal international conferences. The collection on the Pacific since 1939 is being enlarged.

2. British History—(a) English History since 1200, for which the Library contains important documentary sets; (b) The British Empire, with special reference to Canada since 1840, to India, and to Australia.

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.

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 Executive Head of the Department. Note that this program is open only to those with at least one year's teaching experience.

Doctor of Philosophy

The Department offers work for the Ph.D. degree in the fields listed above where the Stanford libraries contain rich collections of source material. The 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 and two secondary fields to be selected from the following: (1) Ancient History (the Greek and Roman world); (2) Europe, 300–1400; (3) Europe, 1400–1789; (4) Europe since 1700; (5) Russia and East Central Europe; (6) The Near and Middle East; (7) The Far East; (8) Britain and the British Empire since 1485; (9) Latin America; (10) The United States (including Colonial America). The candidate in consultation with his adviser will choose a dissertation field within the major field. The student and his adviser, together with the professors in the secondary fields concerned, may delimit a particular area of study within these fields for primary consideration.

A minor in another department or a supporting program of not fewer than thirty 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 a 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 three 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, autumn, (Staff), M11 and three hours by arrangement
or summer, (Staff), five hours to be scheduled

#2. History of Western Civilization—Major developments in Western Civilization in later Middle Ages, Renaissance, seventeenth and eighteenth centuries.
4 units, winter, (Staff), M 11 and three hours by arrangement

#3. History of Western Civilization—Nineteenth, twentieth centuries.
4 units, spring, (Staff), M 11 and three hours by arrangement

II. INTERMEDIATE COURSES

Courses numbered 10–99 are designed primarily for sophomores and juniors.

20. Medieval Europe, 300–1300—Emphasis on transition from ancient Mediterranean to European civilization, development of medieval social, cultural institutions and ideas.
5 units, autumn, (Bark), MTWTh 9

5 units, autumn, (Harris), MTWThF 10
   5 units, winter, (Harris), MTWThF 10
32. Europe Since 1914—Political, social, economic, cultural developments to present.
   5 units, spring, (Wright), MTWThF 10
40. England to 1603—English people, survey of their political, economic, social, cultural history.
   5 units, autumn, (Langmuir), MTWThF 11
60. Interpretive Survey of U.S. History.
   3 to 5 units, spring, (O'Connor)
65. American Social History—Emergence of American people; development, conflicts of social classes; impact of expansion, industrialization, urbanization upon society.
   5 units, autumn, (Knoles), MWF 10, to be given in 1964–65
91. Far Eastern Civilizations: Traditional Period—The origin and development of the civilizations of China and Japan.
   5 units, autumn, (Liu), MTWThF 11
92. Far Eastern Civilizations: Modern Period—The development of the civilizations of China and Japan in the period of Western impact since 1800.
   5 units, winter, (Smith), MTWThF 11
93. The West and the Far East—Middle of nineteenth century to recent times.
   5 units, spring, (Buss), MTWThF 11
95. Masterpieces of Historical Literature.
   4 units, (Staff), offered at overseas campuses only

III. ADVANCED COURSES

Courses numbered 100–104 (Basic Seminars and Honors courses) are open only to juniors and seniors majoring in History. Lecture courses numbered 105–199 are open to juniors, seniors, and graduate students; 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. Basic Seminars and Honors Courses

100a. Basic Seminar.
   5 units, winter, (Bark), T 2–4
100b. Basic Seminar.
   5 units, autumn, (Langmuir), Th 2–4
100c. Basic Seminar.
   5 units, autumn, (Spitz)
100d. Basic Seminar.
   5 units, autumn, (Spitz)
100e. Basic Seminar.
   5 units, winter, (Craig)
100f. Basic Seminar.
   5 units, winter, (Harris)
100g. Basic Seminar.
   5 units, winter, (Vucinich)
100h. Basic Seminar.
  5 units, winter, (Wright)
100i. Basic Seminar.
  5 units, spring, (Lyman)
100j. Basic Seminar.
  5 units, autumn, (O'Connor)
100k. Basic Seminar.
  5 units, spring, (Fehrenbacher)
100m. Basic Seminar.
  5 units, autumn, (Miller)
100n. Basic Seminar.
  5 units, winter, (Potter)
100p. Basic Seminar.
  5 units, autumn, (Pease)
100q. Basic Seminar.
  5 units, spring, (Johnson)
100r. Basic Seminar.
  5 units, winter, (Buss)
100s. Basic Seminar.
  5 units, spring, (Liu)
100t. Basic Seminar.
  5 units, autumn, (Smith)
100u. Basic Seminar.
  5 units, winter, (Knolcs), to be given in 1964–65

104. Interpretations of History—Required of students enrolled in the undergraduate honors program in History.
  4 units, spring, (Harris), TTh 2–4

B. THE ANCIENT WORLD

See Classics, Section V, Courses H100, H101, H102, H103, H104, H200, H205, 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, winter, (Bark), TTh 2
106. Social and Economic History of the Middle Ages.
  3 units, spring, (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, spring, (Langmuir), MWF 9
  5 units, autumn, (Spitz), MTWTh
110. Age of the Reformation—Europe in early modern times with special emphasis on the Protestant Reformation and Catholic reform.
  5 units, winter, (Spitz), MTWTh
111. Humanism, Protestantism, and Catholicism—The intellectual history of early modern Europe with special emphasis on the great humanist and religious classics of the period.
  3 units, spring, (Spitz), MTW 1
114. Directed Reading in Medieval History.  
3 to 5 units, (Bark, Langmuir), by arrangement
115. Senior Research in Medieval History.  
Units not to exceed 5, (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.  
Units not to exceed 5, (Spitz), by arrangement

D. MODERN EUROPE

120. Russia—Founding of first Russian state to collapse of Russian Empire, 1917.  
5 units, autumn, (Masour), MTWThF 8
121. The Russian Revolution—Revolutionary era from fall of Tsarist government to present-day Soviet Russia. Prerequisite: History 31, 32, or 120.  
5 units, winter, (Masour), MTWThF 8
122. Soviet Foreign Policy—Foreign Policy in the West, Near, Middle, and Far East, 1917 to present.  
3 units, spring, (Masour), MWF 8
124. Ottoman Empire—Origin, development, and decline of the Ottoman Empire. An appraisal of Ottoman institutions and civilization. International diplomacy and the emergence of the so-called Eastern Question.  
5 units, autumn, (Vucinich), MTWThF 10
125. History of the Balkan Peoples Prior to 1914—Dissolution of the Ottoman Empire and the rise of modern Albania, Bulgaria, Greece, Rumania, Turkey, and Yugoslavia. Development of nationalism and the founding of national states in the Near East.  
5 units, winter, (Vucinich), MTWThF 8
126. History of the Balkan Peoples Since 1914.  
5 units, spring, (Vucinich), MTWThF 8
128. Germany in the Nineteenth Century.  
4 to 5 units, autumn, (Craig)
129. Germany in the Twentieth Century.  
4 to 5 units, winter, (Craig)
131. The French Revolutionary Epoch in Europe.  
3 to 4 units, autumn, (Wright), to be given in 1964–65
132. Modern France—Foundations of Third Republic to present.  
3 to 4 units, autumn, (Wright)
134. Intellectual History of Europe—Analysis of major currents of thought beginning with Natural Law.  
4 units, spring, (Harris), MTWTh 11
135. European Diplomacy Since 1815.  
4 to 5 units, spring (Craig), MWF 9
136. European Labor and Socialist Movements—Comparative study of the development of trade unions and working-class political movements since 1848, principally in Britain, France, Germany, and Russia.  
4 to 5 units, autumn, (Lyman), MTWThF 8, alternate years, to be given in 1964–65
138. Directed Reading in Modern European History.  
3 to 5 units, (Craig, Harris, Masour, Vucinich, Wright), by arrangement
139. Senior Research in Modern European History.  
Units not to exceed 5, (Craig, Harris, Masour, Vucinich, Wright), by arrangement

E. THE BRITISH COMMONWEALTH AND EMPIRE

140. English Constitutional History—Anglo-Saxon origins, Norman innovations; legal, administrative, parliamentary development under Angevins; limitation of royal power, rise of cabinet system, democratization of Constitution.  
5 units, winter, (Langmuir), MTWTh 9
141. Britain, 1603–1832—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, winter, (Lyman), MWThF 11

142. Britain Since 1832—See description of 141 (above).
4 to 5 units, spring, (Lyman), MWThF 11

143. The British Empire and Commonwealth—Development of the British Empire and of colonial policy in the nineteenth and twentieth centuries; growth and expression of nationalism in Commonwealth countries.
4 to 5 units, autumn, (Lyman), MTWThF 8, alternate years, to be given in 1963–64

145. Directed Reading in British History.
3 to 5 units, (Langmuir, Lyman), by arrangement

146. Senior Research in British History.
Units not to exceed 5, (Langmuir, Lyman), by arrangement

F. The United States

150. The Colonial Period.
3 units, autumn, (Miller)

151. The Revolution, Confederation, and Constitution.
5 units, winter, (Miller)

152. The Colonial Mind—Advanced study of Colonial period through biographical approach to representative figures in fields of politics, art, religion, literature, science, American response to currents of thought from Great Britain, Europe.
3 units, spring, (Miller)

154. American Diplomatic History to 1898.
4 to 5 units, autumn, (O'Connor), MTWTh 9

155. American Diplomatic History since 1898.
4 to 5 units, winter, (O'Connor), MTWTh 9

157. The West in American History to 1860—Colonial background and the influence of the Trans-Appalachian West upon American development before the Civil War.
4 units, autumn, (Fehrenbacher), MTTh

158. The Great West in American History—Exploration, settlement, and historical influence of the Trans-Mississippi West.
4 units, winter, (Fehrenbacher), MTTh

159. History of California—From Spanish period to present, emphasis upon twentieth century.
4 units, spring, (Fehrenbacher), MTTh

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.
5 units, autumn, (Potter), MTWTh 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.
5 units, winter, (Potter), MTWTh 11

162. The Civil War and Reconstruction, 1850–1877—Political, constitutional, economic, cultural, military aspects of conflict between North and South, emphasis on its lasting effects on American civilization.
4 units, spring, (Pease)

163. The Age of Big Business, 1877–1919—Government and the economy in the era of business capitalism; the industrial ethos and progressive reform.
4 units, autumn, (Pease)
164. The United States since 1920—Growth of political and economic power during prosperity, depression, and international conflict; accompanying transformation in American culture.
4 units, winter, (Pease)

4 to 5 units, winter, (Knoles), MWF 10, to be given in 1964–65

4 to 5 units, spring, (Knoles), MWF 10, to be given in 1964–65

170. Interpretations of the American Character—The concept of national character; problems and methods in the study of group character; some social science approaches; travelers' accounts and other historical materials; American social history as a source; historical forces, both traditional and recent, in the shaping of American character. Open to advanced students by permission of instructor.
4 units, spring, (Potter), MWF 2

174. Directed Reading in United States History.
3 to 5 units, (Fehrenbacher, Miller, O’Connor, Pease, Potter), by arrangement

175. Senior Research in United States History.
Units not to exceed 5, (Fehrenbacher, Miller, O’Connor, Pease, Potter), by arrangement

G. LATIN AMERICA

176. Latin America to 1825—Discovery, conquest, growth of political, social, economic institutions; Wars of Independence in Spanish, Portuguese America.
5 units, autumn, (——), MTWThF 11

177. Modern Latin America—Political, social, economic institutions in leading republics since independence.
5 units, winter, (Johnson), MTWThF 11

178. Latin America since 1939—War and post-War attitudes of the Latin American peoples and governments on such current issues as labor organization, social welfare, the “active” State, foreign investment, nationalism and internationalism.
3 units, spring, (Johnson), MWF 12, alternate years, to be given in 1963–64

179. Historical Evolution of Mexico—Economic, social development since 1850 and Mexican foreign relations, especially with United States in twentieth century.
3 units, spring, (——), MWF 12

184. Directed Reading in Latin American History.
3 to 5 units, (——), by arrangement

185. Senior Research in Latin American History.
Units not to exceed 5, (——), by arrangement

H. EAST ASIA

190. Institutional History of China—Topical analysis of key institutions.
3 units, winter, (Liu), MWF 10, alternate years, to be given in 1964–65

3 units, winter, (Liu), alternate years, to be given in 1963–64

192. Modern China—1800 to the present, emphasis on rebellions, reforms, revolutions, and resistance to changes
3 units, spring, (Liu), MWF 10

193. Communist China—Origin and rise of the Chinese Communist party; internal developments and foreign policy of China under the Communists.
3 units, autumn, (Buss)

194. History of Modern Japan—End of the “feudal” period; emergence of Japan
as a modern state; evolution of new economic and social institutions; problems of cultural change.

5 units, autumn, (Smith), MWF 10

195. History of Modern India—Traditional Indian society and thought; establishment of British dominion; achievement of independence; problems of economic development and cultural change.

3 units, spring, (Smith), MWF 11

196. United States and the Far East—Genesis, growth of American interests, policies in Far East, emphasis on immediate background of contemporary period.

3 units, winter, (Buss), MWF 8

198. Directed Reading in Far Eastern History.

3 to 5 units, (Buss, Liu, Smith), by arrangement

199. Senior Research in Far Eastern History.

Units not to exceed 5, (Buss, Liu, Smith), 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, spring, (Bark)

210. Graduate Seminar in Early Modern Europe.

5 units, winter, (Spitz)

220. Graduate Seminar in Russian History.

5 units, spring, (Masour), by arrangement


5 units, autumn, (Vucinich)

228. Graduate Seminar in Modern Germany.

5 units, autumn, (Craig)


5 units, spring, (Wright)

240. Graduate Seminar in Medieval English History.

3 to 5 units, winter, (Langmuir)

243. Graduate Seminar in Modern British History.

5 units, autumn, (Lyman)

250. Graduate Seminar in American Colonial History.

5 units, spring, (Miller)

252. Graduate Seminar in Nineteenth Century United States History.

5 units, winter, (Fehrenbacher)

253. Graduate Seminar in Twentieth Century United States History.

5 units, winter, (Pease)

255. Graduate Seminar in American Diplomatic History.

5 units, winter, (O'Connor), W 3–5


5 units, spring, (Knoles), to be given in 1964–65

260. Graduate Seminar in History of the South.

5 units, autumn, (Potter)

262. New Interpretations of United States History.

5 units, spring, (Potter)

280. Graduate Seminar in Latin America History.

5 units, autumn, (Johnson)

290. Graduate Seminar in the History of China.

5 units, autumn, (Liu)
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, autumn, (Wright), or winter, (Lyman)

301. American Historiography—Main currents in historical research and writing relevant to United States from earliest days.
   5 units, spring, (O'Connor), W 3-5

302. The Teaching of History—Methods of teaching history at the college level.
   1 unit, autumn, winter, or spring, (Staff), by arrangement

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, spring, (Spitz)

325. Graduate Colloquium: Topics in Balkan and Near East History.
   5 units, spring, (Vucinich)

328. Graduate Colloquium: Topics in Modern European History.
   5 units, spring, (Craig)

335. Graduate Colloquium: Europe 1890–1950.
   5 units, winter, (Wright)

338. Directed Reading in Modern European History.
   Units by arrangement, (Craig, Harris, Masour, Vucinich, Wright)

339. Graduate Research in Modern European History.
   Units by arrangement, (Craig, Harris, Masour, Vucinich, Wright)

340. Graduate Colloquium: Topics in Modern British History.
   5 units, spring, (Lyman)

345. Directed Reading in British History.
   Units by arrangement, (Langmuir, Lyman)

346. Graduate Research in British History.
   Units by arrangement, (Langmuir, Lyman)

358. Graduate Colloquium: American Social and Intellectual History.
   5 units, autumn, (Knoles), to be given in 1964–65

359. Graduate Colloquium: American Military Policy.
   5 units, spring, (O'Connor)

360. Graduate Colloquium: American Politics from Jackson to Lincoln.
   5 units, winter, (Fehrenbacher)

374. Directed Reading in United States History.
   Units by arrangement, (Fehrenbacher, Miller, O'Connor, Pease, Potter)

375. Graduate Research in United States History—Guidance of graduate students preparing A.M., Ph.D. theses, other properly qualified graduates by permission of instructor.
   Units by arrangement, (Fehrenbacher, Miller, O'Connor, Pease, Potter)
380. Graduate Colloquium in Latin American History.
5 units, spring, (Johnson)

384. Directed Reading in Latin American History.
Units by arrangement, ( )

385. Graduate Research in Latin American History.
Units by arrangement, ( )

390. Graduate Colloquium: Topics in Chinese History.
5 units, winter, (Liu)

398. Directed Reading in Far Eastern History.
Units by arrangement, (Buss, Liu, Smith)

399. Graduate Research in Far Eastern History.
Units by arrangement, (Buss, Liu, Smith)

HUMANITIES (SPECIAL PROGRAMS)

Executive Head: John W. Dodds
Acting Director: Paul H. Kocher (Graduate Program in Humanities)
Consulting Professor: Paul Fejos (Humanities and Anthropology)
Professors: Robert McAfee Brown (Religion), Paul Harold Kocher (English and Humanities).
Associate Professors: Edwin M. Good (Religion and Hebrew), Jeffery Smith (Humanities and Philosophy)
Assistant Professor: H. Jackson Forstman (Religion)

Special Programs in Humanities include:
1. Undergraduate Honors Program in Humanities
2. Graduate Program in Humanities
3. Curriculum in Religion.

UNDERGRADUATE HONORS PROGRAM


Freshmen and sophomores who are interested in the Honors Program described below should consult with the chairman of the Honors Committee (Room SIM). It is desirable that the student begin to plan his program as early as possible.

Purpose of the Program
The Honors Program aims to develop in its students a greater sense of the relatedness of various fields of knowledge and experience, and to increase their 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 Honors student to plan a balanced and integrated program.

Admission to the Program
Students wishing to enroll in the program should apply to the Chairman of the Committee, and students planning to attend campuses abroad should confer with him as early as possible as to adjustments in scheduling courses, and possible substitutions where necessary.

A University average of at least B is required for admission to the program and for graduation with Honors in Humanities.

The program is open to qualified students majoring in any department of the University. All students will take the same basic humanities requirements. Ad-
ditional requirements, however, vary with different groups. There are three such groupings.

1. If the student plans to major in one of the humanistic departments (Art and Architecture, Asian Languages, Classics, English, History, Modern European Languages, Music, Philosophy, Speech and Drama) the program supplements the regular departmental major. Thus the student will be graduated in the department of his choice plus "Honors in Humanities." In some cases the Honor Program serves as a departmental minor.

2. The student majoring in a social, biological, or physical science should plan with the help and approval of his tutor, a group of courses of at least 12 units (in addition to the regular honors courses). These should be in one of the humanistic departments; some of them may be in individual work. Since the senior essay must relate to the humanities, the courses should be chosen to provide an appropriate and definite background for the essay.

3. In certain exceptional cases (for example, when the student is taking a pre-medical or education-credential curriculum) the student may enroll as a Humanities major.

Requirements of the Program

1. Requirements normally completed during the first two years:
   a) The "World Literature" sequence—Humanities 61, 62, 63—12 units.
   b) Philosophy, a minimum of 4 units, other than Logic.
   c) Fine arts (music, art and architecture, theater), a minimum of 8 units.

2. Requirements during the third year:
   Participation for three quarters (4 units each quarter) in the Humanities Seminar, 12 units.

3. Requirements during the fourth year:
   a) Participation, for two quarters, in the Senior Colloquia in Humanities, 4 units.
   b) Senior essay—In his senior year each honors student will write a senior essay on a subject growing out of his departmental field, but not confined to it. A credit of 8 units is allowed for the essay. A grade of at least a B is required on the essay for graduation with Honors in Humanities.
   c) Oral examination—Upon completion of his essay each student must take an oral examination centered in the field of the essay and testing the student’s critical abilities. The student’s performance will be considered by the Committee in determining the grade on the senior essay.

Courses, First and Second Year

21, 22, 23. World Personalities—A study of the lives and personalities of a number of significant men and women, including such individuals as Jesus, Socrates, St. Francis, Leonardo da Vinci, Madame Curie, Gandhi, and Hitler.

   3 to 4 units, autumn, (Smith), MWF 10, to be given in 1964–65

22. World Personalities: Renaissance and Modern.
   3 to 4 units, winter, (Smith), MWF 10, to be given in 1964–65

23. World Personalities: Twentieth Century.
   3 to 4 units, spring, (Smith), MWF 10, to be given in 1964–65

#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.
HUMANITIES (SPECIAL PROGRAMS)

#61. Classic Literature—Homer, Greek dramatists, Plato, Aristotle, Lucretius, Vergil, Gospels of Mark and John.

4 units (5 units for Honors students), autumn, (Otis, Staff), TTh 11
and one hour by arrangement (two hours for Honors students)

#62. Medieval and Renaissance Literature—Medieval epics, Augustine, Aquinas, Dante, Marlowe, Thomas More, Cervantes, Erasmus, Calvin, Montaigne, Spenser, Molière, others.

4 units (5 units for Honors students), winter, (Whitaker, Staff), TTh 11
and one hour by arrangement (two hours for Honors students)

#63. Literature of the Enlightenment and the Modern World—Camus, Dostoevsky, Flaubert, Goethe, Ibsen, Kafka, Rousseau, Sartre, Voltaire, others.

4 units (5 units for Honors students), spring, (Weinstein, Staff), TTh 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, autumn, winter, spring, (Franklin), by arrangement

191, 192, 193, Interdepartmental Seminars in Humanities.

191. A study of the lives and personalities of certain significant individuals, such as Heloise, Rousseau, Nietzsche, Lincoln, Van Gogh, and Gandhi.

4 units, autumn, (Heimbeck, Smith), by arrangement

192. The Arts as they relate to human experience and values, approached through case studies using works of art drawn from several fields, including literature, music, and the plastic arts.

4 units, winter, (Kerans, Mueller-Vollmer, ———), by arrangement

193. The concern of men as philosophers and historians to determine the possibilities of reason in the ordering of their societies.

4 units, spring, (Pease, Mueller-Vollmer, ———), 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, autumn, (Stegner, Mothershead), by arrangement

or spring, (Good, Mueller-Vollmer), by arrangement

200. Senior Essay—An essay of about 15,000 words.

8 units, (Staff), by arrangement

See also Senior Colloquia.

GRADUATE PROGRAM

Committee in Charge: John W. Dodds (Chairman), Raymond D. Giraud, John D. Goheen, David Harris, James Kerans, Paul H. Kocher (Acting Director), Brooks Otis, Philip H. Rhinelander, Lawrence V. Ryan, 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.

Requirements

a) 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.

b) Within the Program:

1. Continued work in the candidate's major field in accordance with departmental requirements. For these requirements the prospective student should consult the departmental listings.

2. 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 Middle Ages (3d quarter); The Renaissance (4th quarter); The Eighteenth and Nineteenth Centuries (5th quarter); The Modern Period (6th quarter).

3. Participation in the Graduate Humanities Seminar. The Seminar discusses basic intellectual and educational problems of the present in the light of Western traditions. The themes of the first quarter may change from year to year. That of the last quarter is fixed. Topics treated in 1962-63 were: Renaissance Conceptions of Man (2d quarter); The Functions of a University and the Meaning of Education (3d quarter).

4. 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.

5. 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.

6. 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 addressing the Director of the Program.

Graduate Courses

301, 302, 303. The Western Traditions.

301. The Classic Period: Greece.
   4 units, autumn, (Rhinelander), MTWTh 9

302. The Roman and Patristic Periods.
   4 units, winter, (Otis, Strothmann), MTWTh 9

303. The Middle Ages.
   4 units, spring, (Staff), MTWTh 9

304, 305, 306. The Western Traditions.

304. The Renaissance.
   4 units, autumn, (Kocher, Ryan), MTWTh 9, alternate years, to be given in 1964-65
305. The Eighteenth and Nineteenth Centuries.
4 units, winter, (Staff), MTWTh 9, alternate years, to be given in 1964–65
306. The Modern Period.
4 units, spring, (Giraud, Kerans), MTWTh 9, alternate years, to be given in 1964–65
351, 353. Basic Humanistic Problems.
351. Basic Humanistic Problems.
4 units, winter, (Kocher), MW 2–4
353. The Functions of a University and the Meaning of Education.
4 units, spring, (Wert), TTh 2–4

RELIGIOUS STUDIES

Committee in Charge: John W. Dodds (Chairman), Robert McAfee Brown, H. Jackson Forstman, Edwin M. Good, Robert M. Minto, Brooks Otis, 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 world-views. Certain of the offerings are listed in the General Studies Program Bulletin to which reference should be made.

COURSES

4 units, autumn, (Good), to be given in 1965–66
4 units, winter, (Forstman), TWThF 10
4 units, winter, (Good), TWThF 9
#R104. History of Christian Thought: to A.D. 1500—A study of the origin and development of Christian doctrine through the scholastic period, with particular focus on recurrent issues: faith and reason; incarnation and atonement; Church and culture.
4 units, autumn, (Forstman), TWThF 10
#R105. History of Christian Thought: since A.D. 1500—Roman Catholic and Protestant developments during and after the century of the Reformation. Correlation of these developments with other cultural movements.
4 units, winter, (Forstman), TWThF 10
R106. The Protestant Reformation: The Life and Thought of Martin Luther—Major themes and controversies in the theology of Luther: Papacy, Monasticism and Ethics, Sacramentalism, Humanism, Radical Religion and the State, Faith, Biblical Authority, God, Christ, Church.
4 units, spring, (Forstman), TWThF 10
R113. Introduction to Christian Thought—Major areas of doctrine, in Protestant perspective. Particular attention to problem of revelation and reason, and Christian views of God, man, Christ, the church, providence and evil, death and resurrection.
4 units, winter, (Brown), TWThF 11
#R114. Christian Ethics—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.

4 units, spring, (Brown), TWThF 11

R115. Contemporary Trends in Religious Thought—Examination of the thought of present-day theologians such as Niebuhr, Bultmann, Tillich, Barth, and others, through study of their own writings.

4 units, spring, (Brown), TWThF 11, to be given in 1964–65

R120. Religion in America—Critical assessment of the “return to religion,” theological and sociological factors involved. Major attention to Protestantism, Roman Catholicism, and Judaism. Occasional guest lecturers to represent various traditions on the American scene.

4 units, spring, (Brown), TTh 2–4

# R150. Christian Classics—One or two major works will be studied in their religious and historical setting and for their permanent significance. Probable subject: 1963–64: Controversies on the Nature of Christ, 4th–5th centuries A.D.

2 units, winter, (Good), TTh 1

R155. The Prophets of Israel—One or more of the most significant prophets as poets and thinkers. Major motifs: Covenant, Sin, Judgment, Mercy, Future Hope.

4 units, autumn, (Good), TWThF 1, to be given in 1965–66


4 units, spring, (Good), MW 2–4

R165. The Four Gospels—Character, relations of Synoptic Gospels. The Fourth Gospel and its thought. Historical Jesus and the Church’s faith in the Christ.

4 units, autumn, (Forstman), TWThF 9, to be given in 1964–65


4 units, autumn, (Forstman), TWThF 11

# R182. Theology and Contemporary Literature—Theological issues raised by contemporary writers, both Christian and non-Christian. Consideration of Camus, Salinger, Greene, Eliot, Paton, Arthur Miller, Steinbeck, and others.

4 units, winter, (Brown), TWThF 2

R186. Theology of History—Problems in historical understanding and a critical examination of the understanding of history by Christian theologians such as R. Niebuhr, P. Tillich, R. Bultmann, N. Berdyaev, J. Maritain, M. D'Arcy.

4 units, winter, (Forstman), TTh 2–4


4 units, spring, (Forstman), TWThF 9

R190. Christianity and Culture—Seminar for juniors and seniors. Historical consideration of various types of relationship between Christianity and culture. Discussion of contemporary issues, such as nonreligious alternatives to Christian faith, impact on Christianity of social and political ideologies, relation of theology to other intellectual disciplines (e.g., science, philosophy). Admission by permission.

4 units, spring, (Brown, Staff), TTh 2–4, to be given in 1964–65

R199. Individual Work.

(Staff), by arrangement

For related courses see the departments of Anthropology, Classics, English, History, Modern European Languages, and Philosophy.

See also Senior Colloquia.

Hebrew Language: See Classics.
LINGUISTICS

Committee in Charge:
Chairman: Alphonse Juilland
Professors: Robert W. Ackerman, Alphonse Juilland, C. H. van Schooneveld
Associate Professor: A. Kimball Romney

PROGRAMS OF STUDY

Master of Arts

1. 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.

2. Requirements
a) Language
A reading knowledge of French and German, as established by Committee examination or certification.

b) Course
40 units of graduate work, selected among courses listed below, and distributed approximately as follows:
1) 15 units in general linguistics (descriptive, comparative, and historical linguistics; phonology, morphology, syntax; lexicology, dialectology, typology; etc.);
2) 15 units in a particular language or language family (graduate courses of the chosen language department);
3) 10 units in a particular linguistic discipline (e.g., Anthropological Linguistics, Psycholinguistics, Sociolinguistics, Statistical Linguistics; etc.).

c) Examination
Satisfactory passing of an oral examination on the principles of Linguistics and on the particular language or language family chosen by the student.

d) Thesis
A thesis of some scope and originality (5 units).

Doctor of Philosophy

1. 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 Psychology, or in Sociology, or in Speech Pathology and Audiology, etc.).

2. Requirements
a) Language
A working knowledge of French and German, to be established by Committee examination or certification; a reading knowledge of a third language, such as Russian or Spanish, is strongly recommended.
b) Course (beyond the A.M.)

40 units of graduate work, selected among courses listed below, numbered 200 or above, and distributed approximately as follows:

1) 15 units in general linguistics (descriptive, comparative, historical linguistics; phonology, morphology, syntax, lexicology, dialectology, typology, etc.);

2) 15 units in a particular language or language family (graduate courses of a given language department);

3) 10 units in a related discipline (e.g., Anthropological Linguistics, Mathematical Linguistics, Psycholinguistics, Sociolinguistics, Statistical Linguistics, etc.).

c) Examination

Successful passing of a written Committee examination and of a University oral 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.);

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., Indoeuropean Linguistics, or Amerindian Linguistics, or African Linguistics, etc.; Romance Linguistics, or Germanic Linguistics, or Slavic Linguistics, etc.).

d) Dissertation

An original dissertation of such substance and scope as would justify publication (up to 36 units).

COURSES

Courses recognized toward the A.M. and Ph.D. degrees in Linguistics are those listed below, and those approved by the Committee.

General Courses: A101. Science of Language. (See French and Italian.)


Asian Languages: J381, J382. History of the Japanese Language.

Communication and Journalism: 211. Theory of Communication I; 212. Theory of Communication II.


French: Fr204. Etudes de style; Fr205. Modern French; Fr310. Old French; Fr311. Old French Texts. (See French and Italian.)

German: G205. Modern German; G251. Gothic and Historical German Grammar; G253. Old Norse; G255. Old Saxon; G257. Old High German; G258. Middle High German; G259. Advanced Middle High German. (See Modern European Languages.)

Romance Linguistics and Philology: L180. An Introduction to the Study of Language; L203. Vulgar Latin; L204. Introduction to Romance Linguistics; L205. Old Provençal; L250. Seminar in Romance Linguistics; L260. Applied Linguistics; L270. Topics in Structural Linguistics. (See French and Italian or Modern European Languages.)

Roumanian: Rou221, Rou222, Rou223. Intensive Roumanian; Rou231, Rou232, Rou233. Modern Roumanian—Literature, Composition and Advanced Grammar; Rou241, Rou242, Rou243. The Structure of Roumanian. (See French and Italian.)


Speech and Drama: 1. Characteristics of Spoken Language.


Teaching Training: T400. Seminar in the Use of a Language Laboratory; T401. Seminar in the Development of Laboratory Techniques. (See Modern European Languages.)

MATHEMATICS

Emeriti: Stefan Bergman, Charles Loewner, William Albert Manning, George Polya, Gabor Szegö (Professors)

Executive Head: David Gilbarg
Associate Executive Head: Karel deLeeuw
Professor of Education and Mathematics Education: Edward G. Begle
Assistant Professors: Paul Fife, Mary Virginia Sunseri. Acting: William Pohl
Instructors: Reuben Hersh, Stephen S. Shatz, Ta-Sun Wu
COMPUTER SCIENCE DIVISION

Director: George E. Forsythe
Professors: George E. Forsythe, John George Herriot, John McCarthy
Visiting Professor of Computer Science and Statistics: Albert W. Tucker (winter quarter)
Visiting Assistant Professor: Gene H. Golub
Instructor: Harold R. Van Zoeren
Affiliated Faculty: Robert Vernon Oakford, Professor of Industrial Engineering (on leave 1963-64)

OFFERINGS AND FACILITIES

The introductory courses consist of four alternative sequences in analytic geometry and calculus (10, 11, 21, 23, 44, 45, 46, or 41, 42, 43, 44, 45, 46, or 41, 52, 53, 54, 55, or 41, 62, 63, 64). 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, 64 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 can often 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; in some cases the student may be asked to take a supplementary examination prepared and administered by the Department in order to complete requirements for advanced placement. 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 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,
MATHEMATICS

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 (114a, 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) 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 2.0.

4. French 23, German 23, or Russian 23; 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 must achieve a satisfactory score in the Department's comprehensive examination.

For the degree of Master of Science in Computer Science, see below.

**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, and 212. 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. In addition he should be expert in communicating with automatic digital computers. His program of study should include Computer Science 136, 137, 138, 237a, b, c, 236a, b or 238a, b, 382 (or equivalent courses taken elsewhere). In view of the several requirements in Computer Science, consideration will be given to a reduction in the variety of other mathematics courses required for the degree.

For further information concerning degree programs, requirements for a Ph.D.
Teachers' Credentials

The requirements for a teaching major in mathematics for the General Secondary Credential are: Courses 10, 11, 21, 22, 23, 24 (or 41, 42, 43, 24, or 41, 52, 53, 54) together with 21 units selected from courses numbered 100 or above, and in addition, 15 units selected from courses numbered 100 or above or in courses in other departments requiring extensive application of mathematics. 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, 24 (or 41, 42, 43, 24, 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 129, 142, and 157 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."

COMPUTER SCIENCE DIVISION
OFFERINGS AND FACILITIES

The Computer Science Division aims to acquaint students with the power and capabilities of automatic digital computers as revolutionary tools for research and operations in many different fields of human activity. 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.

Since the solutions of many problems involve the execution of very large numbers of individual instructions, each of which is obeyed in a few microseconds, it is essential that the machines prepare their own instructions. Thus one of the basic problems of computer science is the design of languages for the description of algorithms and the preparation of translation programs for the generation of machine programs from the algorithms stated in the language. The Computer Science Division offers courses and carries on research in this area.

One use of computers is for the extension or simulation of human perceptual and cognitive activities in recognizing patterns, manipulating symbols, and solving problems. The Computer Science Division offers courses and carries on research in these areas, collectively known as "artificial intelligence."

Computer science also includes numerical analysis, the study of data processing, the design of computer systems, etc. The Division offers both beginning and advanced courses in numerical analysis, and is actively engaged in research in this area.

Courses in data processing are offered by the Industrial Engineering Department and in the Graduate School of Business. Computer system design is studied in the
Electrical Engineering Department. Several other departments offer courses which are of interest to students of computer science.

In connection with its courses and research, the Division makes considerable use of the Computation Center. See the section, "Computation Center," in this Bulletin.

Students majoring in mathematics who wish to specialize in computer science should include Computer Science 136, 137, and 138 in their course of study. There is no Bachelor's degree in computer science.

There is no regular Ph.D. degree program in Computer Science. As described above, Ph.D. students specializing in Computer Science will ordinarily work for the Ph.D. in Mathematics. Some students in other departments may write Ph.D. dissertations under the supervision of members of the Computer Science Division.

If it seems appropriate, and if a student is especially well qualified, a special program may be arranged. (See "Graduate Division Special Programs" in this Bulletin.)

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 requirements of this Division for the Master of Science in Computer Science:

A candidate is expected to complete an approved course program of 45 units; at least 36 units will be in this Division, or in the Mathematics Department, or selected from relevant courses in such other departments as Statistics, Philosophy, Psychology, or Electrical Engineering. (See the list of suggested courses at the end of the course offerings in Computer Science below.)

As an undergraduate or graduate student he should have taken Mathematics 106, 114a, b, 115, 130, 131 and Computer Science 136, 137, 138, or equivalent courses elsewhere. The candidate should take 6 units of Computer Science 239, Computer Science 236a, b or 237a, b or 238a, b, and 9 additional units of courses numbered 200 or above.

The candidate must have a B average in his course work.

INTRODUCTORY AND UNDERGRADUATE COURSES

Introductory courses will be offered only if ten or more students enroll.

A. Algebra—Fundamental laws: negative and fractional powers; quadratic equations, curve plotting, logarithms, binomial theorem, complex numbers.

3 units, autumn or winter, (------), MT WThF 10, 12, or 2

C. Plane Trigonometry—Trigonometric functions; identities, equations; solution of right triangles, oblique triangles, including use of logarithms; applications to practical problems; De Moivre's theorem. Continuation in course depends upon student's passing a qualifying examination given during first week of course and covering algebra.

3 units, autumn or winter, (------), MTWThF 10, 12, or 2

#1. Elementary Mathematical Analysis I—Structure of the real number system; logic of algebra; fundamental concepts of geometry. No credit allowed if taken after courses numbered 10 or higher.

3 units, autumn or winter

#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, winter or spring

#3. Elementary Mathematical Analysis III—Continuation of courses 1 and 2. Further study of fundamental concepts of algebra and geometry with emphasis upon logical structure; applications. Recommended for candidates for teaching credentials
with specialty in Elementary Education. No credit allowed if taken after courses numbered 10 or higher. Prerequisites: 1 and 2.

3 units, alternate years, to be given in 1963-64

#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 plane trigonometry.

3 units, autumn, (--), MWF 8, 10, or 2
or winter, (--), MWF 10, 12, or 2

#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, winter, (--), MWF 8, 10, or 2
or spring, (--), MWF 10, 12, or 2

#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 functions, the logarithmic and exponential functions. Prerequisite: 11.

3 units, autumn, (--), MWF 8 or 3
or spring, (--), MWF 8, 10, or 2


3 units, autumn, (--), MWF 9, 11, or 1
or spring, (--), MWF 8 or 3

#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 derivatives. Prerequisite: 22.

3 units, winter, (--), MWF 9, 11, or 1
or spring, (--), MWF 8 or 3

#24. Analytic Geometry and Calculus—Continuation of 23 or 43 (below). 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, l'Hospital’s Rule, absolute and conditional convergence, differential equations of first order (homogeneous, linear, exact). Prerequisite: 23 or 43.

3 units, autumn, (--), MWF 8, 9, or 11
or winter, (--), MWF 8 or 12
or spring, (--), MWF 9, 11, or 1

#41. Analytic Geometry and Calculus—41 and 42 together cover the same subjects as 10, 11, 21, and part of 22. Requirements for admission to 41 same as for 10.

5 units, autumn, (--), MTWThF 8 or (--), MTWThF 9 or (--), MTWThF 10 or 2
or winter, (--), MTWThF 12
#42. Analytic Geometry and Calculus—Continuation of 41.
5 units, winter, (———), MTWThF 8, 9, 10, or 2
or spring, (———), MTWThF 12

#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 derivatives, differential equations of first order (homogeneous, linear), special second order differential equations. Prerequisite: 42.
5 units, autumn, (———), MTWThF 8, 9, or 10
or spring, (———), MTWThF 12

#44. Advanced Calculus I—Infinite series, convergence tests, parallel topics on improper integrals. Uniform convergence. Power series, Fourier series. Prerequisite: 23 or 43 or concurrent registration in 23 or 43 and consent of instructor.
3 units, autumn, (———), MWF 8, 9, or 1
or winter, (———), MWF 12
or spring, (———), MWF 9 or 11

#45. Advanced Calculus II—Vectors in the plane and space, linear dependence, inner product, wedge product, vector product. Geometry of lines and planes. Vector functions of one variable, curves and motion. Scalar functions of several variables, gradient, partial derivatives, differentials, extreme values, line integrals. Prerequisite: 44 or concurrent registration in 44 and consent of instructor.
3 units, winter, (———), MWF 8, 9, or 1
or autumn, (———), MWF 9 or 11

#46. Advanced Calculus III—Multiple integrals, vector functions of several variables, divergence theorem, Stokes’ theorem. Curvilinear coordinate systems, differential geometry of surfaces. Vector spaces of higher dimension. Prerequisite: 45.
3 units, winter, (———), MWF 9 or 11
or spring, (———), MWF 8 or 9

#54. Honors Calculus—54 and 55 together constitute an honors version of 44, 45, 46.
3 units, autumn, (———), MWF 9

#55. Honors Calculus—54 and 55 together constitute an honors version of 44, 45, 46.
3 units, winter, (———), MWF 9

#62. Calculus—(Enroll in Statistics 62.)

#63. Calculus—(Enroll in Statistics 63.)

64. Calculus—(Enroll in Statistics 64.)

Courses for Undergraduate and Graduate Students

Calculus through Mathematics 24 or 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.
3 units, autumn, (———), MWF 11, or (———), MWF 2
or spring, (———), MWF 8
or summer (———)

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, winter, (——), MWF 11

114a. 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: Fields, linear equations; 
vector spaces, linear dependence, bases and coordinate systems; linear transforma-
tions and matrices, rank and nullity, equivalence, congruence.
3 units, autumn, (——), MWF 9, or (——), MWF 11 
or winter, (——), MWF 10, or (——), MWF 1
or summer

114b. Linear Algebra and Matrix Theory—Continuation of 114a. A deeper study 
of the algebra of matrices. Topics include: Similarity and characteristic values; inner 
products, orthogonal and Hermitian matrices; orthogonal congruence and the reduc-
tion of quadratic forms.
3 units, winter, (——), MWF 9 
or spring, (——), MWF 10

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, autumn, (——), MWF 11, or (——), MWF 10 
or winter, (——), MWF 11, or (——), MWF 10

3 units, winter, (——), MWF 11 
or spring, (——), MWF 11

120. Modern Algebra—Integral domains, fields, polynomials, divisibility theory, 
groups. Prerequisite: 114a.
3 units, winter, (——), MWF 1 
or spring, (——), MWF 1

121. Modern Algebra—Continuation of 120.
3 units, spring, (——), MWF 1

123. Theory of Probability—This is an introductory course to the theory of prob-
ability 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, winter, (Chung), MWF 4

124. Theory of Probability—Continuation of 123.
3 units, spring, (Chung), MWF 4

129. Elementary Mathematics from the Higher Point of View—Special em-
phasis on methodical, historical points; ideas of broader scientific interest. Intended 
primarily for candidates for teaching credentials in mathematics.
3 units, spring, (Bacon), MWF 8

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, autumn, (——), MWF 8, 11, or 2 or winter, (——), MWF 10 
or summer, (——)
131. Partial Differential Equations I—Boundary value problems for wave, heat equations; separation of variables, Fourier series, Bessel functions.
   3 units, winter, (——), MWF 8, 11, or 2
   or spring, (——), MWF 10

132. Partial Differential Equations II—Boundary value problems for Laplace's equation; Legendre polynomials, spherical harmonics, Poisson's formula, Green's functions.
   3 units, spring, (——), MWF 8, 11, or 2

136. Use of Automatic Digital Computers—(Enroll in Computer Science 136.)

137. Numerical Analysis—(Enroll in Computer Science 137.)

138. Numerical Analysis—(Enroll in Computer Science 138.)

139. Intermediate Computer Programming—(Enroll in Computer Science 139.)

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, autumn, (Bacon), MWF 8

143. Topics in Geometry—Discussion of the various geometries and the axiom systems which characterize them; the concept of betweenness and the axiom of Pasch; Desargues's theorem and the introduction of coordinates; consequences of the metric axioms; elliptic, Euclidean, and hyperbolic planes. Prerequisites: 120 and 142.
   3 units, winter, (Royden), MWF 11

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, autumn, (Szegő), MWF 2

   3 units, winter, (Szegő), MWF 2

157. Non-Euclidean Geometry—Hyperbolic, elliptic plane geometry, trigonometry
   3 units, autumn, (Bacon), MWF 8, alternate years, to be given in 1964–65

160a. Symbolic Logic—Propositional and restricted predicate calculi. Validity, provability, consistency, completeness, definability, decision problems for these calculi. (Enroll in Philosophy 160a.)
   3 units, winter, (Tait), MWF 2

160b. Symbolic Logic—Continuation of 160a. (Enroll in Philosophy 160b.)
   3 units, spring, (Tait), MWF 2

161. Introduction to Set Theory—Operations on sets, relations, functions, ordering relations, well-orderings, equipollence of sets, transfinite induction, axiom of choice, discussion of axiomatization of set theory. (Enroll in Philosophy 161.) Prerequisite: consent of instructor.
   3 units, autumn, (Tait), MWF 1

162. Theory of Automata—An introduction to the theory of finite automata, Turing machines, and certain intermediate types of logical networks. (Enroll in Philosophy 162.) Prerequisite: consent of instructor.
   3 units, autumn, (——), MWF 2

195. Undergraduate Colloquium—Based on reading and discussion of topics in History and Philosophy of Mathematics. Prerequisite: Consent of instructor.
   3 units, winter, (Hawley), T 2–4

199. Undergraduate Honors.
   (Staff), by arrangement
COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS

205a, b, c. Theory of Functions of a Real Variable—Point set topology in metric spaces and more general spaces. Functions of bounded variations, absolute continuity, Lebesgue measure, and the Lebesgue-Stieltjes integral. More advanced theories of measure and integration. Prerequisite: 116 or equivalent.

3 units, autumn, winter, and spring, (Phillips), MWF 11

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.

3 units, autumn, winter, and spring, (Loewner), MWF 10

210a, b, c. Modern Abstract Algebra—Groups, field extensions and Galois theory; commutative rings and modules; Dedekind domains; local algebra; introduction to homological methods in algebra. Prerequisite: 120 or equivalent; 121 may be helpful.

3 units, autumn, winter, and spring, (Shatz), TTh 9:30-10:45

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 taken by all first-year students having good backgrounds who are seriously considering the Ph.D. degree.

3 units, autumn, (Loewner), MW 4:00-5:30

214a, b. Infinite Processes—A thorough treatment of infinite series and infinite products. Summability of series, especially linear transformations which preserve convergence. The methods of Cesaro, Hölder, M. Riesz, Abel, Euler and Borel are discussed and applied to various problems in analysis. Theory of continued fractions whose elements are numbers or functions; applications to the approximation of irrational numbers by rational ones and to problems of diophantine approximations. Prerequisites: 115 and 116.

3 units, autumn and winter, (Szego), MWF 3


3 units, autumn, (Hawley), MWF 2

and winter, (Pohl), MWF 12

220a, b, c. Methods of Mathematical Physics—Potential theory, Green's functions, integral equations; Hilbert space approach to problems of mathematical physics; elementary spectral theory; variational methods.

3 units, autumn, winter, and spring, (Schiffer), TTh 11:00-12:15

221a, b. Calculus of Variations—Euler-Lagrange equations, theory of fields, Hilbert integral, sufficient conditions; applications to eigenvalue problems, geometry, mechanics; direct methods, Dirichlet's principle, conformal mapping and Plateau's problem.

3 units, winter and spring, (Finn), MWF 2

225. Difference Equations—Theory and methods for the solution of linear difference equations which express recurrences between functions defined either at integer arguments or in terms of a continuous variable. Applications of difference equations to problems in analysis and physics.

3 units, spring, (Levine), MWF 2

230a, b. 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 Statistics 230 a, b.) Prerequisite: 123, 124, 205a or equivalent courses.

3 units, winter and spring, (Karlin), TTh 1:15-2:30

232a, b. Topics in Stochastic Processes—Selected topics in Markoff processes, with special attention to branching, birth and death, queueing and diffusion processes.

3 units, autumn and winter, (Karlin), MWF 9
232c. Topics in Stochastic Processes—The topics covered will be independent of those in 232a, b.

3 units, spring, (Chung), MWF 2

236a, b. Advanced Computer Programming—(Enroll in Computer Science 236a, b.)

237a, b, c. Advanced Numerical Analysis—(Enroll in Computer Science 237 a, b, c.)

239. Computer Laboratory—(Enroll in Computer Science 239.)

240a, b. Selected Topics in Function Theory.
3 units, autumn and winter, (Tammi), TTh 1:15–2:30

243a, b. Conformal Mapping—Prerequisite: 206b.
3 units, autumn and winter, alternate years, to be given in 1964–65

244a, b. Riemann Surfaces—Theory of abstract Riemann surfaces; classical existence theorems; Abelian differentials; Riemann-Roch theorem, and Abel’s theorem. The problem of moduli and quasiconformal mapping. Open Riemann surfaces. Prerequisites: 206a, b, c.
3 units, winter and spring, (Royden), MWF 10

3 units, spring and summer, (Hörmander), TTh 11:00–12:15

246a, b. Complex Manifolds—Introduction to complex analytic manifolds and fiber bundles, theory of Harmonic integrals, and deformation of complex structures. Prerequisite: 206.
3 units, autumn and winter, (Spencer), MWF 1

249. Transform Theory—Selected topics from classical transform theory including Fourier, Laplace, Hankel, Mellin, Lebedeff transforms with applications to boundary value problems. Prerequisite: 206b.
Alternate years, to be given in 1964–65

252a, b. Orthogonal Polynomials—Definition and principal properties of orthogonal polynomials with particular references to special classes and problems of importance in probability and mathematical statistics.
Alternate years, to be given in 1964–65

254a, b. Advanced 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, winter and spring, (Latta), MWF 1

3 units, autumn, winter, and spring, (Berg), MWF 2

3 units, spring, (Gilbarg), TTh 9:30–10:45
3 units, autumn, winter, and spring, (Cohen), MWF 11

263. Lie Groups—Topics from: elementary properties, classical groups; Lie algebra; structure theory and classification; representations.
3 units, autumn, (Samelson), TTh 9:00-10:15

265a, b. Selected Topics in Abstract Analysis
3 units, autumn and winter, (deLeeuw), MWF 11

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.
3 units, autumn and winter, (Levine), MWF 2

272a, b. Fluid Dynamics—Foundations of hydrodynamical theory; mathematical problems associated with the equations of motion; dynamics of fluid motion; linearized theory of compressible flow; compressible fluid theory.
3 units, autumn and winter, (Schiffer), MWF 10

273. Electromagnetic Theory—A systematic characterization of field equations, conservation laws and interfacial (or boundary) conditions by means of variational principles. Representation theorems for the fields due to prescribed or equivalent sources in finite and infinite domains.
Alternate years, to be given in 1964-65

3 units, spring, (Hawley), MWF 2

3 units, autumn, winter, and spring, (Samelson), MWF 9

283a, b. Selected Topics in Topology—Topics from: Fiber spaces and fiber bundles, characteristic classes, cohomology operations, sheaves, homology of groups. Prerequisite: 281 or equivalent.
Alternate years, to be given in 1964-65

291a, b, c. Set Theory—Axiomatic set theory; cardinal and ordinal numbers; alternative axiomatizations, questions of consistency and independence. Prerequisite: 161 or consent of instructor.
Alternate years, to be given in 1964-65

293a, b, c. Recursion Theory—Decidability and undecidability; examples of unsolvable mathematical problems. Recursive functions and recursively enumerable sets. The final quarter will discuss more advanced topics (e.g., recursive functionals, recursive equivalence types; metamathematical applications of recursive theory to undecidability of particular mathematical theories) as the interests of the instructor and students warrant. (Enroll in Philosophy 293a, b, c.) Prerequisite: consent of instructor.
3 units, autumn, winter, and spring, (Feferman), MWF 1

297. Theory of Algebras—Structure theorems; simple algebras, division algebras, applications to group theory.
3 units, winter, (———), by arrangement
MATHEMATICS

360. Advanced Reading and Research.
   *Any quarter, (Staff), by arrangement*

   *By arrangement*

381. Seminar in Analysis
   *By arrangement*

382. Seminar in Computer Science—(Enroll in Computer Science 382.)
   *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*

391. Seminar in Foundations of Mathematics.
   *By arrangement*

COMPUTER SCIENCE

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

CS5. Computer Programming for Engineers—This course is an introduction to 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 students. Prerequisites: Mathematics A and C, or equivalents.

   2 units, autumn, (Van Zoeren), MW 3
   or spring, (——), MW 3

CS136. Use of Automatic Digital Computers—Methods of utilizing automatic digital computers in the solution of problems. Study of problem-oriented languages for description of algorithms. Programming of elementary problems from mathematics and other fields, and testing the programs on a computer. Freshmen and sophomores with strong backgrounds in high school mathematics may enroll with consent of instructor. In spring quarter, the section MWF at 11 is directed to students of social science and the humanities, and is closed to students of mathematics, engineering, or the physical sciences, and to students with prior experience in computing.

   3 units, autumn, (Herriot), MWF 11, or (——), MWF 1
   or (——), TTh 9:35-10:50
   or winter, (——), MWF 10, or (——), MWF 1
   or spring, (Forsythe), MWF 11, or (——), MWF 1

CS137. Numerical Analysis—This course and 138 are designed to acquaint seniors and graduate students of mathematics, science, and engineering with methods of solving technical problems on automatic digital computers. Problems discussed include numerical differentiation and integration, solution of linear and nonlinear equations and systems of equations, solution of differential equations, and approximation of functions. Introduction to the analysis of convergence and errors. Pitfalls in automatic computation and their remedies. The section at 11 is especially suited to students of science and engineering, while that at 2 is especially suited to students of mathematics and computer science. Prerequisites: Mathematics 114a, 130, and CS136, or equivalents.

   3 units, winter, (Forsythe), MWF 11, or (Herriot), MWF 2

CS138. Numerical Analysis—Continuation of CS137. The instructor may occasionally give permission to take CS138 without CS137. The sections at 11 and 2 will continue as described under CS137.

   3 units, spring, (Herriot), MWF 11 or 2

3 units, Winter, (Van Zoeren), MWF 1

Courses Intended Primarily for Graduate Students

CS236a, b. Advanced Computer Programming—Selected topics from the theory and practice of devising languages for communication between men and digital computers, and constructing machine programs to translate among these languages, including construction of ALGOL translators and development of programming and operating systems for modern high-speed digital computers. Prerequisite: CS136 or consent of instructor.

3 units, Winter and Spring, (Van Zoeren), TTh 9:35-10:50


3 units, Autumn, (^——), MWF 2
and Winter, (^——), MWF 2
and Spring, (^——), MWF 2

CS238a, b, c. Selected Topics in Computer Science—In 1963-64 the following will be included: Autumn: Computing with symbolic expressions; the LISP language. Winter: A mathematical theory of computation. Spring: Artificial intelligence. Prerequisite: graduate standing and experience with some programming language.

3 units, Autumn, Winter, and Spring, (McCarthy), TTh 11:00-12:15

CS239. Computer Laboratory—Prerequisite: CS138 or CS139 (or equivalent). A substantial computational program is undertaken and written up.

AnyQuarter, (Staff), by arrangement

CS360. Advanced Reading and Research.

AnyQuarter, (Staff), by arrangement

CS382. Computer Science Seminar—There is ordinarily a section on numerical analysis and one on non-numerical aspects of computer science.

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

The following courses offered in other departments may be of interest to students of Computer Science:

Data Processing—See Industrial Engineering 110, 161, 210, 257, 261, and 263.
Data Processing in Business Problems—See Business 367, 368, and 369.

Linear Programming—See Statistics 255.
Statistical Inference in Economics—See Economics 272.
Advanced Statistical Methods in Psychology—See Psychology 250.
Organizational Behavior—See Psychology 213 and 267.
Mathematical Models in Behavioral Sciences—See Behavioral Sciences offerings.

Mathematical Logic—See Philosophy 160a, b.
Recursion Theory—See Philosophy 293a, b, c.
Theory of Automata—See Philosophy 162.
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.

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 U. S. 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.

CURRICULUM

The curriculum embraces general military science subjects common to all branches of the Army, such as psychology and techniques of leadership, U.S. Army and national security, U.S. 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 classroom 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. Military science is not offered during the summer quarter. 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.
DEFERMENT—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, and in the case of nonveterans not more than 23 years of age. 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

A monetary allowance of approximately $27 per month for the last two years of the course is made to students in good standing. Uniforms and texts are supplied without cost.

ROTC SUMMER CAMP

Every student attends one six-week ROTC summer camp normally between the junior and senior academic year. 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.

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, autumn

1 unit, winter


1 unit, spring

Each course normally has eight sections meeting at the following hours: lec. (I) M 8, lec. (II) M 9, lec. (III) M 10, lec. (IV) M 1:15, lec. (V) M 2:15, lec. (VI) M 3:15, lec. (VII) T 10, lec. (VIII) T 11

**SECOND-YEAR COURSES**


2 units, autumn

22. **American Military History and Map and Aerial Photograph Reading**—American Military History continued. Basic principles of map reading.

2 units, winter


2 units, spring

Each course normally has five sections meeting at the following hours: lec. (I) MW 10, lec. (II) MW 1:15, lec. (III) MW 2:15, lec. (IV) TTh 10, lec. (V) TTh 2:15

**THIRD-YEAR COURSES**

131. **Leadership and Military Teaching Principles**—Basic problems in small unit leadership. Techniques of military instruction.

2 units, autumn

132. **Military Teaching Principles, Branches of the Army**—Practical exercises in preparation, presentation, and evaluation of military instruction. Role of various branches of the Army.

3 units, winter

133. **Small Unit Tactics and Communications**—Principles of offensive and defensive combat. Communications systems, procedures, and security. Counterinsurgency operations.

3 units, spring

Each course normally has five sections meeting at the following hours: autumn, lec. (I) TTh 8, lec. (II) TTh 9, lec. (III) TTh 11, lec. (IV) TTh 1:15, lec. (V) TTh 2:15, winter and spring, lec. (I) TWHTh 8, lec. (II) TWHTh 9, lec. (III) TWHTh 11, lec. (IV) TWHTh 1:15, lec. (V) TWHTh 2:15

**FOURTH-YEAR COURSES**


3 units, autumn

142. **Army Administration and Military Law**—Personnel management. Mili-

3 units, winter


2 units, spring

Each course normally has three sections meeting at the following hours: autumn and winter, lec. (I) TWTh 9, lec. (II) TWTh 12, lec. (III) TWTh 1:15; spring, lec. (I) TTh 9, lec. (II) TTh 12, lec. (III), TTh 1:15

199. Command and Staff Procedures—Theory, practice in developing staff studies and military programs. Prerequisites: completion of basic course and permission of PMS.

1 unit, autumn, winter or spring, by arrangement

MODERN EUROPEAN LANGUAGES

Emeriti: Bayard Quincy Morgan, Kurt F. Reinhardt (Professors); Grace Knopp (Assistant Professor)

Executive Head: F. W. Strothmann
Associate Executive Heads: Aurelio Macedonio Espinosa, Jr., Cornelis H. van Schooneveld, Gertrude L. Schuelke


Associate Professors: Helmut R. Boeninger, Daniel C. McCluney, Jr., Isabel Schevill, Gertrude L. Schuelke, Ruth Hirsch Weir


Visiting: Gerhard Walter Burkhardt

Instructors: Herbert John Izzo, Gisela Luther, Rudolph Morgan. Acting: Edwin A. Hopkins

Lecturer: Nicholas S. Pashin

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 G, R, or Sp. These 35 units must include:
MODERN EUROPEAN LANGUAGES

For German majors: G100, G110, G111, G112, G113, G131, G132, G133, and G185; For Russian majors: R100, R110, R111, R112, R113, R184, and three literature courses; For Spanish majors: Sp110, Sp111, Sp112, Sp113, and three courses to be chosen from those numbered Sp131, Sp132, Sp133, Sp134 or Sp135, Sp186, Sp187, Sp188, Sp189. (Only one course of the series Sp120–126 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.

General Secondary Teaching Credential in German, Russian, or Spanish

State of California minimum requirements
For the major in any subject field: 36 semester hours or 54 quarter units.
For the minor in the subject field: 20 semester hours or 30 quarter units.

Stanford requirements
For professional education requirements, see requirements set forth by the School of Education.

All students eligible for the General Secondary Credential Program with either a teaching major or a teaching minor in a foreign language must have at least a B average in that language in courses which follow the first-year series (or their equivalent). After admission to the program, a B average must be maintained.

The following requirements must be met for certification by Stanford for teaching German, Russian, or Spanish in a California high school. Students who have received the A.B. degree in German, Russian, Spanish, or Hispanic American Studies will have fulfilled most of the requirements listed below.

Teaching minor in German, Russian, or Spanish

1. First-Year sequence (G, R, or Sp1–3) ........................................ 12
2. Second-Year sequence (G, R, or Sp52–54, or equivalent) .............. 15
3. Advanced Conversation (G, R, or Sp100) .................................... 3
4. Pronunciation (G, R, or Sp110) .............................................. 3
5. Third-Year Composition (G, R, or Sp111–113) ............................. 6–7
6. Introduction to General Linguistics and Applied Linguistics (L180 and G190 or Sp190) .................................................... 4–5*
7. Qualifying language examination ............................................. —

Total minimum for language teaching minor ............................... 43–45

*Not included in ordinary A.B. program in language; prerequisite to Ed282a and should therefore be completed before embarking on formal fifth-year Credential Program.

Teaching major in German, Russian, or Spanish

Ordinarily, an A.B. degree in the appropriate language is considered a standard condition for acceptance into the program for a major teaching credential. In exceptional cases, however, where a nonlanguage major has completed a significant amount of work in the language at an acceptable level of scholarship, the Department will waive the formal degree requirement. Regardless of the undergraduate major, the minimum requirements for a teaching major are as stated below. Most of the courses listed are supplementary to the ordinary A.B. sequence, except for the elective literature courses, which the A.B. in any language would include.
German teaching major:

1. Completion of German teaching minor (above) .......................... 43
2. G201-202. Advanced Grammar and Composition .......................... 4
3. G205. Modern German .................................................. 4
4. G185. History of the German Language ................................... 2
5. Elective: Upper division or graduate courses in German literature .... 7

Total minimum for German teaching major ................................. 60

Russian teaching major:

1. Completion of Russian teaching minor (above) ............................. 43
2. SL201-204. Synchronic Phonology, Morphology, and Syntax of Russian 11*
3. Elective: Upper division or graduate courses in Russian Literature ... 6

Total minimum for Russian teaching major ................................. 60

* Either SL201-202 or SL203-204 should be taken during the senior year.

Spanish teaching major:

1. Completion of Spanish teaching minor (above) .............................. 45
2. Sp201-202. Advanced Composition and Grammar ........................... 5
3. Elective: Upper division or graduate courses in Spanish Literature or in Hispanic American Studies ............................ 10

Total minimum for Spanish teaching major ................................. 60

Special Three-Year Master's Degree Program for College Teaching of German

In addition to the regular major programs, the Department of Modern European Languages offers, with the support of the Ford Foundation, a special three-year Master of Arts program especially designed to prepare college teachers of German. Highly qualified students begin this program at the beginning of their junior year and continue for eleven consecutive quarters. Two of these quarters are spent at a German university. This program is planned to include sufficient course work in a second foreign language to equip the student with a minor teaching field. For information regarding eligibility, admission to the program, and special scholarships write to Professor Daniel C. McCluney, Jr., Program Director, Three-Year Master's Degree Program, Office of the Dean, Graduate Division, Stanford University, Stanford, California.

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.

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 desir-
able. 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, enable him to follow a richer program during the required period of residence, and, in the event that he continue his studies, could shorten the time needed for completion of the Ph.D. degree.

The departmental requirements for the completion of the Master of Arts degree are given below:

I. 30 units of graduate work in the major field, to be distributed as follows:
   a) Advanced composition. G201, G202 4 units
   b) Proseminar and seminar. G249, G250 4 units
   c) Courses in philology or linguistics selected from G190, G205, G251-259 8 units
   d) Literature: G213; one course selected from G211, G214, and G215; and an additional course numbered 180 or higher 10 units
   e) A thesis (Individual work. G299) 4 units

II. 14 units of electives in support of the major, selections subject to the approval of the graduate adviser. With minor exceptions, these courses will be numbered 100 or higher.

III. A departmental oral examination on completion of the required courses. The thesis will generally be nearing completion at this point.

A candidate for whom the Master of Arts is a terminal degree can complete the requirements in one year. If, however, he intends to continue with work toward the Ph.D. degree, he is advised to include in his Master's program certain requirements for the higher degree. This will result in a delay before completion of the Master's degree but will appreciably shorten the additional time needed for the doctorate.

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.

The complete program of course work leading to the doctorate falls within the range of 72 to 90 units of graduate work after the A.B. degree. The lower limit may reflect superior preparation on entry or private study not evident in registered units. The dissertation may be written either before or after the oral examination.

Departmental Requirements:
I. A reading knowledge of one modern language other than English or German.
II. Course Work—The total Ph.D. requirement is measured by knowledge and not by units. The following statements may, however, serve as a guide for the selection of courses.
   a) Regardless of his field of specialization, each student needs to take the courses (45 units) listed in this section or establish that he has already fulfilled the requirement.
      1) Advanced composition. G201, G202 4 units
      2) Modern German. G205 4 units
      3) Classical literature. G213 4 units
      4) Literary and cultural history. G211, G212, G214, G215 16 units
      5) Philology and applied linguistics. G190, G251, G257, G258 13 units
      6) Two seminars beyond the A.M. requirement 4 units
   b) A minimum of 25 additional units in elective courses in German language or literature numbered 200 or higher is required. It should be noted that
this number can easily be increased for some students, while others who are more advanced on entry can apply part of the requirement to individual work for the dissertation.

c) Each candidate is to take a minimum of 18 units of advanced work either in a formal minor or in an area (such as history) other than that of German language or literature. Students enrolled in the Graduate Humanities Program fulfill this requirement automatically. Others are advised to plan a program with the help of the graduate adviser.

III. Candidates may specialize either in language or in literature. In either case, they will write a dissertation that embodies such results of research as would merit publication.

IV. A departmental as well as a university oral examination is required.

V. 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.

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. A working knowledge of Latin is also desirable.

Requirements:

I. 30 units of graduate work to be distributed approximately as follows:
   a) Advanced composition (R184) 3 units
   b) Graduate seminar 2-4 units
   c) Philology or general linguistics 8 units
   d) Three graduate courses in the history of literature 9-12 units
   e) Thesis 4 units

II. Electives chosen with the approval of the student's adviser 13-18 units

Total 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 a departmental 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 Slavic literature.
   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, candidates in Slavic
   Languages and Literatures must have a reading knowledge of two Slavic languages
   other than Russian.

6. Teaching experience in this Department is required of all candidates for the
   Ph.D. degree as a condition to receiving such degree. Teaching assistantships are
   available to help candidates fulfill this requirement, which will be waived only in the
   case of students who have a minimum of two years of teaching experience in other
   institutions.

Specialization:

1. 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 gradu-
   ate 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.

2. Candidates specializing in literature 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 they select French, German, or Spanish,
   the amount of work completed should total not less than 18 units of advanced work
   (including Fr113, G113, or Sp113).

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

General Requirements:

No student is accepted for candidacy unless he has completed the equivalent of
the training represented by the requirements for the A.B. degree in Spanish.

For the A.M. program in Hispanic American Studies, see under Institute of His-
panic American and Luso-Brazilian Studies.

Course Requirements:

I. A working knowledge of Latin.

II. 30 units of graduate-level work, to be distributed approximately as follows:
   a) Advanced composition and grammar (Sp201, Sp202) ............... 5 units
   b) Graduate proseminar and/or seminar (Sp249 and Sp250 or Sp251;
       or HAS248) .................................................................. 5 units
   c) Philology and linguistics (Li180, Sp190, Sp260 or Sp261) .... 8 units
   d) Two graduate courses in the history of Spanish and Spanish-
      American literature ....................................................... 8 units
   e) Thesis ........................................................................... 4 units
III. Advanced or graduate courses dealing with Spain or Hispanic America other than in the fields of language and literature .................. 8 units

IV. Electives in Spanish, Hispanic American Studies 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.

For the Ph.D. program in Hispanic American Studies, see under Institute of Hispanic American and Luso-Brazilian Studies.

**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. Teaching experience in the Department is required of all candidates as a condition to receiving the degree. 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.

**Specialization:**

Candidates for the Ph.D. degree in Spanish specialize in one of the following fields: Spanish literature; Spanish American literature; philology and linguistics; or Hispanic American Studies. 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 three fields. Those specializing in Hispanic American Studies will work out a program in agreement with the Institute of Hispanic American and Luso-Brazilian Studies.

**Minor:**

1. Candidates are not obliged to present a minor, but they are urged to offer one. A minor in a second language or Hispanic American Studies is strongly recommended. A minor in these fields is equivalent to the course requirements for the degree of Master of Arts.
2. Candidates who do not elect a formal minor and are not enrolled in the Grad-
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 Fr113, G113, or R113). If the minor field selected is Hispanic American Studies, a minimum of three quarters of HAS248 is required.

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.

Hispanic American Studies

The attention of students majoring in Spanish (A.B. or A.M.) is called to the possibility of qualifying for a special certificate by working for three quarters on the Hispanic American Report (HAS248). For details about this program, consult the Institute of Hispanic and Luso-Brazilian Studies.

Intensive Language Work in European Study Centers

Each student accepted by the Committee on General Studies for work at a Stanford center in France, Germany, or Italy will complete twelve units of Intensive French, German, 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, German, or Italian. All courses regardless of the level at which the work is completed bear the designation Fr, G, It80, 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.

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.

A. General Courses

#A142. The Theological Novel of Modern Europe—Lectures, discussions on theological problems in works of Dostoevsky, Bloy, Mauriac, Greene, Waugh, C. S. Lewis, Le Fort, Werfel, etc.
   3 units, spring, (Hyde), MWF 9
A150. Introduction to the Critical Reading of Literature.
   3 units, alternate years, to be given in 1964–65
A185. Existentialism in Modern Thought and Literature—Problems of human existence in the works of Pascal, Kierkegaard, Nietzsche, Heidegger, Jaspers, Rilke, Kafka, Camus, Marcel, Caruso, etc.
   3 units, summer, (Reinhardt), MTWTh 10
A199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor.
   1 to 3 units, each quarter, (Staff), by arrangement

AG. German

#AG75. Goethe's Faust—Lectures in English, reading of Faust in translation. Not open to freshmen.
   3 units, winter, (Lohner), MWF 3
AG156. Brecht—Representative works in English translation.
3 units, alternate years, to be given in 1964–65

AG181. Nietzsche—Life and works, considered in relation to contemporary German thought and culture.
3 units, alternate years, to be given in 1964–65.

AG183. Thomas Mann—Major works in both fiction and essay in English translation.
3 units, autumn, (Boeninger), MWF 9

AR. RUSSIAN

AR145. Russian Literature—Russian literature of nineteenth century up to and including Tolstoy in English translation. Open to all students except freshmen.
5 units, winter, (Posin), MTWThF 11

AR151. Fedor Dostoevsky.
3 units, autumn, (Stenbock-Fermor), MWF 9

AR153. Leo Tolstoy—Chief works of fiction in English translation. Open to all students except freshmen.
3 units, winter, (——), MWF 10

AR162. Modern Russian Literature—Social and literary scene and personalities from end of nineteenth century to present. Open to all students except freshmen.
4 units, spring, (Posin), MTWTh 10

AR191. Russian Civilization—Geography and history; peoples and institutions; religion and philosophy; language and literature; art and music. Open to all students except freshmen.
5 units, autumn, (Posin), MTWThF 11

AS. SPANISH

AS75. Don Quixote in Translation—Reading, interpretation of Don Quixote.
3 units, spring, (Schevill), MWF 2

AS150. Unamuno and Ortega—Present-day conflicts in literary works of Unamuno, Ortega y Gasset.
2 to 3 units, winter, (Schevill), alternate years, to be given in 1964–65

AS151. The Contemporary Spanish Novel in Translation—Analysis, discussion of representative works of Spanish novelists of present day.
3 units, winter, (Schevill), TTh 2

AS152. Lorca and Other Contemporary Spanish Dramatists in Translation—Modern trends, tensions as reflected in significant Spanish dramatists of present day.
3 units, spring, (Schevill), alternate years, to be given in 1964–65

AS156. Introduction to Mexican Culture—Mainly Mexican folkways, but also illustrated lectures on fine arts, arts and crafts.
2 units, (Rael), alternate years, to be given in 1964–65

Note: For other courses in the civilisation of Spain and Latin America see under Hispanic American Studies.

G. 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.

#G1. First-Year German.
4 units, autumn, winter, or spring, (Staff)
MODERN EUROPEAN LANGUAGES

#Gls. First-Year German (Special Course) — This course covers material similar to that of G1, but with additional emphasis on oral-aural skills. Enrollment limited.
5 units, autumn, (Staff)

#G2. First-Year German — Continuation of G1.
4 units, autumn, winter, or spring, (Staff)

#G2s. First-Year German (Special Course) — Prerequisite: Gls or permission of Department.
5 units, winter, (Staff)

#G3. First-Year German — Continuation of G2.
4 units, autumn, winter, or spring, (Staff)

#G3s. First-Year German (Special Course) — Prerequisite: G2s or permission of Department.
5 units, spring, (Staff)

G5. Intensive First-Year German — Equivalent to G1, 2, and 3 combined. Enrollment limited.
12 units, summer, (Staff), MTWThF 8–9:30, 10:30–12 and W 2–4

G10. 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, autumn or winter, (Staff), MTWTh 8
or summer, (Staff), MTWThF 8

Note: Students wishing to stress speaking and writing in addition to reading are advised to take G52, G53, and G54.

#G22. Second-Year Reading — Prerequisite: G3.
3 units, autumn, winter, or spring, (Staff)

#G23. Second-Year Reading — Continuation of G22.
3 units, autumn, winter, or spring, (Staff)

G24. Second-Year Composition — Prerequisite: G3 or equivalent.
2 units, autumn, winter, (Staff)

2 units, winter, spring, (Staff)

G27. Second-Year Conversation — Prerequisite: G3. May be taken twice for credit.
2 units, autumn, winter, or spring, (Staff)

#G52. Second-Year German — Emphasizes speaking, writing in addition to reading. Reading material corresponds to that of G22. A grade of B in G3 (or equivalent) required for admission. Students electing this course may not take G22 and G24. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 8, 9, or 1

#G53. Second-Year German — Continuation of G52. Level of reading material corresponds to that of G23. Students electing this course may not take G25 and G27. Prerequisite: G52 (or G22 plus G24). Enrollment limited to 15.
5 units, winter, (Staff), MTWThF 8, 9, or 1

#G54. Second-Year German — Continuation of G53. Students electing this course may not take G27. Prerequisite: G53 (or G23 plus G25 and G27). Satisfies General Studies requirement under C.
5 units, spring, (Staff), MTWThF 9 or 1

#G82–86. Intensive German — Given only at Stanford in Germany.
6 units for each of two quarters, summer–autumn or winter–spring, (Staff), MTWTh two hours daily

G99. Individual Reading — Prerequisite: G23 or G53. Enrollment only by special permission of Department. Not required for majors in German. Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit.
1 to 2 units, each quarter, (Staff), by arrangement
THIRD- AND FOURTH-YEAR

G100. Practice in Listening and Speaking—Listening to original recorded material such as radio programs, plays, university lectures. Discussion and oral presentation of assigned topics. Prerequisite: G54 or equivalent. Course may be taken twice for credit.
3 units, autumn, (Luther), MWF 2
or spring), (———), MWF 2

G110. German Pronunciation—Prerequisite: G22.
3 units, winter, (Luther); MWF 9, or (———), MWF 2

G111. Third-Year German Composition—Prerequisite: G54 or equivalent.
2 units, autumn, (Luther), TTh 9, or (———), TTh 2

G112. Third-Year German Composition—Continuation of G111.
2 units, winter, (Luther), TTh 9, or (———), TTh 2

G113. Third-Year German Composition—Continuation of G112.
2 units, spring, (Luther), TTh 2

#G120. German Cultural Readings—Training in careful reading of books with a significant cultural content. Prerequisite: G23.
4 units, spring, (Luther), MTWTh 1

#G131. Masterworks of German Literature—The Classical Period. Prerequisite: G23 or G53.
4 units, autumn, (Burkhart), MTWTh 10

#G132. Masterworks of German Literature—Romanticism and Poetic Realism. Prerequisite G23 or G53.
4 units, winter, (McCluney), MTWTh 10

#G133. Masterworks of German Literature—From Naturalism to the Present. Prerequisite: G23 or G53.
4 units, spring, (Boeninger), MTWTh 9

#G142. The German Novelle—Reading and discussion of representative Novellen of the nineteenth and twentieth centuries. Prerequisite: G23 or G53.
4 units, spring, (McCluney), MTWTh 9

#G144. Goethe.
3 units, (———), alternate years, to be given in 1964–65

#G150. Schiller.
3 units, winter, (Burkhart), MWF 2

#G158. Die deutsche Lyrik.
3 units, (———), alternate years, to be given in 1964–65

#G160. Rilke.
3 units, autumn, (Schuelke), MWF 9

#G165. Kafka.
3 units, alternate years, to be given in 1964–65

ADVANCED AND GRADUATE

#G180. The Dramas of Kleist, Grillparzer, and Hebbel.
4 units, alternate years, to be given in 1964–65

#G181. Der moderne Roman—Thomas Mann, Musil, Döblin, Broch u.a.
4 units, spring, (Boeninger), MTWTh 11

#G182. Das moderne Drama—Wedekind, Hofmannsthal, Kaiser, Brecht u.a.
3 units, autumn, (Lohner), MWF 2

#G184. Goethes Faust.
4 units, alternate years, to be given in 1964–65

G185. History of the German Language.
2 units, winter, (Schuelke), TTh 8

#G188. Adalbert Stifter, Gottfried Keller, und Conrad Ferdinand Meyer.
3 units, alternate years, to be given in 1964–65
G190. Introduction to German Linguistics—General principles of Applied Linguistics and their relevance for German. German Phonology and Morphology. 
2 units, autumn, (Hopkins), TTh 2

#G195. Moderne Lyrik—Von Nietzsche bis Celan.
3 units, winter, (Mueller-Vollmer), MTTh 1

G199. Individual Work—Open only to German majors who are working on special projects. May be repeated for credit.
1 to 3 units, each quarter, (Staff), by arrangement

GRADUATE COURSES IN GERMAN AND GERMAN LITERATURE

G200. Methods of Teaching German.
4 units, spring, (Lohnes), TTh 4-6

G201. Advanced Composition and Grammar—Prerequisite: qualifying examination.
2 units, autumn, (Boeninger), M 4-6

2 units, winter, (Boeninger), M 4-6

G205. Modern German—The syntax of modern German.
4 units, winter, (Strothmann), MTWTh 11

G211. Deutsche Literatur- und Kulturgeschichte I—Das Mittelalter.
4 units, autumn, (Strothmann), MTWTh 11

G211a. Einzelprobleme I—Analyse der Werke eines Schriftstellers oder eines literarischen Problems aus der in G211 behandelten Periode.
3 units, alternate years, to be given in 1964-65

G212. Deutsche Literatur- und Kulturgeschichte II—Von Luther bis Lessing.
4 units, winter, (Hyde), TWThF 3

G212a. Einzelprobleme II—Analyse der Werke eines Schriftstellers oder eines literarischen Problems aus der in G212 behandelten Periode.
3 units, alternate years, to be given in 1964-65

4 units, spring, (Lohner), MTThF 2

4 units, alternate years, to be given in 1964-65

3 units, autumn, (Lohner), MWTh 3

4 units, alternate years, to be given in 1964-65

3 units, spring, (Burkhardt), MWTh 11

G230. Methoden der Literaturwissenschaft—New approaches to literary criticism.
2 units, spring, (Mueller-Vollmer), M 4-6

2 units, autumn, (Mueller-Vollmer), T 4-6

G250. Graduate Seminar—Subject to be announced in Time Schedule.
2 units, autumn, (Mueller-Vollmer), Th 4-6
or winter, (Lohner), T 4-6
or spring, (Lohner), W 4-6
G251. Gothic and Historical German Grammar — Development of Germanic languages; reading of selected texts from the Gothic Bible.
   5 units, autumn, (Schuelke), MTWThF 10
G253. Old Norse.
   4 units, alternate years, to be given in 1964–65
G255. Old Saxon.
   2 units, alternate years, to be given in 1964–65
G257. Old High German.
   2 units, winter, (Schuelke), TTh 2
G258. Middle High German.
   4 units, winter, (Schuelke), MTWTh 10
G259. Advanced Middle High German.
   4 units, spring, (Schuelke), MTWTh 10
G299. 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

L. LINGUISTICS COURSE

L180. An Introduction to General Linguistics—A survey of the fields of phonemics, morphology, linguistic geography, and related areas.
   2 units, autumn, (Weir), TTh 11

P. PORTUGUESE COURSES

[Under the direction of Ronald Hilton]
P5. Elementary Portuguese—Intensive course primarily for social scientists, students specializing in Hispanic American literature, civilization. Cannot be taken to fulfill General Studies language requirements. Prerequisite: Knowledge of Spanish or French.
   4 units, autumn, (———), MTWF 12
   4 units, winter, (———), MTWF 12
   4 units, spring, (———), MTWF 12
P99. Individual Reading—Prerequisite: P7. Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit.
   1 to 3 units, each quarter, (Hilton), by arrangement

Note: For advanced Portuguese and courses in Luso-Brazilian studies, see under Hispanic American Studies.

R. RUSSIAN AND SL. SLAVIC COURSES

FIRST- AND SECOND-YEAR

[Under the direction of Elisabeth Stenbock-Fermor]

#R1. First-Year Russian.
   4 units, autumn or winter, (Staff)
#R2. First-Year Russian—Continuation of R1.
   4 units, winter or spring, (Staff)
#R3. First-Year Russian—Continuation of R2.
   4 units, autumn or spring, (Staff)
R5. Intensive First-Year Russian—Equivalent to R1, 2, and 3 combined. Enrollment limited. Consent of instructor necessary.
   12 units, summer, (Staff), MTWThF 8:00–9:30, 10:30–12:00 and W 2–4
R10. 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, spring, (E. Stenbock-Fermor), MTWTh 8

#R22. Second-Year Reading—Prerequisite: R3.
3 units, autumn or winter, (Staff)

#R23. Second-Year Reading—Continuation of R22.
3 units, winter or spring, (Staff)

R27. Russian Conversation. May be taken twice for credit.
2 units, autumn and spring, (——), by arrangement

12 units, summer, (Staff), MTWThF 8:00-9:30, 10:30-12:00 and W 2-4

#R52. Second-Year Russian—Emphasizes speaking and writing, in addition to reading. Reading material corresponds to that of R22. A grade of B in R3 (or equivalent) required for admission. Students electing this course may not take R22. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 9 or 1

#R53. Second-Year Russian—Continuation of R52. Level of reading material corresponds to that of R23. Students electing this course may not take R23 and R27. Prerequisite: R52. Enrollment limited to 15.
5 units, winter, (Kliachko), MTWThF 1

#R54. Second-Year Russian—Continuation of R53. Prerequisite: R53 (or R23 and R27). Enrollment limited to 15. Satisfies General Studies requirement under C.
5 units, spring, (Kliachko), MTWThF 1

R99. Individual Reading—Prerequisite: R23 or R53. 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.
1 or 2 units, each quarter, (Staff), by arrangement

SL15. Polish I.
2 units, winter, (——), every fourth year, to be given in 1966-67

SL16. Polish II.
2 units, spring, (——), every fourth year, to be given in 1966-67

SL17. Bulgarian I.
2 units, winter, (——), every fourth year, to be given in 1965-66

SL18. Bulgarian II.
2 units, spring, (——), every fourth year, to be given in 1965-66

SL19. Czech (and Slovak) I.
2 units, winter, (——), every fourth year, to be given in 1964-65

SL20. Czech (and Slovak) II.
2 units, spring, (——), every fourth year, to be given in 1964-65

THIRD- AND FOURTH-YEAR

R100. Third-Year Russian Conversation—Prerequisite: R54 or equivalent. Course may be repeated for credit.
3 units, autumn, winter, or spring, (Kliachko), MWF 2

R110. Russian Pronunciation—Prerequisite: R23 or equivalent.
3 units, winter, (Pashin), MWF 9

R111. Third-Year Russian Composition—Prerequisite: R54 or equivalent.
2 units, autumn, (Posin), TTh 1

R112. Third-Year Russian Composition—Continuation of R111.
2 units, winter, (Pashin), TTh 9

R113. Third-Year Russian Composition—Continuation of R112.
2 units, spring, (Pashin), TTh 2

#R131. The Russian Novel—Prerequisite: R23.
4 units, winter, (Posin), MTWTh 10
### Graduate Courses in Slavic

**SL201. Synchronic Phonology, Morphology, and Syntax of Russian I.**
3 units, autumn, (C. H. van Schooneveld), alternate years, to be given in 1964–65

**SL202. Synchronic Phonology, Morphology, and Syntax of Russian II.**
3 units, winter, (C. H. van Schooneveld), alternate years, to be given in 1964–65

**SL203. Synchronic Phonology, Morphology, and Syntax of Russian III.**
2 units, autumn, (C. H. van Schooneveld), MWF 3

**SL204. Synchronic Phonology, Morphology, and Syntax of Russian IV.**
3 units, winter, (C. H. van Schooneveld), MWF 3

**SL211. Old Church Slavonic I.**
3 units, autumn, (C. H. van Schooneveld), MWF 4

**SL212. Old Church Slavonic II.**
3 units, winter, (C. H. van Schooneveld), MWF 4

**SL214. Old Church Slavonic Literature.**
2 units, autumn, (———), TTh 10

**SL221. Diachrony of East Slavic and Readings in Old Russian I.**
3 units, autumn, (C. H. van Schooneveld), alternate years, to be given in 1964–65

**SL222. Diachrony of East Slavic and Readings in Old Russian II.**
3 units, winter, (C. H. van Schooneveld), alternate years, to be given in 1964–65

**SL226. Diachrony and Synchrony of South Slavic.**
2 units, spring, (C. H. van Schooneveld), alternate years, to be given in 1964–65

**SL227. Diachrony and Synchrony of Western Slavic.**
2 units, winter, (C. H. van Schooneveld), TTh 3

**SL228. Divergence of Slavic Languages.**
2 units, autumn, (C. H. van Schooneveld), TTh 3

**SL231. The Early History and Culture of the Slavs.**
2 units, autumn, (———), TTh 9

**SL250. Graduate Seminar in Linguistics—Subject announced in Time Schedule.**
2 units, autumn, (———), by arrangement
SL261. Russian Folklore.
2 units, spring, (E. Stenbock-Fermor), TTh 10

SL262. Comparative Slavic Folklore.
2 units, spring, (———), MW 3

SL264. Russian Epic Tradition.
2 units, winter, (———), alternate years, to be given in 1964-65

SL265. Comparative Slavic Epic Tradition.
2 units, spring, (———), alternate years, to be given in 1964-65

SL271. Russian Literature of the 17th and 18th Centuries.
2 units, autumn, (E. Stenbock-Fermor), TTh 9

SL272. Russian Symbolism.
2 units, winter, (———), alternate years, to be given in 1964-65

SL274. The 20th Century After Symbolism in Russian Literature.
2 units, winter, (Stenbock-Fermor), TTh 1

SL276. Pushkin.
3 units, autumn, (Posin), MWF 1

SL277. Gogol.
3 units, winter, (Posin), every three years, to be given in 1964-65

SL278. Tolstoy.
3 units, autumn, (———), every third year, to be given in 1965-66

SL279. Dostoevsky.
3 units, winter, (Stenbock-Fermor), every third year, to be given in 1965-66

SL281. Comparative Slavic Mediaeval Literature.
2 units, winter, (———), MW 9

2 units, autumn, (———), MW 10

SL283. Comparative Slavic Baroque Literature.
2 units, spring, (———), TTh 3

SL284. Comparative Slavic Classicist Literature.
2 units, spring, (———), every third year, to be given in 1964-65

2 units, spring, (———), every third year, to be given in 1964-65

SL286. Comparative Slavic Realism.
2 units, winter, (———), every third year, to be given in 1964-65

2 units, winter, (———), every third year, to be given in 1965-66

4 units, spring, (———), every third year, to be given in 1965-66

SL299. Individual Work—Exclusively for graduate students in Slavic working on thesis or engaged in special work.
1 to 12 units, each quarter, (Staff), by arrangement

SL300. Graduate Seminar in Literature—Russian criticism of the 19th century.
2 units, autumn, (———), F 10-12

SP. 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.

#Sp1. First-Year Spanish.
4 units, autumn or winter, (Staff)
#Sp2. First-Year Spanish—Continuation of Sp1.
4 units, autumn, winter, or spring, (Staff)

#Sp3. First-Year Spanish—Continuation of Sp2.
4 units, autumn, winter, or spring, (Staff)

Sp5. Intensive First-Year Spanish—Equivalent to Sp1, 2, and 3 combined. Enrollment limited. Consent of instructor necessary.
12 units, summer, (Staff), MTWThF 8-10 and 11-12

Sp10. 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, spring, (Staff), MTWTh 1

Note: Students wishing to stress speaking and writing in addition to reading are advised to take Sp52 and Sp53 instead of Sp22 and Sp23.

#Sp22. Second-Year Reading—Aims primarily at reading ability. Prerequisite: Sp3.
3 units, autumn, or winter, or spring, (Staff)

#Sp23. Second-Year Reading—Continuation of Sp22. Reading material assigned will vary from section to section.
3 units, autumn, winter, or spring, (Staff)

#Sp23a. Second-Year Reading—The development of Latin America. For 3 units, reading of Américo Castro's *Iberoamérica*, and training in the understanding of talks in Spanish. For the 4th unit, reading of Spanish-language newspapers under the supervision of *Hispanic American Report* staff. An alternative to Sp23. Prerequisite: Sp22, with a grade of B or better.
3 to 4 units, autumn, or winter or spring, (Hilton), MWF 8

Sp24. Second-Year Grammar and Composition—Students taking Sp52 may not take this course. Prerequisite: Sp3.
3 units, autumn or winter, (Staff)

2 units, winter or spring, (Staff)

Sp27. Second-Year Conversation—Prerequisite: Sp3. Students taking Sp53 may not take this course.
2 units, autumn or winter, (Staff)

Sp28. Second-Year Conversation—Prerequisites: Sp24 and Sp27. Students taking Sp54 may not take this course.
2 units, winter or spring, (Staff)

#Sp52. Second-Year Spanish—Emphasizes speaking, writing in addition to reading. Reading material corresponds to that of Sp22. Grade of B in Sp3 (or equivalent) required for admission. Students electing this course may not take Sp22 and Sp24. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 9 or 1

#Sp53. Second-Year Spanish—Continuation of Sp52. Level of reading material corresponds to that of Sp23 or Sp23a. Students electing this course may not take Sp23, Sp23a, Sp25, and Sp27. Prerequisite: Sp52 (or Sp22 plus Sp24). Enrollment limited to 15.
5 units, winter, (Staff), MTWThF 9 or 1

#Sp54. Second-Year Spanish—Continuation of Sp53. Students electing this course may not take Sp28. Prerequisite: Sp53 (or Sp23 plus Sp25 and Sp27). Enrollment limited to 15. Satisfies General Studies requirement under C.
5 units, spring, (Staff), MTWThF 9

Sp99. Individual Reading—Prerequisite: Sp23 or Sp53. Enrollment only by special permission of Department. Not required for majors in Spanish. Thirty-six hours of reading per unit, weekly conference with instructor.
1 to 2 units, summer, (Staff), by arrangement
THIRD- AND FOURTH-YEAR

Sp100. Advanced Spanish Conversation—Prerequisite: Sp28 or equivalent. May be repeated for credit.

3 units, winter, (Schevill), MWF 2

Sp110. Spanish Pronunciation—Prerequisite: Sp22.

3 units, autumn, (Espinosa, Morgan), TTh 11 and one hour by arrangement

Sp111. Third-Year Spanish Grammar and Composition—Prerequisite: Sp53 or equivalent (Sp23 or Sp23a plus Sp25).

3 units, autumn, (Rael), MWF 9 or 11

Sp112. Third-Year Spanish Composition—Prerequisite: Sp111 or equivalent.

2 units, winter, (Rael), TTh 8 or 9

Sp113. Third-Year Spanish Composition—Continuation of Sp112.

2 units, spring, (Rael), TTh 8 or 9

#Sp120. Readings in Current Periodicals—Readings in Spanish language newspapers and journals to familiarize students with the structure of Latin American society and the language in which that society is described. It is of special interest for social science majors and those planning to work on the Hispanic American Report. Students who wish to take this course to satisfy General Studies requirements should take it for four units. Prerequisite: either Sp23a or Sp 53, or equivalent.

3 to 4 units, each quarter, (Hilton), MWF 9

#Sp121. Hispanic American Cultural Readings—The life of Simón Bolívar. For 3 units, reading of Campos Mcnédex, Se llamaba Bolívar, and training in the understanding of talks in Spanish. For the 4th unit, reading of Spanish-language newspapers under the supervision of Hispanic American Report staff. Students wishing to take this course to satisfy General Studies requirements should take the course for four units. Prerequisite: either Sp23a or Sp 53, or equivalent.

3 to 4 units, autumn or winter, (Hilton), MWF 10

#Sp122. Hispanic American Cultural Readings—The life of José Vasconcelos. For 3 units, reading of selections of autobiography, in Spanish, and training in the understanding of talks in Spanish. For the 4th unit, see under Sp121.

3 to 4 units, spring or summer, (Hilton), MWF 10

#Sp125. Spanish Cultural Readings—Training in careful reading of books with significant cultural content. Prerequisite: Sp23 or Sp53 or equivalent.

4 units, autumn, (Espinosa), MTWTTh 1

#Sp126. Cervantes—Reading and interpretation of selected passages from Don Quijote and the Novelas ejemplares. Prerequisite: Sp23 or equivalent.

4 units, spring, (--), MTWTTh 1

#Sp131. Masterworks of Spanish Literature I—From its origins to end of fifteenth century. Prerequisite: Sp23 or equivalent.

3 to 4 units, spring, (Espinosa), MWF 10

#Sp132. Masterworks of Spanish Literature II—Sixteenth and seventeenth centuries. Prerequisite: Sp23 or equivalent.

3 to 4 units, (Espinosa), alternate years, to be given in 1964–65

#Sp133. Masterworks of Spanish Literature III—From 1700 to 1898. Prerequisite: Sp23 or equivalent.

3 to 4 units, (--), alternate years, to be given in 1964–65

#Sp134. Modern and Contemporary Spanish Literature I—The Generation of 1898. Prerequisite: Sp23 or equivalent.

3 to 4 units, autumn, (Espinosa), alternate years, to be given in 1964–65

#Sp135. Modern and Contemporary Spanish Literature II—Outstanding writers of present-day Spain. Prerequisite: Sp23 or equivalent.

3 to 4 units, autumn, (Schevill), MWF 10

#Sp142. The Spanish Novel of the Nineteenth Century.

3 to 4 units, winter, (Schevill), alternate years, to be given in 1964–65
#Sp143. The Spanish Romantic Drama.
3 to 4 units, winter, (——), MWF 10

ADVANCED AND GRADUATE

#Sp180. Lope de Vega, Tirso y Calderón—Estudio e interpretación de cuatro o cinco comedias representativas.
3 to 4 units, winter, (Espinosa), MWF 1
#Sp182. Teatro español contemporáneo.
3 to 4 units, spring, (Schevill), MWF 4
Sp184. Spanish Dramatics—Reading, staging of a Spanish play. May be repeated for credit. Prerequisites: Sp100 and Sp112 and permission of instructor.
3 to 4 units, winter, (Schevill), TTh 4–6
#Sp186. Literatura hispanoamericana I—General introduction to Spanish-American Colonial literature; literature of Cuba, Venezuela. Open only to graduate and advanced undergraduate students.
3 to 4 units, autumn, (Rael), alternate years, to be given in 1964–65
#Sp187. Literatura hispanoamericana II—Literature of Bolivia, Chile, Colombia, Ecuador, Peru. Open only to graduate and advanced undergraduate students.
3 to 4 units, winter, (Rael), alternate years, to be given in 1964–65
#Sp188. Literatura hispanoamericana III—Literatures, cultural history of Argentina, Uruguay. Open only to graduate and advanced undergraduate students.
3 to 4 units, autumn, (Rael), MWF 8
#Sp189. Literatura hispanoamericana IV—Cultural history of Mexico, representative writers. Open only to graduate and advanced undergraduate students.
3 to 4 units, winter, (Rael), MWF 8
Sp190. Introduction to Hispanic Linguistics and Phonology of Modern Spanish.
3 units, autumn, (Weir), MWF 10
Sp199. 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, summer, (Staff), by arrangement

Note: For other courses see under Hispanic American Studies.

GRADUATE COURSES IN SPANISH AND SPANISH LITERATURE

3 units, winter, (Weir), MWF 10
Sp201. Advanced Composition and Grammar—Translation of connected English prose into Spanish; original compositions; dictation. Prerequisite: qualifying examination.
3 units, autumn, (Schevill), MWF 3
2 units, spring, (Schevill), TTh 4
Sp211. Historia de la literatura española I—From the origins to 1500.
4 units, spring, (——), MWF 11
Sp212. Historia de la literatura española II—Sixteenth and seventeenth centuries.
4 units, (——), alternate years, to be given in 1964–65
Sp213. Historia de la literatura española III—Desde 1700 hasta 1850.
4 units, winter, (Espinosa), MWF 11
4 units, autumn, (Schevill), TTh 4–6
3 to 4 units, autumn, (Schevill), alternate years, to be given in 1964–65
MODERN EUROPEAN LANGUAGES

Sp217. Teatro español del Siglo de Oro.
4 units, autumn, (———), MWF 11

Sp218. Renaissance Prose and Mysticism.
3 units, autumn, (———) MWF 2

Sp220. Cervantes.
4 units, winter, (———), MWF 2

Sp222. La novela española moderna.
3 to 4 units, winter, (Schevill), MWF 4

Sp224. La novela hispanoamericana.
3 units, spring, (Rael), Th 2-4

3 to 4 units, (Rael), alternate years, to be given in 1964–65

Sp228. La poesía española contemporánea.
3 to 4 units, spring, (Schevill), alternate years, to be given in 1964–65

Sp230. Hispanic Folklore.
3 units, (Espinosa), every third year, to be given in 1964–65

Sp231. Mexican Folk Drama.
2 to 3 units, (Rael), every third year, to be given in 1964–65

Sp232. The Spanish Epic Tradition.
3 units, (Espinosa), every third year, to be given in 1965–66

Sp240. Spanish Versification.
2 units, winter, (Espinosa), every third year, to be given in 1966–67

Sp249. Proseminar: Bibliography and Introduction to Research.
2 units, autumn, (Espinosa), TTh 9

Sp250. Graduate Seminar in Spanish Literature—Subject announced in Time Schedule.
3 to 4 units, winter, (———), W 2-4

3 to 4 units, spring, (Rael), alternate years, to be given in 1964–65

3 units, spring, (Espinosa), MWF 2

Sp261. Old Spanish—Elements of phonology, morphology; reading of Old Spanish texts.
3 units, spring, (Espinosa), alternate years, to be given in 1964–65

Sp263. Historical Spanish Linguistics I. Prerequisite: Sp260 or 261.
3 units, (Weir), alternate years, to be given in 1964–65

Sp264. Historical Spanish Linguistics II.
3 units, spring, (Weir), MWF 2

Sp266. Hispanic Dialectology.
3 units, (Espinosa), every third year, to be given in 1964–65

Sp299. 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.

Note: For other courses see under Hispanic American Studies.

T. TEACHER TRAINING COURSES
[Under the direction of Ruth H. Weir]

T400. Seminar in the Use of a Language Laboratory.
2 units, winter, (Morgan), W 7–9 p.m.
or summer, (Morgan), TTh 9 or by arrangement

T401. Seminar in the Development of Laboratory Techniques.
2 units, summer, (———), TTh 1 and one hour by arrangement
TG199. Practice Teaching in German in the Elementary Schools—May be taken for six quarters. Prerequisite: G54 or equivalent.
1 unit, any quarter, (Weir), by arrangement

TR199. Practice Teaching in Russian in the Elementary Schools—May be taken for six quarters. Prerequisite: R54 or equivalent.
1 unit, any quarter, (Posin), by arrangement

TS199. Practice Teaching in Spanish in the Elementary Schools—May be taken for six quarters. Prerequisite: Sp54 or equivalent.
1 unit, any quarter, (Espinosa), by arrangement

TS252. Spanish for Elementary Teachers—For those intending to teach Spanish in elementary schools. Pronunciation of Spanish; its basic vocabulary, grammar, syntax. Prerequisite: Sp3 or equivalent.
6 units, summer, (Staff), MTWThF 9 and MWF 1

6 units, summer, (Staff), MTWThF 9 and MWF 1

TS300. Seminar in the Development of Instructional Materials.
4 units, summer, (Staff), MTWThF 3

See also Senior Colloquia.

MUSIC

Emeritus: Warren Dwight Allen (Professor)

Executive Head: William Loran Crosten
Professors: Putnam Calder Aldrich, William Loran Crosten, Wolfgang Erasmus Kuhn, Herbert Boswell Nanney, Leonard Gilbert Ratner, Sandor Salgo, Harold Carl Schmidt
Assistant Professor: George Louis Houle, Leland Clayton Smith
Acting Director of Bands: Arthur Page Barnes
Lecturer and Music Librarian: Edward Eugene Colby
Lecturers in Applied Music: Earle Blew (Piano), Charles R. Bubb (Brass Instruments), Marjorie Chauvel (Harp), Raymond Herbert Duste (Oboe), Joseph Schuster (Violoncello), Ivan Burdette Rasmussen (Voice), Dean Gordon Williams (Contrabass), Lloyd Gowen (Flute)

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.

Excellent facilities for practice are available in Stanford's new Music 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. Supplementing 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:

I. Theory of Music: 21, 22, 26, 121, 122
II. Music History: 100, 101, 102, 103, 104
III. 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.)

IV. 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 better-known composers. This acquaintance will be checked by a series of identification examinations which should be passed normally before the beginning of the senior year.

Music majors will be expected to maintain a grade-point average of at least 2.0 in music classes excluding performance activities.

Undergraduate minor—A program of 26-28 units of required work is offered as follows:

I. Music Literature: Music 1 and any two other courses in music history or literature given by the Department.
II. Theory of Music: Music 21 and 22.
III. Musical Performance: At least three consecutive quarters of (a) individual study, and (b) ensemble.

(Note: The music minor may not enroll for individual 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 means 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 9-12 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.

Teachers’ Credentials

Students in the Department may work for the Stanford General Secondary Cre-
dential with a teaching major in music. This credential requires completion of the A.B. degree and one year of graduate work.

The student is admitted to the program at first on a provisional basis. Final selection of candidates will be made on the basis of their academic attainments and personal aptitude for the teaching profession.

Following are the course requirements:

General Studies: As specified by the University
Music Theory: 21, 22, 26, 121, 122, 127
Music History: 100, 101, 102, 103, 104
Music Education: 180, 181, 182
Conducting: 130, 131, (9 units)
Ensemble: 6 quarters
Piano: Sufficient to pass piano proficiency test
Voice Class: Music 83a, b, c (3 units)
Instrumental Classes: Music 84, 85, 86 (3–5 units)
Teaching minor: Units vary according to the subject; the average is 30 units.

Courses in the School of Education: 32 units (includes 12 units in observation and student teaching).

Proficiency examinations must be taken in piano, voice, and conducting.

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.

To attain graduate standing in Music, students must have completed the equivalent of the Department's requirements for the Bachelor of Arts degree, which includes the ability to play the piano with moderate facility. None of Stanford's required undergraduate courses in music may be credited toward an advanced degree. Prior to his initial registration, each student must take a placement examination in the history, literature, and theory of music and must be prepared to demonstrate his skill in musical performance. Admission to any of the concentrations listed below requires permission of the faculty adviser in that area.

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. Only work that receives a grade of “A,” “B,” or “plus” will be recognized as fulfilling the advanced degree requirements in music. The recommended programs for the different concentrations are indicated below.

I. Concentration in Musical Research:

Music 200—Music Bibliography (3 units)
Music 221—History of Music Theory (3 units)
Music 226—Advanced Counterpoint, or
Music 229—Tonality and Structure
Music 240—Seminar in Music History and Analysis (two quarters, 8 units)
Music 299—Master of Arts Project (4 units)
Ensemble (three quarters, 3–6 units)
Electives (12–15 units)
Foreign Language—Demonstrate a reading knowledge of French, German, or Italian, and a comprehension of the principal musical terms encountered in the selected language. This test will be given before the student's initial registration.

II. Concentration in Composition:

Music 200—Music Bibliography (3 units)
MUSIC 221—History of Music Theory (3 units)
Music 223—Seminar in Composition (two quarters, 8 units)
Music 240—Seminar in Music History and Analysis (4 units)
Music 299—Master of Arts Project (4 units)
Ensemble (three quarters, 3–6 units)
Electives (12–15 units)
Foreign Language—Same as under Concentration in Musical Research

III. Concentration in Music Education:
Music 200—Music Bibliography (3 units)
Advanced Studies in Performance or Conducting (4–8 units)
Music 240—Seminar in Music History and Analysis (4 units)
Music 280—Seminar in Music Education (4 units)
Music 281—Administration and Supervision of Public School Music (4 units)
Music 299—Master of Arts Project (4 units)
Ensemble (three quarters, 3–6 units)
Electives (7–14 units)
Foreign Language—Same as under Concentration in Musical Research

IV. Concentration in Performance Practice
Music 200—Music Bibliography (3 units)
Music 226—Advanced Counterpoint, or
Music 229—Tonality and Structure
Music 240—Seminar in Music History and Analysis (4 units)
Studies in performance practice appropriate to the candidate's chosen instrument or voice (two quarters, 8 units)
Music 272—Advanced Studies in Solo Performance (6 units)
Music 299—Master of Arts Project (4 units)
Ensemble (three quarters, 3–6 units)
Electives (6–9 units)
Foreign Language—Same as under Concentration in Musical Research

V. Concentration in Conducting (Choral or Orchestral):
Music 151—Studies in Choral Music (4 units), or
Music 153—Studies in Orchestral Music (4 units)
Music 200—Music Bibliography (3 units)
Music 224 and 225—Solfége and Score Reading (8 units)
Music 226—Advanced Counterpoint, or
Music 229—Tonality and Structure
Music 230a, b—Advanced Orchestral Conducting (8 units), or
Music 231a, b—Advanced Choral Conducting (8 units)
Music 240—Seminar in Music History and Analysis (4 units)
Music 299—Master of Arts Project (4 units)
Ensemble (three quarters, 3–6 units)
Foreign Language—Same as under Concentration in Musical Research

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
Doctor of Musical Arts

The purpose of the Doctor of Musical Arts program is to offer advanced training in the practice of music parallel to the musicological studies leading to the Ph.D. degree. Students may concentrate in composition, conducting, performance practice in early music, or music education. 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 in the D.M.A. program 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—An applicant should possess a good general education as well as sound basic training in the theory, history, and performance of music. Beyond that, 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. Each applicant will be given an entrance test as a measure of his ability in music theory and analysis and in verbal expression. He will also be asked to submit evidence of accomplishment in his particular field of concentration.

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, including the following:

1. tutorial study in his field of concentration,
2. doctoral seminar in musical analysis,
3. studies in the history and theory of music as appear necessary on the basis of the placement and advisory examinations,
4. the teaching of music in college,
5. electives in the humanities (12 units),
6. final project or thesis.

Project or thesis—(1) Composition: an extended work for chorus, orchestra, chamber ensemble, or a combination of voices and instruments. (2) Conducting: (a) Four assigned works from different style periods to be prepared and conducted. (b) A written analysis dealing with style and performance problems in a major composition and a conductor's workbook giving detailed proposals for the treatment of these problems. (3) Music education: a thesis based on independent research in the candidate's field of specialization. (4) Performance practice of early music: (a) Four assigned works from different style periods (Medieval, Renaissance, early Baroque, late Baroque) to be prepared for performance; (b) A written analysis and demonstration of the style and performance practice of a major work.

Foreign language requirements—All students are required to demonstrate (a) a reading knowledge of at least 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. This examination must be taken prior to the student's first registration. A second language may be required if necessary to a particular concentration.

Departmental examinations—(1) Prior to the initial registration, a comprehensive placement test will be given in the history, theory, and literature of music and in general musicianship (including piano proficiency). Each student will also be tested in his proposed field of concentration. (2) An advisory examination will be given toward the end of the student's first year in residence, to determine whether he will be recommended to continue work for the degree. (3) A final qualifying examination must 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. The following are departmental requirements:

An applicant for admission should possess a well-rounded general education as well as sound basic training in the theory, analysis, history, and performance of music. Prior to his initial registration the student will be given a placement test in those fields. He should also be prepared at that time to demonstrate a reading knowledge of French or German and a moderate proficiency on the piano.

**Residence**—The candidate must spend at least three consecutive quarters beyond the first year of graduate study as a registered student at Stanford, and must devote at least one full quarter in residence to work on his dissertation.

**Basic requirements**—In addition to his doctoral dissertation, each candidate must complete a minimum of 90 units of study beyond the Bachelor’s degree. The program will include work under the following headings:

(1) music bibliography, (2) musical notation, (3) history of music theory, (4) advanced practical studies in music theory or composition, (5) studies in musical performance, (6) historical studies in musical style and aesthetics, (7) humanistic studies totaling 20 units outside the Department of Music.

**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. Considering the interests of the faculty and the resources of the Stanford Library, doctoral concentrations generally will be confined within the period from the Renaissance to the present day.

**Foreign language requirements**—A reading knowledge of French and German plus any other language necessary to research in the candidate’s field of specialization.

**Departmental examinations**—(1) An oral 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 be in four parts, dealing 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 repertoires. Prerequisite: Music 1 or equivalent.

3 units, autumn, (Kuhn)

**#3. Opera**—Opera as a musico-dramatic form; examples from Mozart to present. Prerequisite: Music 1 or equivalent.

3 units, winter, (Crosten)

**#7. Concerto**—Selected concertos, seventeenth century to present. Prerequisite: Music 1 or equivalent.

3 units, spring, (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 rhythm, melody, harmony to musical form. Written exercises in various textures, sight-reading, ear-training, analysis, elementary vocal and instrumental scoring, keyboard drill. Lectures and drill sections. Open to all students desiring basic technical knowledge of music. No prerequisite for Music 21 except ability to read music.

4 units, autumn, winter, (Nanney); winter, spring, (Houle)

26. Counterpoint—Prerequisite: 22.
4 units, autumn, spring, (Houle, Aldrich)

4 units, winter, spring, (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, autumn, (Smith)

221. History of Music Theory.
3 units, spring, (Ratner)

223. Seminar in Composition—May be repeated for credit.
4 units, any quarter, (Smith)

224, 225. Solfege and Score Reading—Prerequisite: permission of instructor.
4 units, winter, spring, (Smith)

3 units, autumn, (Ratner)

227. Advanced Orchestration—Prerequisite: Music 127.
3 units, winter, (Smith)

229. Tonality and Structure—Study of harmonic functions; relation between details of progression and total structure.
4 units, autumn, (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, autumn, (Houle)

4 units, winter, (Aldrich)

102. Music of the Classic Period.
4 units, spring, (Nanney)

4 units, autumn, (Crosten)

104. Music of the Modern Period.
4 units, winter, (Smith)

142. The String Quartets of Beethoven—Prerequisite: 102.
4 units, (Ratner)

150. Studies in Opera.
4 units, (Crosten)

4 units, (Schmidt)

4 units, autumn, (Salgo)

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, autumn, winter, (Aldrich, Ratner)

Seminar in Aesthetics and Music—See Philosophy 175.

MUSICAL PERFORMANCE

12. Introductory Piano.

1 unit, autumn, winter, spring, (Blew)

172, 272. Vocal and Instrumental Instruction.

2 units, autumn, winter, spring, (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 Music 12 or in any branch of 172 or 272.

130a, b. Orchestral Conducting—Prerequisite: 127.

3 units, winter, spring, (Salgo)

131a, b. Choral Conducting.

3 units, autumn, winter, (Schmidt), to be given in 1964-65

169. Performance Practice.

169a. Renaissance and Early Baroque.

4 units, winter, (Houle)

169b. Eighteenth Century.

4 units, spring, (Houle)

230a, b. Advanced Orchestral Conducting.

4 units, autumn, winter, (Salgo)

231a, b. Advanced Choral Conducting.

4 units, autumn, winter, (Schmidt)

269a, b. Seminar in Performance Practice of Early Music—Prerequisite: 169a, b, or equivalent.

4 units, autumn, winter, (Aldrich)

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 admis-
sion to any University musical organization. Audition schedules will be announced in advance of each registration period.

160. University Orchestra.
1 unit, autumn, winter, spring, (Salgo), M 7:45 p.m. and Th 7:30 p.m.

161. University Band—Autumn: marching band open only to men. Winter, spring: concert band open to both men, women.
1 unit, autumn, winter, spring, (Barnes), TTh 7:15 p.m.

162. University Chorus.
1 unit, autumn, winter, spring, (Schmidt), M 4–5:30, W 7–8:30 p.m.

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, Th 7–8:30 p.m., Sunday 10–12 a.m.

1 unit, autumn, winter, spring, (Schmidt)

166. Chamber Orchestra—Open to advanced players who have had orchestral experience.
1 unit, autumn, winter, spring, (Salgo)

1 unit, autumn, winter, spring, (Schmidt), T 7–8:30, Th 4:15–5:30 p.m.

171. Chamber Music—Open to any student with sufficient technical ability to play in combinations for strings, wind instruments, piano, harpsichord.
1 unit, autumn, winter, spring, (Salgo, Staff)

Music Education

83. Voice Class—For Secondary Credential Candidates.
1 unit, autumn, winter, spring, (Rasmussen)

84, 85, 86. Instrumental Classes for Secondary Credential Candidates.
84a, b. Strings.
1 unit, autumn, winter, (Kuhn)
85a, b. Woodwinds.
1 unit, spring, (Barnes)
86a, b. Brass and Percussion.
1 unit, (Barnes)

180. Music in the Junior High School.
3 units, autumn, (Kuhn)

3 units, spring, (Kuhn)

182. Instrumental Music in the High School.
3 units, spring, (Kuhn)

280. Seminar in Music Education.
4 units, any quarter, (Kuhn)

281. Administration and Supervision of Public School Music.
4 units, (Kuhn)

4 units, autumn, (Kuhn, Rasmussen)

380. The Teaching of Music in College.
4 units, spring, (Staff)

GRADUATE RESEARCH AND SPECIAL STUDIES

200. Music Bibliography—Use of bibliographical materials in graduate study; introduction to methods of research.
3 units, autumn, (Colby)
NAVAL SCIENCE

Executive Head: George F. Waters, Jr. (Colonel, USMC), Commanding Officer
Executive Officer: ——
Professor: George F. Waters, Jr. (Colonel, USMC)
Assistant Professors: Donald J. Burger (Major, USMC), Peter D. Abbott (Lieutenant, USN), John A. Mueller (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 U.S. 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. 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. During the last two years of their undergraduate work, Contract students are paid at the rate of $27 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 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, 41L, 42 and 42L and one of the following, Engr. 31, or Chem. 173, or Phys. 170, are exempt from NS411 and NS412.

COURSES

Naval Science courses are three-quarter courses. With the exception of second-year courses, the third digit of the course number determines the quarter in which it is given (1-autumn; 2-winter; 3-spring). Courses with M 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.

111. Naval Orientation—Mission, ideals, standards, traditions and customs of the Naval Service. Introduction to seamanship, naval warfare, and naval leadership. 3 units, autumn, (Abbott), MWF 8, 12; lab. Th 8, 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, winter, (Abbott), MWF 8, 12; lab. Th 8, 12

113. Evolution of Sea Power II—Continuation of 112. 3 units, spring, (Abbott), MWF 8, 12; lab. Th 8, 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, autumn, (Staff), MWF 8, 2:15; lab. Th 8, 2:15

212. Naval Weapons II—Continuation of 211. Jet and rocket propulsion, aerodynamics, inertial guidance systems, principles of nuclear physics. 3 units, spring, (Staff), MWF 8, 2:15; lab. Th 8, 2:15

213. General Psychology—Study of psychological nature of individual and group. Influences affecting human action and interaction. Designed to provide foundation in basic principles of human relations for study of leadership in senior year. (Enroll in Psychology 1.)


312. Navigation and Introduction to Naval Operations—Continuation of 311. Tactical communications. Nautical rules of the road. Relative motion and the maneuvering board. 3 units, winter, (Mueller), MWF 10, 12; lab. Th 10, 12

313. Naval Operations—Maneuvering and screening instructions. Fleet communications and meteorology. 3 units, spring, (Mueller), MWF 10, 12; lab. Th 10, 12
311M. 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, autumn, (Burger), MWF 11,1:15; lab. Th 11,1:15

312M. Evolution of the Art of War II—Continuation of 311M.
3 units, winter, (Burger), MWF 11,1:15; lab. Th 11,1:15

313M. 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, spring, (Burger), MWF 11,1:15; lab. Th 11,1:15

411. Naval Machinery—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, autumn, (Staff), MWF 11,1:15; lab. Th 11,1:15

412. Naval Machinery 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, winter, (Staff), MWF 11,1:15; lab. Th 11,1:15

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, winter, (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, spring, (Staff), MWF 11,1:15; lab. Th 11,1:15

411M. Amphibious Warfare I—Historical development of amphibious warfare. Current doctrine.
3 units, autumn, (Burger), by arrangement

412M. Amphibious Warfare II—Continuation of 411M.
3 units, winter, (Burger), by arrangement

413M. Military Justice and Leadership—Leadership principles in military organization. Uniform Code of Military Justice. Moot courts used to give student opportunity to observe mechanics of administration of military justice.
3 units, spring, (Burger), by arrangement

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: ———
Director of Tutorial Program: Philip H. Rhinelander
Professors: Donald H. Davidson, John D. Goheen, John L. Mothershead, Jr., Philip H. Rhinelander (on leave winter and spring quarters), Patrick Suppes
Visiting Professor of Philosophy and the Foundations of Mathematics: Georg Kreisel (spring quarter)
Associate Professors: Solomon Feferman, David S. Nivison, Jeffery Smith (on leave winter and spring quarters)
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, 9–24 units of tutorial work as described below and 24–39 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 consultation with their Departmental advisers, a program of courses emphasizing one of the major areas of philosophy indicated by the four groups of courses. All majors will select, in consultation with their Departmental advisers, programs of courses outside the Department which will complement their major programs or enable them to further an interest 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 juniors 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 writing 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 performance 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 comprehensive examination equivalent to the Junior Tutorial Examination with distinction.

Senior Tutorial involves 15 units total of tutorial work. For the academic year 1963–64 all students accepted for Senior Tutorial automatically become candidates
for Departmental Honors. To achieve Departmental Honors, the Senior Tutorial Essay must be distinguished. Failing to attain Departmental 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 offered for philosophy majors who wish to supplement their Departmental work for the A.B. degree by a related carefully guided program of studies. See the section "Humanities (Special Programs)" for a description of the Honors Program.

**Honors Program in Behavioral Sciences**

Philosophy majors with a central interest in methodological problems may participate in an Interdepartmental Program in Quantitative Methods in the Behavioral Sciences. See the section "Behavioral Sciences (Honors Program) in Quantitative Methods" for a description.

**Advanced Degrees**

The members of the Department are prepared to direct and supervise individual study and research to supplement instruction offered in courses listed below. In addition, advanced seminars, unlisted in the catalog, are frequently organized in response to student interest. Candidates for advanced degrees are urged to discuss their entire program of study with the Director of Graduate Study 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 Advanced 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 average grade of B or better. Course work shall include one or two quarters in Philosophy 241.
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 the Director of Graduate Study. All graduate students take the Graduate Proseminar (Philosophy 241) during their first year at Stanford.

Preliminary Examinations—Candidates for the Ph.D. must pass written examinations in the following fields: Ethics and Theory of Value; Epistemology and Metaphysics; the History of Philosophy; and Logic and the Philosophy of Science. These examinations of four hours each must be taken and passed as a group. They are normally taken toward the end of the first year of graduate work at Stanford; they may be taken a second time at the end of the second year. In special circumstances, an extension of time or permission to take the examination a third time may be granted.

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 four or five 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, and 5.

Several National Defense Education Act three-year fellowships are available in the special program in Logic and Foundations of Mathematics.

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, in Philosophy, or in a field of study especially designed for the individual student, as circumstances may dictate. Candidates for the doctor’s degree must meet the requirements of the department concerned. Students interested in a specially designed field of study should consult the section "Graduate Division Special Programs" in this Bulletin. For further information concerning this program, students should write Professor John Myhill of the Department of Philosophy.

At the beginning graduate level there are courses in Theory of Automata (162), Intermediate Logic (160a, b), and Introduction to Set Theory (161), designed in such a manner as to permit the entering graduate student either to start his logical studies from scratch or, if he has had some previous logical training, to make up whatever deficiencies there may have been in it, 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. 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.

The culmination of the Program is the Seminars. These will be given at a Ph.D. level. There will be one or two in 1963-64 according as student interest and preparation warrant, and they will probably be in Recursion Theory, Metamathematics, or Constructivity. As the program expands it is hoped to establish further Seminars, including one in Set Theory. 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 will also be arranged for individual students.

Fellowships in Logic and Foundations of Mathematics

In addition to the regular University and Departmental scholarships and fellowships available to graduate students in the Philosophy and Mathematics Departments, and to the teaching assistantships available in those Departments, there are four National Defense Education Act fellowships specifically for the support of graduate students in logic under the present Program. These will defray $1,000 of the $1,260 annual tuition for three years, and will in addition provide a living allowance of $2,000, $2,200, and $2,400 for the first, second, and third years, respectively, plus $400 per year for each dependent. There are also from time to time funds available from government contracts on which faculty members involved in the Program may be working.

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.

#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.

#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.

#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. Prerequisite: sophomore standing (third quarter freshmen with good records may be admitted).

#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.

#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.

#10. Introduction to Philosophical Analysis—An analysis of selected philosophical problems. Readings will include important historical texts as well as contemporary writers.

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, or 10.


4 units, spring, (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, winter, (Mothershead), MTWTh 9

104. Contemporary Philosophy—Some principal developments in contemporary philosophical thinking. Prerequisite: a total of two philosophy courses.

4 units, spring, (Goheen), MTWTh 10

106. Introduction to Philosophy—For graduate students. Lectures same as Philosophy 5.

4 units, summer, (——), MTWThF 10 and Th or F section

II. COURSES IN THE PHILOSOPHY OF A PERIOD AND IN INDIVIDUAL PHILOSOPHERS

The following courses will be offered in 1963-64. 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, (Goheen), MF 4:15

137. Seminar in the Philosophy of Plato—A study of selected dialogues. Prerequisite: 100 or equivalent.

3 units, (Goheen), by arrangement, to be given in 1965-66

140. The Philosophy of St. Thomas Aquinas.

4 units, spring, (——), MTWTh 2, to be given in 1965-66

144. Seminar in the Philosophy of Spinoza — A study of the basic works of Spinoza.

4 units, autumn, (Rhinelander), TTh 2-4

145. The Philosophy of David Hume—Prerequisite: 102 or equivalent.

4 units, spring, (Nivison), MTWTh 9

147. The Philosophy of Kant—An intensive examination of Kant’s Critique of Pure Reason. Prerequisite: 102 or equivalent.

4 units, autumn, (——), MTWTh 10

148. Seminar in the Philosophy of Rudolf Carnap—Text: The Philosophy of Rudolf Carnap, P. A. Schilpp, ed. (Seminars dealing with the writings of other philosophers may be offered in other quarters under the same course number. Such additions will be announced in the Time Schedule; students may repeat 148 for credit.)

3 units, spring, (Jeffrey), W 4:15-6:05, to be given in 1964-65

150. Seminar in the Philosophy of A. N. Whitehead.

3 units, spring, (Goheen), Th 4:15-6:05, to be given in 1965-66

155. Seminar in Phenomenology.

3 units, spring, (Goheen, Tait), by arrangement

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, winter, (Davidson), MTWTh 1 and Th or F section

157a. **Introduction to Logic**—For graduate students. Lectures same as Philosophy 3.
   4 units, autumn, (Suppes), MTWTh 1 and Th or F section
   or spring, (———), MTWTh 9 and Th or F section

157b. **Intermediate Logic**—Continuation of Philosophy 157.
   3 units, winter, (———), MWF 2

164. **Philosophy of Science**—A study of conflicting accounts of the structure and methods of empirical science and of its connections with logic and mathematics, in the context of questions about probability, induction, observability, and measurability. Prerequisite: 3.
   4 units, spring, (Suppes), MTWTh 2

165. **Philosophy of Logic**—Some or all of the following topics will be discussed from a semi-formal point of view: Platonism vs. nominalism, relation between logic and mathematics, epistemological implications of Gödel’s and Church’s theorems, contrafactuals, necessity and possibility, extensional and intensional contexts, synonymy, intuitionism, constructivity.
   3 units, spring, (———), MWF 10

166. **Probability and Induction**—Development of the notions of probability and utility within an axiomatic theory of preference. Rational behavior and inductive inference. Inductive probability measures. Examination of alternative accounts of probability and induction. Prerequisite: consent of instructor.
   3 units, winter, (———), MWF 10, to be given in 1964–65

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, winter, (———), MTWTh 9, to be given in 1964–65

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, autumn, (Larson), MTWTh 10

172. **Proseminar in Ethical Theory**—Analysis and class discussion of selected writings in contemporary ethical theory leading to short student papers to be read and discussed in class. Prerequisite: 2 or permission of instructor.
   4 units, spring, (Mothershead), MTWTh 9

   4 units, winter, (Larson), MTWTh 3

177. **Political Philosophy**—An analysis of fundamental political conceptions and problems: State, law, natural law, rights, natural rights, political obligations, and others.
   4 units, winter, (———), MTWTh 11, to be given in 1964–65

179. **Philosophy of Law**—Enquiry into historical sources and present significance of concepts underlying some of the jural systems of the West, together with analysis of criteria proposed for validation of legal principles and relation of such criteria to a general theory of value.
   3 units, spring, (———), MWF 9, to be given in 1964–65

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, winter, (———), MWF 9, to be given in 1964–65

181. **Philosophy of Language**—Nature and uses of language. Concepts of mean-
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ing, 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.

4 units, autumn, (Davidson), MTWTh 1

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, spring, (Larson), MTWTh 4

184. Theory of Knowledge—Systematic analysis of the central problems of epistemology. Idealism, phenomenalism, pragmatism, empiricism, realism as theories of knowledge will be discussed in the light of contemporary developments.

4 units, autumn, (Davidson), MTWTh 3

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, autumn, ( ), MTWTh 9, to be given in 1964–65

191. Tutorial—Junior year.

3 units, each quarter, (Rhinelander, Staff), 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, spring, (Davidson), MTWTh 1

196. Tutorial—Senior year.

3 units, each quarter, (Rhinelander, 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: Philosophy of Mind

3 units, autumn, (Larson), by arrangement

Topic: Explanation

3 units, winter, (Nivison), by arrangement

202. Theory of Meaning—Theory of truth. Survey of positions of Frege, Quine, Church, Fitch, Carnap, Wittgenstein, Strawson, others. Analysis of belief sentences and modal sentences; Russell's theory of descriptions; problem of analyticity. Prerequisite: two courses in logic or permission of instructor.

4 units, spring, (Davidson), MTWTh 3

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, spring, (Suppes), MWF 1, to be given in 1964–65

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, winter, (Suppes), MW 2 and one hour by arrangement

ences, 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. (Same as Statistics 206.) Prerequisite: Mathematics 63 or equivalent.

3 units, autumn, (Suppes), TTh 2 and one hour by arrangement

207. Mathematical Models in Behavioral Sciences: Behavior Theory—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. (Same as Statistics 207.) Prerequisite: Mathematics 63 or equivalent.

3 units, winter, (Suppes), TTh 2 and one hour by arrangement


3 units, winter, (-——, Davidson), M 8–10 p.m.

240. Individual Work for Graduates.

Each quarter, (Staff), by arrangement

241. Proseminar—Required of first-year graduate students.

1 unit, autumn, (———), W 4
and winter, (———), W 4

242. Seminar in the Philosophy of Science.

3 units, spring, (Suppes), M 4:15–6:05, to be given in 1964–65

243. Seminar in Foundations of Mathematical Behavior Theory—(Same as Psychology 272.)

2 to 3 units, spring, (Estes, Suppes), by arrangement

244. Seminar in Metaphysics.

3 units, winter, (———), T 8–10 p.m., to be given in 1964–65


Each quarter, (Staff), by arrangement

299. Advanced Seminar in Recent Philosophical Literature.

Topic: (To be announced)

3 units, winter, (Larson), MTh 4–6

Topic: Wittgenstein’s Investigations

3 units, spring, (Larson), by arrangement

IV. THE GRADUATE PROGRAM IN LOGIC

160a. Symbolic Logic—Propositional and restricted predicate calculi. Validity, provability, consistency, completeness, definability, decision problems for these calculi.

3 units, winter, (Tait), MWF 11

160b. Symbolic Logic—Continuation of 160a which is prerequired.

3 units, spring, (Tait), MWF 2

161. Introduction to Set Theory—Operations on sets, relations, functions, ordering relations, well-orderings, equipollence of sets, transfinite induction, axiom of choice, discussion of axiomatization of set theory. Prerequisite: consent of instructor.

3 units, autumn, (Tait), MWF 1

162. Theory of Automata—An introduction to the theory of finite automata, Turing machines, and certain intermediate types of logical networks. Prerequisite: consent of instructor.

3 units, autumn, (———), MWF 2, to be given in 1964–65

291a. Set Theory—Axiomatic set theory; cardinal and ordinal numbers; alternative axiomatizations, questions of consistency and independence. Prerequisite: 161 or consent of instructor.

3 units, autumn, (———), TTh 1:00-2:15

291b. Set Theory—Continuation of Philosophy 291a which is prerequired.

3 units, winter, (———), TTh 1:00-2:15

291c. Set Theory—Continuation of Philosophy 291b which is prerequired.

3 units, spring, (———), TTh 1:00-2:15
292a. **Metamathematics** — Formalized first-order theories. Validity and decidability. Model theory. Completeness and decidability of various algebraic theories. Incompleteness and undecidability of elementary number theory and various extensions. Introduction to the Hilbert consistency problem, Gödel’s theorem, cut-free proofs. The final quarter will discuss more advanced topics as the interests of the instructor and students warrant. Prerequisite: 160b or consent of instructor.

*3 units, autumn, (Tait), MWF 3*

292b. **Metamathematics**—Continuation of Philosophy 292a which is prerequisite.

*3 units, winter, (Tait), MWF 3*

292c. **Metamathematics**—Continuation of Philosophy 292b which is prerequisite.

*3 units, spring, (Tait), MWF 3*

293a. **Recursion Theory**—Decidability and undecidability; examples of unsolvable mathematical problems. Recursive functions and recursively enumerable sets. The final quarter will discuss more advanced topics (e.g., recursive equivalence types; degrees of undecidability; hierarchy theory and constructive ordinals; metamathematical applications of recursion theory to undecidability of particular mathematical theories) as the interests of the instructor and students warrant. Prerequisite: consent of instructor.

*3 units, autumn, (Fejerman), MWF 1*

293b. **Recursion Theory**—Continuation of Philosophy 293a which is prerequisite.

*3 units, winter, (Fejerman), MWF 1*

293c. **Recursion Theory**—Continuation of Philosophy 293b which is prerequisite.

*3 units, spring, (Fejerman), MWF 11*

391a. **Seminar in Foundations of Mathematics.**

*Autumn, (———), by arrangement*

391b. **Seminar in Foundations of Mathematics.**

*Winter, (Tait), by arrangement*

391c. **Seminar in Foundations of Mathematics.**

*Spring, (Kreisel), by arrangement*

**Seminars in Humanities**—See Humanities 192 and 193.

**Function of a University**—See Humanities 353.

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**PHYSICAL SCIENCES (GENERAL PROGRAM)**

*Professor: Claudio Alvarez-Tostado*

*Lecturer: William A. Perkins*

*Physical Sciences Subcommittee: Claudio Alvarez-Tostado, Willis W. Harman, Leonard I. Schiff, Konrad B. Krauskopf (Chairman)*

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.
- 45 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**—Surveys 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.

3 units, autumn, winter, and spring, (Alvarez-Tostado), TTh 8 or 9; lab. by arrangement

**#50. Modern Astronomy**—A review of current concepts and ideas regarding the nature of the solar system, galaxy, and extragalactic systems; essentially nonmathematical discussion of the basis for these concepts. Telescopic observations if possible.

3 units, spring, (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, winter, (Krauskopf), MWF 11

**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, autumn, (Alvarez-Tostado), alternate years, to be given in 1964–65

**200. Master’s Thesis.**

Any quarter, (Staff)

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**PHYSICS**

**Emeriti:** Joseph Grant Brown, Paul Harmon Kirkpatrick, David Locke Webster

(Professors)

**Executive Head:** Leonard Isaac Schiff

**Professors:** Felix Bloch, Marvin Chodorow, William Martin Fairbank, Edward Leonard Ginzton (on leave), Stanley S. Hanna, Robert Hofstadter, Walter Ernst Meyerhof, Calvin Forrest Quate, Arthur Leonard Schawlow, Leonard Isaac Schiff, Peter Andrew Sturrock
OFFERINGS AND FACILITIES

The new Russell H. Varian Laboratory of Physics, the adjacent Physics Lecture Hall, and the nearby W. W. Hansen Laboratories of Physics (High-Energy Physics Laboratory, Microwave Laboratory, and Biophysics Laboratory) form a closely related complex housing a range of Physics activities from general courses through advanced research, and including several accelerators up to 1 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 the recently authorized two-mile-long 45-Bev electron accelerator. It is hoped that research involving this machine will commence by 1966 or 1967. Professor Walter Carlisle Barber is the Director of the High-Energy Physics Laboratory; Professors Hofstadter, Mozley, Prepost, Ritson and Yearian are on the staff of the Laboratory. The staffs of the other branches of the W. W. Hansen Laboratories of Physics and of the Stanford Linear Accelerator Center are mentioned elsewhere in this catalog (see Applied Physics Division, Biophysics Laboratory, Stanford Linear Accelerator Center).

One of the most important facilities is the Physics-Mathematics-Statistics Library, located in the Varian Laboratory. In physics, this excellent collection 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, 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 February 8, 1964, for the following autumn. Graduate students may normally enter the Department only at the beginning of autumn quarter.

PROGRAMS OF STUDY

The study of physics is undertaken by three principal classes of undergraduates: those including physics as part of a general education, those preparing for careers in professional fields that require a knowledge of physics, such as medicine or engineering, and those preparing for teaching or research careers in physics itself. In this Department the courses numbered below 200 are planned to serve all three of these groups. The courses numbered above 200 meet the needs mainly of the third group, but also of some students majoring in other branches of science and in engineering.

Bachelor of Science

Department requirements for the degree of Bachelor of Science are as follows: Physics 51, 52, 53, 54, 61, 100, 101, 110, 111, 120, 121, 122, 130, 131, 132, 170, 171, 200,
201; Chemistry, 11 units (normally Chemistry 1, 2, and 3); Language, completion of French 3, German 3, or Russian 3 (or placement in more advanced courses).

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 upperclass years. The sample programs emphasize mathematics and physics 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.

**NORMAL SEQUENCE**

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*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**

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<tr>
<td>Total units</td>
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</table>

Grand total of units: 176

*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 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, 114a, b, 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.
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, 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**

In its capacity as agent for the State Board of Education, the University grants credentials for teaching in California in junior and senior high schools and junior colleges. Applicants for these credentials should consult the Credential Secretary of the School of Education for details of the requirements in connection with the teaching of physics.

**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 February 8, 1964.

**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, autumn, (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, winter, (Hofstadter), lec. and lab.

#29. **Modern Physics**—Basis of modern atomic theory, structure and properties of atoms, the nucleus, radioactivity. Prerequisite: 23.

4 units, spring, (Fairbank), lec. and lab.

#51. **Mechanics**—Equilibrium, uniform and accelerated motion, force, work, momentum and energy; fluids, mechanical vibrations. Discussions based on use of calculus. Prerequisites: Mathematics 41 or 11 and continuation in Mathematics 42, or permission of instructor.

4 units, winter, (——), lec.; (Scott), discussions

#52. **Mechanics Laboratory**—Concurrent registration in Physics 51 is required.

1 unit, winter, (——)

#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, spring, (Little), lec.; (——), discussions

#54. **Electricity Laboratory**—Concurrent registration in Physics 53 is required.

1 unit, spring, (Scott)

#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, autumn, (Ritson), lec.; (Iddings), discussions

#56. **Light and Heat Laboratory**—Concurrent registration in Physics 55 is required.

57. **Atomic Physics**—Experimental basis of quantum theory; atoms, nuclei, x rays, atomic structure, radioactivity. Prerequisite: 55.

3 units, winter, (Yearian), TThS 11
3 units, summer, (Whitten), MTWF 9

61. **Optics and Wave Motion**—Theory of wave motions from point of view of Huygens' principle, superposition; interference, diffraction phenomena. Prerequisites: Physics 55 or admission to Accelerated Sequence; Mathematics 42 and concurrent or prior registration in 43.

3 units, spring, (Block), TTh 11:00-12:15

100, 101. **Intermediate Physics Laboratory**—Experiments in mechanics, heat, electricity and magnetism, optics and atomic physics. Equipment for a number of experiments will be simultaneously 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 or fifteen during two quarters. Concurrent registration in 121 and 122 is required.

100. 2 units, winter, (Prepost), by arrangement
101. 2 units, spring, (Prepost), by arrangement

110, 111. **Intermediate Mechanics**—Vectors, statics of rigid bodies, dynamics of point particles, central force motion, dynamics of rigid bodies, theory of small vibrations, coupled oscillators, elementary mechanics of deformable solids. Prerequisites: Physics 51, Mathematics 130.

110. 3 units, winter, (Iddings), MWF 10
111. 3 units, spring, (Iddings), MWF 10

120, 121, 122. **Intermediate Electricity and Magnetism**—Passive d.c., a.c. circuits in steady, transient states; fields, potential; electrostatics in simple geometries, law of magnetostatics, magnetic circuits, slowly varying magnetic fields, Maxwell's equations, plane waves, dispersion, skin effect, waveguides, propagation in nonisotropic media, motion of charged particles in electric and magnetic fields. Prerequisite:
53. Concurrent or prior registration in Mathematics 130 and 131 with Physics 120 and 121, respectively, is required.

120. 3 units, autumn, (Austin), MWF 8
121. 3 units, winter, (Austin), MWF 8
122. 3 units, spring, (Austin), MWF 8

130, 131, 132. Atomic and Nuclear Structure—Fundamental concepts of quantum mechanics and their application to the structure of atoms and atomic nuclei. Prerequisites: Physics 57 or admission to Accelerated Sequence, 61, 111. Concurrent or prior registration in Physics 120, 121, 122, or equivalent, and in Mathematics 130 and 131 is required.

130. 3 units, autumn, (Pratt), MWF 11
131. 3 units, winter, (Pratt), MWF 11
132. 3 units, spring, (Pratt), MWF 11

140. Elementary Nuclear Physics—Elements of nuclear structure, systematics of nuclei, radioactivity, interactions of nuclear radiations with matter, detection of nuclear radiations, nuclear models, fission and fusion, neutron physics. Prerequisites: 57 or 130 and knowledge of calculus.

3 units, autumn, (——), 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: Physics 55 or admission to Accelerated Sequence and Mathematics 130.

3 units, autumn, (——), 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: Physics 130 and 170, or equivalent.

3 units, winter, (Hofstadter), 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: Physics 171, or Physics 57 and Electrical Engineering 255.

3 units, spring, (Schawlow), 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, and cosmic rays, including Zeeman effect, isotope shift, charge and gyromagnetic ratio of the electron, β spectra, α-particle scattering, Compton effect, π-μ decay, semiconductor characteristics, and others. Experiments in electronic circuits, including amplifiers, oscillators, scaling circuits, 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—Physics 100, 101, 121, and 131; for Physics 202—Physics 201 or consent of instructor; for Physics 203—Physics 202. (Note: Any of these courses may be taken in any of the three quarters. Furthermore, a student may take 200 alone or simultaneously with 201.)

200. 2 units, autumn, winter, or spring, (Hanna), by arrangement
201. 2 units, autumn, winter, or spring, (Hanna), by arrangement
202. 3 units, autumn, winter, or spring, (Hanna), by arrangement
203. 3 units, autumn, winter, or spring, (Hanna), by arrangement

210, 211, 212. Introductory Theoretical Physics—Mechanics in canonical variables. Variational methods in mechanics, optics. Theory of linear transformations as
applied to small oscillations, other eigenvalue problems. Fourier transforms. Application to solution of various partial differential equations to problems in continuum mechanics. Prerequisites: Physics 111, 122, and Mathematics 132.

210. 3 units, autumn, (——), MWF 10
211. 3 units, winter, (——), MWF 10
212. 3 units, spring, (Yearian), MWF 10


220. 3 units, autumn, (Chilton), MWF 9
221. 3 units, winter, (Chilton), MWF 9
222. 3 units, spring, (Chilton), MWF 9

230, 231, 232. Quantum Mechanics—Physical basis of quantum mechanics, Schrödinger wave equation, energy levels, collision theory. Heisenberg matrix mechanics and transformation theory, approximation methods, identical particles, spin, radiation theory; applications to atomic, molecular, and nuclear systems. Prerequisites: Physics 131 and 212 and Mathematics 106 and 132, and preferably Physics 132 and 220.

230. 3 units, autumn, (Schiff), MWF 11
231. 3 units, winter, (Schiff), MWF 11
232. 3 units, spring, (Schiff), MWF 11


240. 3 units, autumn, (Meyerhof), TTh 9:00-10:15
241. 3 units, winter, (Meyerhof), TTh 9:00-10:15


3 units, spring, (Prepost), TTh 9:00-10:15

270. Statistical Mechanics—Development of concepts, methods of classical and quantum-statistical mechanics from ensemble viewpoint; microscopic basis for thermodynamics. Prerequisite: Physics 171. Concurrent or prior enrollment in Physics 232 and Mathematics 106 is required.

3 units, spring, (Ritson), 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, 331, 332. Advanced Quantum Mechanics—Dirac’s relativistic electron theory; quantization of electron, electromagnetic fields; covariant perturbation theory, applications to high-energy processes; mass and charge renormalization of quantum electrodynamics; radiative corrections to scattering; Lamb shift. Prerequisites: Physics 222 and 232.

330. 3 units, autumn, (——), by arrangement
331. 3 units, winter, (——), by arrangement
332. 3 units, spring, (——), by arrangement

336. Advanced Topics in Theoretical Physics—Discussion of selected topics of current interest in theoretical physics. Prerequisite: Physics 330.

3 units, winter, (——), by arrangement
340, 341, 342. **Nuclear Theory**—Theory of properties of atomic nuclei by application of quantum mechanics to proton-neutron model. Collision of nuclear fragments, radioactive decay, nuclear energy levels, reactions and models. Prerequisite: Physics 232, 241, and preferably 222.

- **340.** 3 units, autumn, (Shaw), TTh 1:15-3:00
- **341.** 3 units, winter, (Shaw), TTh 1:15-3:00
- **342.** 3 units, spring, (Shaw), TTh 1:15-3:00

346. **Nuclear Moments**—Electric, magnetic moments of atomic nuclei, their relation to nuclear constitution. Investigation of the moments by measurements on hyperfine structure, molecular beams, nuclear induction. Prerequisite: Physics 232.

- **3 units, spring, (Scott), TTh 8:30-10:00, in alternate years, to be given in 1963-64**

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, autumn, (Fairbank), TTh 8:30-10:00, alternate years, to be given in 1963-64
- **371.** 3 units, winter, (Little), TTh 8:30-10:00, alternate years, to be given in 1963-64

390. **Research**—All work in experimental or theoretical problems in research, as distinguished from independent study of nonresearch character listed as Physics 190 and 290. Written report of work required at end of quarter. Open only to graduate physics major students, with permission of instructor.

- Any quarter, (Staff), by arrangement

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**DIVISION OF APPLIED PHYSICS**

**Executive Head:** Marvin Chodorow  
**Professors:** Marvin Chodorow, Edward Leonard Ginzton (on leave 1963–64), Hubert Heffner, Calvin Forrest Quate, Peter Andrew Sturrock  
**Assistant Professor:** Marshall Scott 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. These areas include solid state, plasmas, quantum electronics, and studies of the electrodynamic aspects of geophysics and space physics. Research activities are carried out in the W. W. Hansen Laboratories of Physics and the Stanford Electronics Laboratories.

The number of graduate students admitted to Applied Physics is limited. Applications should be received by February 7, 1964.

**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 six 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 210, 211, 212, 130, 131, 132, 170, 171, 172, 220 (or Electrical Engineering 272), one quarter of advanced laboratory (chosen from Physics 200, 201, 202, Applied Physics 351, 353, 355, or E.E. 256a, b, or c), plus sufficient additional approved courses in Applied Physics, Physics, Engineering, or Mathematics, to total forty-five units. A reading knowledge of French, German, Italian, or Russian can be substituted for nine of these required units. A minimum grade average of B is required in the courses taken toward the Master's degree.

Doctor of Philosophy

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" in this Bulletin. The departmental requirements include a good reading knowledge in any one of the four languages: French, German, Italian, 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, 170, 171, 172, 220 (or E.E. 272), 221, 230, 231, 232, and two quarters of advanced laboratory (chosen from Physics 200, 201, 202, Applied Physics 351, 353, 355 [E.E. 256a, b, or c]). 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 Aids and must be completed by February 7, 1964.

COURSES

250, 251. Microwave Electronics—Detailed treatment of motion of electrons in microwave devices, including beam focusing, interaction with electromagnetic fields, space-charge effects. Emphasis on general properties of electron dynamics common to all microwave tubes. Specific types of tubes such as klystrons, traveling-wave tubes, etc., insofar as they illustrate general principles. Transit time loading, space-charge waves, Llewellyn's equations, noise in beams, etc. Prerequisite: Physics 212 or equivalent.

250. 3 units, autumn, (Chodorow), MWF 9
251. 3 units, winter, (Chodorow), MWF 9

255. Linear Operator Principles in Electromagnetic Theory—Application of the methods of linear vector spaces to electromagnetic theory. Methods include linear operators, eigenvalues and eigenfunctions, transformation theory, Green's functions,
perturbation theory, variational methods and symmetry, all treated from a unified point of view. Prerequisite: Physics 220 or E.E. 272.

3 units, spring, (Sparks), TThS 10

256. Advanced Microwave Theory—Reduction of field theory to circuit theory, general network theorems for microwave structures, analysis in terms of scattering matrices, interconnection of multiterminal structures, special microwave structures. Radiation from prescribed current distributions, theory of properties of materials at microwave frequencies. Prerequisite: Applied Physics 255.

3 units, winter, (——), alternate years by arrangement, to be given in 1964–65

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—A grade of + indicates satisfactory work; no letter grade is assigned.

Any quarter, (Staff), by arrangement


3 units, winter, (Sturrock), MWF 11


3 units, spring, (Sturrock), MWF 11


3 units, autumn, (Sturrock), MWF 11


3 units, autumn, (Siegman)


3 units, winter, (Heffner), MWF

350. Microwave Measurements I—Lecture course which, together with 351, is intended to introduce fundamental measurement methods, and instruments in microwave region. Measurement of impedance, power, frequency wavelengths; laboratory oscillators, methods of detection. Prerequisites: E.E. 270 and concurrent registration in E.E. 271 or equivalent.

2 units, autumn, (Quate), TTh 8

351. Microwave Measurements Laboratory I—Experimental work to accompany 350. Concurrent registration in 350 required.

2 units, autumn, (Quate), by arrangement
352. **Microwave Measurements II**—Continuation of 350. Microwave theory as related to laboratory practice: waveguide impedance concepts; representation, measurement of microwave circuits. Selected topics from following: periodically loaded transmission lines and space harmonics; determination of properties of materials; impedance bridges, directional couplers, filters, attenuators; experimental study of microwave vacuum tubes (klystron, magnetron, traveling-wave tube, backward-wave oscillator). Prerequisites: 350 and 351.

2 units, winter, (Quate), TTh 8

353. **Microwave Measurements Laboratory II**—Laboratory course to accompany 352. Prerequisites: 350 and 351. Concurrent registration in 352 is required.

2 units, winter, (Quate), by arrangement

354. **Microwave Measurements III**—A continuation of 350 and 352. Microwave theory as related to laboratory practice; measurement of dielectric constant, properties of ferrites, characteristics of microwave devices (klystron, BWO, TWT, parametric amplifiers, masers). Also selected topics of current interest. Prerequisites: 352 and 353.

2 units, spring, (Quate), TTh 8

355. **Microwave Measurements Laboratory III**—Laboratory course to accompany 354. Prerequisites: 352 and 353.

2 units, spring, (Quate), by arrangement


377. 3 units, winter, (Sparks), MWF 10
378. 3 units, spring, (Sparks), MWF 10

**POLITICAL SCIENCE**

Emeriti: Thomas S. Barclay, Anthony E. Sokol, Graham H. Stuart (Professors)

Executive Head: Robert A. Walker
Associate Executive Head: Kurt Steiner
Professors: Philip W. Buck, Heinz Eulau, Christina Phelps Harris, Nobutaka Ike, Robert C. North, Kurt Steiner, Robert A. Walker, James T. Watkins IV
Associate Professors: Robert A. Horn (on leave autumn quarter), Hubert R. Marshall (on leave 1963–64), Arnold A. Rogow, Jan F. Triska
Assistant Professors: Irene Blumenthal, Richard A. Brody, Richard R. Fagen, Charles A. Drekmeier, Giuseppe Mammarella (Director of Administration, Stanford in Italy), Martin Shapiro, Raymond E. Wolfinger
Lecturers: Milorad M. Drachkovitch, Carl F. Stover

**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 post-graduate 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 co-ordinators of the program.

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) Courses 10, 20, and 150, or their equivalent. Political Science 1 may be counted toward these 45 units.
   b) An advanced course in at least three of the following fields: administration, comparative government, international relations, political theory, politics, and public law. Political Science 150 may be counted as an advanced course in the field of political theory.

3. The completion of 15 units outside the department in courses appropriately related to political science. Such courses must be approved by the student's adviser.

Honors Program in Political Science

The Honors Program is designed to provide a few unusually well qualified 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 no later than the second quarter of the junior year. Applicants will be required to submit evidence of aptitude and promise, and no applicant will be considered who has not achieved a 3.0 average or better in all University work, and a 3.3 average or better in political science courses.

Honors candidates will complete all requirements for a major in political science. In fulfilling these requirements they must take 15 units of work in undergraduate seminars or tutorials. In addition, all candidates will take the honors seminar, Political Science 198, in their senior year. Honors candidates will also submit an honors thesis during their senior year. The thesis, which will represent a full quarter's work, will be awarded a maximum of 15 credits. In certain cases, the honors thesis may relate to a research project in which a member of the Department is engaged. Following his selection of a thesis topic, the honors candidate will be assigned an adviser who will closely supervise his thesis research.

Graduation with Honors in Political Science will require (1) a 3.0 average or better in all University work; (2) a 3.3 average or better in political science; and (3) the submission of an acceptable honors thesis. Students who successfully complete the program will graduate "With Honors in Political Science." Interested students should consult the chairman of the Honors Program Committee in their junior year.
**Special Curricula**

**Executive and management option**—An executive and management program is offered to prepare students to meet the increasing demand of federal, state, and local governments, as well as industry, for college graduates. Students thus recruited after graduation usually enter executive training programs looking to eventual middle and upper level executive positions. The program, reflecting the close interrelation of government and business and recognizing that such positions call for a broad educational background, is drawn from course offerings in a number of departments. Two courses, 100, Public Administration; 105, Public Personnel Administration; and 107, Government Control of Business; and 30 additional units of related work, are required. Interested students should request a more detailed statement of the executive and management option from the Departmental secretary.

**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 Science: International Relations (see description at end of political science offerings).

**Law**—Many students desiring to complete an undergraduate liberal arts education before entering law school take a political science major since “law” and “government” are inseparable. Preparation should include study of political, social, and economic theories and institutions and competence in the use of English. Interested students should consult with Department faculty in public law.

**Studies of the Communist System**—The Department offers a wide range of courses on the Communist bloc. For these courses see below under Comparative Government, International Law and Relations, Political Theory, and Public Law, and under Graduate Courses. Fellowships for Soviet Studies under the National Defense Education Act and fellowships and research fellowships for studies of the Communist system are available for qualified graduate students.

Administered through the Department of Political Science, the Studies in International Conflict and Integration offer a limited number of assistantships for interdisciplinary research and training in international 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 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.

**Master of Arts**

A candidate for the Master’s degree must have a creditable record (with average grade of B or better) of undergraduate work in political science and other social science subjects.

The faculty of the Department recommends a candidate for this degree upon the satisfactory completion of at least one full academic year as a graduate student in this Department, with 45 units of work in political science including at least 15 units in seminars and the presentation of an approved thesis for which no more than 5 units of formal credit will be counted toward the degree. By special permission, work done in related departments may be accepted in lieu of a portion of the work in political science. It is expected that a graduate student will maintain at least an average grade of B in all his work.

During the first quarter in residence a candidate for the Master’s degree should
register for Political Science 400, Method and Scope of Political Science. The Department will waive this requirement only when the candidate demonstrates to its satisfaction that he has training equivalent to that provided by this course.

The University’s basic requirements for the Master’s degree are discussed in the section “Degrees” in this Bulletin.

**Master of Arts in the Teaching of Political Science**

The degree of Master of Arts in Teaching is offered jointly by this department and the School of Education. The degree is intended for 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 section “School of Education” in this Bulletin.

**Doctor of Philosophy**

A candidate for the doctorate shall have a creditable record of previous work in political science and the other social science subjects. In exceptional cases, waiving the Master of Arts requirement may be recommended for Department approval by the professor in charge of the student’s special field or by the Graduate Student Adviser.

Not later than the end of the third week of the third quarter in residence the candidate will submit to the Department a statement of (a) his program for fulfilling the language requirement; (b) his five fields of political science, chosen in accordance with the sections on the *Fields of Concentration in Political Science* and on *Area Studies* below; (c) his minor or supplemental program in accordance with the sections on *Requirements for the Minor or Supplemental Program* and on *Area Studies* below; (d) his program for making up deficiencies in accordance with the section on the *Fields of Concentration in Political Science*; and (e) his proposed field of investigation for the dissertation. This statement will be the subject of an oral interview of the candidate with the faculty or a committee thereof. After this interview of the candidate and the evaluation of his work, the faculty will decide whether the candidate will be permitted to proceed toward the Ph.D. degree in this Department.

If the faculty decides on the basis of the interview mentioned above that the candidate will be permitted to proceed toward the Ph.D. degree in the Department, a date for the departmental and University examinations will be set in the light of the student’s total program. After the interview the candidate completes the preliminary procedures for his minor department, if any, fulfills the language requirement in accordance with the next paragraph, and files an application for formal admission to candidacy with the Secretary of the University Committee on the Graduate Division.

Ph.D. candidates are required to demonstrate one of the following:

a) a reading knowledge of two Western languages (e.g., French and German); or

b) a reading knowledge of one non-Western language (e.g., Arabic, Chinese or Japanese) or of Russian; or

c) a reading knowledge of and conversational ability in one language (e.g., French, German, Spanish); or

d) a reading knowledge of one language and knowledge of a skill field.

The language or languages selected 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 program proposed by the candidate in the statement, mentioned in the preceding paragraph. It will accept alternative “d” above if it finds that the special skill contributes
more to the candidate's proficiency in political science than would a reading knowledge of a second Western language or conversational ability in the Western language chosen. The language requirements are fulfilled by passing the appropriate Ph.D. foreign language examinations. Examiners are designated by the Department. Knowledge of a skill field is demonstrated by successfully accomplishing a program of at least 15 quarter units of selected courses, not in the major, minor or supplemental program. Prior to submission of the application for formal admission to candidacy, the candidate must fulfill the University foreign language requirement (i.e., he must demonstrate reading ability in at least one foreign language and obtain the requisite certification to that effect). The additional language requirements (reading knowledge of a second language, conversational ability or knowledge of a skill field) must be fulfilled before making arrangements for the University oral examination.

**Fields of Concentration**—General Political Theory is a field required of all Ph.D. candidates. In addition, all candidates offer four of the fields listed below. These four fields shall be selected in such a manner that the program is coherent and focused and yet avoids over-specialization. Approval of the program by the Department is required.

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<thead>
<tr>
<th>American</th>
<th>Comparative</th>
<th>International</th>
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<tr>
<td>Theory</td>
<td>American Theory</td>
<td>Comparative Political Thought</td>
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<tr>
<td>Politics</td>
<td>American Politics</td>
<td>Comparative Politics</td>
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<tr>
<td>Law</td>
<td>American Public Law</td>
<td>Comparative Law and Jurisprudence</td>
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<td>Administration</td>
<td>American Public Administration</td>
<td>Comparative Administration</td>
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A candidate may offer, in addition to General Political Theory, three fields in any of the vertical columns (his concentration) and one field outside his concentration; or he may offer, in addition to General Political Theory, three fields in one of the horizontal lines (his concentration) and one additional appropriate field outside his concentration; or he may offer two appropriate fields from each of two of the horizontal lines.

**Deficiencies**—The candidate, in preparing for the departmental examinations, is expected to make up deficiencies, on the undergraduate level, in the sub-fields he presents. In addition, he is expected to have had some preparation, on the undergraduate or graduate level, in each of the four generic aspects of political science (theory, politics, law, and administration) as well as some preparation in each of the three areas to which these apply (American, Comparative, International). The candidate should consult his adviser at the earliest possible time to determine the existence of deficiencies and the specific field or fields in which work should be taken to remove the deficiencies.

**Required Courses**—While the departmental requirements for the Ph.D. degree are in general not stated in terms of course requirements or unit requirements, all Ph.D. candidates take Political Science 401.

Ph.D. candidates in their second year of graduate work are expected to participate in the Departmental Research Seminar and to present to it a research project. The Departmental Research Seminar meets three times each quarter throughout the academic year.

**The Minor or Supplemental Program**—In addition to the preparation of the five fields in Political Science the candidate shall complete either (1) a minor in another department which comprises part of the University oral examination or (2) a sup-
plemental program, consisting of a coherent group of advanced courses, totaling not less than 25 units, taken outside the Department of Political Science as part of the student's graduate work. The candidate will be examined in this program as part of his University oral examination. Approval either of the minor or the supplemental program by the Department of Political Science is required.

Area Studies—A candidate who wishes to specialize in a particular area or country of the world or in a functional area may, with the permission of the Department, arrange a coherent group of advanced courses within and without the Department, totaling not less than forty units. The work done in the Political Science Department may be substituted for any field, other than General Political Theory or a field considered essential for his area work by his adviser and the Department. Twenty-five of the forty units must be taken outside the Department of Political Science as part of the student’s graduate work in area courses or other courses related to the area program. These twenty-five units constitute the student’s supplemental program. The candidate will be examined by a member of the Political Science Department in collaboration with an outside examiner.

Departmental Examinations—After the candidate has completed his preparation in all of his fields and in his minor or supplemental program, and after he has fulfilled his language requirement, he takes the written departmental examinations in all of his fields. These examinations are uniformly scheduled in the autumn and spring quarters, beginning in the fifth week of the autumn quarter and the third week of the spring quarter. The requirement that all candidates offer the field of General Political Theory shall be considered as satisfied by a successful Departmental written examination in this field. As a result of the written examinations the candidate

a) proceeds to the University oral examination in the remaining four fields and in his minor or supplementary program (if he clearly passed all the written examinations) or
b) repeats the examination in one field at a regularly scheduled time (if he fails the written examination in one field) or
c) petitions the Department to repeat the written examinations in all of his fields at a regularly scheduled time (if he fails the written examination in more than one field) or
d) takes the Departmental oral examination in all of his fields (if, in the view of any member of the Committee administering the written examinations this is necessary to resolve doubts regarding his performance).

The Departmental oral examination in case “d” shall be two hours in length. Considering the function of the examination, the examiners may agree to allot unequal time to the various fields. The conditions for passing the Departmental oral examination shall be the same as for the University oral examination. (Favorable vote of three-fourths or more of the examining committee.)

University Oral Examination and Dissertation—The candidate arranges for the University oral examination through the Graduate Study Secretary in consultation with the Graduate Student Adviser in the Department. The degree will be granted upon recommendation by the Department and the University Committee on the Graduate Division after satisfactory completion of the University oral examination and a dissertation. The University’s basic requirements for the doctorate are discussed in the section “Degrees” in this Bulletin.

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 Soviet affairs, 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, and the Graham H. Stuart Award for the outstanding senior student in the Department of Political Science.

I. INTRODUCTORY COURSES

**#1. Major Issues of American Public Policy**—Alternative public policies in selected areas, including control of monopoly, labor relations, agriculture, social welfare, civil rights, foreign policy. Political process; influence of cultural, economic, political factors on determination of public policy. Prerequisites: History 1 and 2.

5 units, autumn, (Staff), MTWThF 10
or winter, (Staff), MTWThF 11
or spring, (Staff), MTWThF 10

**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, autumn, (Shapiro), MTWThF 9
or winter, (Horn), MTWThF 11
or spring, (Rogow), MTWThF 10

**20. Contemporary Governments Abroad**—General survey of governments of England, France, Russia, Germany, Japan. Present-day political situation in these states described and analyzed.

4 or 5 units, autumn, (Buck), MTWThF 8
or winter, (Buck), MTWThF 8
or spring, (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 instructor. May be taken for a maximum of three quarters.

1 unit, autumn, winter, and spring, (Watkins), by arrangement

II. ADVANCED COURSES

Open to students who have taken the necessary prerequisites and also to graduates where advisable.

**Administration**

**100. Public Administration**—Relation of policy to administration, planning, principles of organization, problems of supervision and personal motivation, public rela-
tions, decision-making, the budget, administrative responsibility. Prerequisite: 1 or 10.

103. State and Local Government—Role of states in the Federal system; state constitutions; state government; political process. Federal-state, interstate, state-local relations. Municipal government; politics, popular control, administrative organization. Prerequisite: 10.

104. Local Government Laboratory—Field course in municipal affairs offered in cooperation with the Coro Foundation (San Francisco).

105. Public Personnel Administration—Personnel administration in large scale organizations; recruitment, position-classification, training, promotion, human relations and morale, labor unions in the public service, political activity of public servants, loyalty. Organization for personnel administration. Prerequisite: 100.

107. Government Control of Business—Federal policy regulating or promoting business. Interrelationship of such programs. Politics of establishing, revising, administering regulatory programs. Prerequisite: 1 or 10, or Economics 1.

110. Administrative Behavior—Environment of administrative action; political social, psychological factors in management; problem of incentives. Prerequisite: 100.

113. Introductory 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 planning process. Prerequisite: 100. Economics 1 is desirable.

115. Introductory Seminar in Administrative Responsibility — Conflicting loyalties, accountabilities of administrative officials in decision-making process; responsibility to public at large, pressure groups, chief executive, legislature, profession. Case study method used. Prerequisite: 100.

116. Introductory Seminar in Administrative Regulation — Administrative techniques for applying congressional regulatory policy. Scope of rule-making, decision-making, licensing, examining, enforcing powers; how to ensure their responsible exercise. Prerequisite: permission of instructor.

119. Directed Reading in Administration—Advanced individual study in public administration. Prerequisite: 100.

For graduate courses in Administration, see Part III.

COMPARATIVE GOVERNMENT

120. Problems of Modern Government—Government organization, constitutional framework; administrative action and procedures; political parties and public opinion; emphasis on United States, Great Britain, France, Germany, Russia. Topics deal with each problem in several countries.

122. The British Commonwealth and Empire—Imperial organization, Dominion status; governments of Canada, Australia, South Africa. Prerequisites: 10 and 20.

123. Government and Politics in Asia—Survey of governmental institutions and
the political process in Asian countries. Desirable prerequisite: 20 or previous study of the area.

124. Government and Politics in Japan—Governmental institutions and the political process in prewar and postwar Japan; the influence of tradition and social change; the impact of the occupation. Desirable prerequisite: 20 or 123.


127. Government and Politics of Africa South of the Sahara—Political conditions and government institutions in Africa south of the Sahara.


127e. Seminar on Political Movements in Europe—Selected topics concerning the contemporary European political movements (Conservatism, Liberalism, Christian Democracy, Socialism, Communism).

128. Ideology v. Society: the USSR—Study of the social institutions and the process in which the conflict of Marx-Leninist ideology with traditional forces has resulted in "postponement" of Communism.

128a. Politics of Italy—Problems of Contemporary Italian Politics.

129. Directed Reading in Comparative Government—Prerequisites: 10 and 20.

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.

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.

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.

133. Control of Foreign Policies in Major World Powers — How foreign
policies are made by the major foreign powers; important social, economic, political
factors in actual formulation and conduct of respective foreign policies.

4 or 5 units, spring (Brody), MTWThF 9

136. Soviet Union in World and Communist Bloc Affairs—Analysis of Soviet
foreign policy. Emphasis on topics such as decision-making, diplomacy, treaties,
trade, foreign Communist parties, coexistence, and Soviet concept of international
relations.

4 or 5 units, autumn, (Triska), MTWThF 2

136a. Seminar on Soviet-Chinese Relations.

5 units, spring, (North), T 4–6


5 units, autumn, (Triska), by arrangement, to be given in 1964–65

136c. Seminar on the Communist Bloc.

5 units, spring, (Triska), by arrangement

136d. Analysis of the Socialist and Communist Internationals (1864–1956)
—Emphasis on the ideological bases, operational devices and historical meanings
of the First, Second, and Third Internationals, including the Cominform period.

4 or 5 units, autumn, (Drachkovitch), to be given in 1964–65

138. Latin America and the United States—Diplomatic and commercial relations
between United States and the republics of Latin America.

4 or 5 units, autumn, ( ), MTW 9

139. Directed Reading in International Relations.

(Harris, North, Watkins), units by arrangement

140. Introductory Seminar in International Relations—May be repeated for
credit.

5 units, autumn, (Watkins), Th 7:30–9:30 p.m.

141. International Relations: An Introductory Seminar in Scope and
Method.

5 units, winter, (Brody), T 2–4

142. Seminar in Egyptian Nationalism and International Politics—Back-
ground and analysis of the Egyptian Revolution and reform movement of 1952.

5 units, spring, (Harris), W 2–4

143. Seminar on Great Powers in the Middle East in the Twentieth Century
—Conflicting interests and policies; reaction of the Middle East peoples to Great
Power pressures and to westernization.

5 units, winter, (Harris), W 2–4

144. Seminar in American Policy Toward the Middle East—American inter-
ests and problems of policy-making in the Arab world, Turkey and Persia.

5 units, winter, (Harris), W 2–4, to be given in 1964–65

145. 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 organiza-
tion given special attention.

4 or 5 units, spring, (Watkins), to be given in 1964–65

146. The Modern Arab World—Introduction to the problems of the Arab suc-
cessor states of the Ottoman Empire. Internal politics, the Arab League, and inter-
national relations.

4 or 5 units, autumn, (Harris), MWF 11

147. 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 or 5 units, spring, (Watkins), MTThF 10

148. Introductory Seminar in International Organization—Prerequisite: 147
or equivalent.

5 units, spring, (Watkins), Th 7:30–9:30 p.m., to be given in 1964–65
149. Directed Reading in International Organization.  
(Watkins), units by arrangement  
For graduate courses in International Relations, see Part III.

**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 or 5 units, autumn, (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.  
4 or 5 units, winter, (Drekmeier), MTWThF 11

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.  
4 or 5 units, spring, (Drekmeier), MTWThF 11

153. Political Organization and Social Theory—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, Michels, Freud, and Parsons will be discussed.  
4 or 5 units, spring, (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 or 5 units, winter, (Ike), MTWThF 1

155. Comparative Marxist Theory—A critical examination of the chief theories developed by Marx, Engels, Lenin, Stalin, Mao Tse-tung and various revisionists. Special emphasis on Soviet and Chinese Communist ideologies. Prerequisite: Political Science 150 or equivalent.  
4 or 5 units, autumn, (North), MTWThF 2

156. American Political Thought: 1620–1865—The development of the American political tradition from the Puritan Theocracy to the Civil War. Special reference to pre-Revolutionary political thought, the American Revolution, the Constitutional Convention, Jacksonian Democracy, Slavery and Secession.  
4 or 5 units, autumn, (Rogow), MTWThF 10

157. American Political Thought: 1865 to the Present—The American political tradition since the Civil War. Special reference to the contributions of clergymen, businessmen, politicians, lawyers, economists, reformers and agitators.  
4 or 5 units, winter, (Rogow), MTWThF 10

159. Directed Reading in Political Theory—Prerequisite: 150.  
(Drekmeier, North, Rogow), units by arrangement

For graduate courses in Political Theory, see Part III.

**Politics**

160. American Parties and Politics—Nature and development of American political parties; party organization, structure, leadership, activities; theories, functions of party system, responsibility; attitudes and behavior in the political community; party and public opinion as influences upon government.  
5 units, autumn, (———), MTWThF 9
161. Introduction to the Study of Political 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, autumn, (Wolfinger), MTWThF 11

162. Advanced Study of Political Behavior—Intensive analysis of selected studies in political behavior: theory, method, and data requirements. Prerequisite: 161, graduate standing, or permission of the instructor.
5 units, winter, (Eulau), MTWTh 1

163. Practicum in Political Behavior—Field work and analysis of political survey data. Prerequisite: permission of the instructor.
5 units, spring, (Eulau), MW 1 and by arrangement

164. Legislative Behavior—Analysis of 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. Prerequisite: 10.
5 units, winter, (Wolfinger), MTWThF 11

165. Seminar in Group Politics and Political Power—Group pressures, role of interest groups in the political process; political, economic and social forces promoting conflict and consensus in contemporary society; analysis of internal politics of private associations; social structure, distribution of power as conditioning factors in American politics.
5 units, spring, ( ), T 2-4

167. Introductory Seminar in Politics—Historical, social and ideological factors affecting American politics; emergent patterns in the party system; stratification and class in American society; analysis of the nature of public opinion and voting behavior.
5 units, autumn, ( ), T 2-4

168. Seminar in the Nature and Structure of Power in American Society—The meaning and concept of power; liberal ideology and the American approach; strategy and tactics of private power in the context of the present institutional scene; business, labor, religion, the professions as organized power. Implications for a democratic society.
5 units, spring, ( ), Th 2-4

169. Directed Reading in Politics—Prerequisite: 10.
( ), units by arrangement

For graduate courses in Politics, 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, winter, (Horn), MTWThF 1

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, (Horn), to be given in 1964–65

173. Civil Liberties in the United States—Civil liberties in contemporary American culture; theory, history underlying them. Free speech, press in era of mass com-
munications; 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, spring, (Horn), MTWThF 1

174. American Court Systems—The role of the courts in American government, inter-relation of courts with other agencies of government. Judicial personnel and administration.

5 units, winter, (Shapiro), MTWThF 2


4 or 5 units, spring, (Blumenthal, Triska), to be given in 1964–65

179. Directed Reading in Public Law—Prerequisite: consent of instructor.

(Horn, Shapiro), units by arrangement

Undergraduate Honors

198. Honors Seminar—Open only to honors candidates in their senior year.

5 units, autumn, (Fagen), M 2–4

199. Senior Honors Thesis.

Each quarter, (Staff), units by arrangement

For graduate courses in Public Law, see Part III.

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.

201a. Seminar in Science and Government—The nature and significance of the Federal government’s role in scientific research and development: government organization for science and technology, national science policy, the government contract and grant systems, security and conflict of interest, the politics of science, the professional responsibility of scientists, and related issues. Prerequisite: consent of instructor.

5 units, spring, (Stover), M 4–6

221. Reform and Revolution in Twentieth Century China and Japan

5 units, winter, (Ike), T 2–4


5 units, winter, (Triska), by arrangement


5 units, spring, (Triska), by arrangement

226b. Advanced Research in the Communist Bloc.

5 units, autumn, (Triska), by arrangement

226c. Research Seminar on the Communist Bloc.

5 units, winter, (Triska), to be given in 1964–65

232. Seminar in International Relations Theory.

5 units, winter, (Watkins), T 2–4

240. Changing Nature of Dependent States—Techniques of inter-state control; protectorates, puppet states, colonies, other forms of dependency and control.

5 units, spring, (Ike), to be given in 1964–65

247. Seminar in International Organization.

5 units, spring, (Watkins), to be given in 1964–65


5 units, winter, (Rogow), M 4–6
252. Seminar in Political Philosophy: Political Power.
5 units, winter, (Drekmeyer), to be given in 1964–65

253. Seminar in Political Philosophy: Reason, Law, and Authority.
5 units, winter, (Drekmeyer), M 2–4

262. Seminar in Political Behavior: Modes of Analysis.
5 units, winter, (Eulau), to be given in 1964–65

262c. Graduate Seminar in Politics: The Policy Formation Process—Basic concepts and important theories dealing with political institutions and practices; hierarchy and bargaining; the distribution of power in democratic societies. Open to advanced undergraduates with the consent of the instructor.
5 units, winter, (Wolfinger), W 2–4

263c. Graduate Seminar in Politics: The American Party System—The party system as a means of coordinating political decisions; fragmentation, consensus and leadership in American politics. Open to advanced undergraduates with the consent of the instructor.
5 units, autumn, (Wolfinger), W 2–4

270. The Supreme Court and the Constitution—See 170.


5 units, (Horn), to be given in 1964–65

300. Thesis.
Each quarter, (Staff), units by arrangement

301. Colloquium in Public Administration.
5 units, spring, (Walker), to be given in 1964–65

302. Research Seminar in Public Administration.
5 units, (———), to be given in 1964–65

303. Directed Reading and Research in Public Administration.
(Walker), units by arrangement

306. Colloquium in Comparative Public Administration—History and methodology of comparative analysis. Substantive focus on problems of public administration in the underdeveloped world.
5 units, spring, (Fagen), W 2–4, to be given in 1964–65

307. Research Seminar in Comparative Public Administration—Various approaches to the study of public administration. Special problems in the study of administration in the underdeveloped nations.
5 units, spring, (Fagen), W 2–4

308. Directed Reading and Research in Comparative Public Administration.
(Fagen), units by arrangement

311. Colloquium in International Organization and Administration.
5 units, autumn, (Watkins), M 2–4

312. Research Seminar in International Organization and Administration.
5 units, (———), to be given in 1964–65

313. Directed Reading and Research in International Organization and Administration.
(Blumenthal, Watkins), units by arrangement

5 units, winter, (Eulau), M 7:30–9:30 p.m.

317. Research Seminar in American Politics: Group Interests and Democratic Politics.
5 units, autumn, to be given in 1964–65

Behavior—Survey of current findings on attitude formation, perception, political participation and voting behavior; student research on numerous aspects of individual political behavior using data from the Inter-University Consortium for Political Research; these materials cover a very wide range, including such topics as voting, attitudes toward public policy and institutions, and organizational behavior.

      5 units, spring, (Wolfinger), W 2-4

319. Directed Reading and Research in American Politics.
      (Eulau, Wolfinger), units by arrangement

320. Colloquium in Comparative Politics.
      5 units, autumn, (Steiner), to be given in 1964-65

321. Research Seminar in Comparative Politics.
      5 units, winter, (Buck), M 2-4

322. Directed Reading and Research in Comparative Politics.
      (Blumenthal, Buck, Ike, Steiner, Triska), units by arrangement

323. Colloquium in International Politics.
      5 units, winter, (Brody), to be given in 1964-65

324. Research Seminar in International Politics.
      5 units, winter, (North), T 4-6

325. Directed Reading and Research in International Politics.
      (Brody, Harris, North, Triska, Watkins), units by arrangement

326. Colloquium in American Political Theory.
      5 units, spring, (Rogow), M 4:15-6:05

327. Research Seminar in American Political Theory.
      5 units, spring, (Rogow), to be given in 1964-65

328. Directed Reading and Research in American Political Theory.
      (Staff), units by arrangement

329. Colloquium in Comparative Ideologies.
      5 units, winter, (Ike and Triska), to be given in 1964-65

330. Research Seminar in Comparative Ideologies.
      5 units, (Drekmeier), to be given in 1964-65

331. Directed Reading and Research in Comparative Ideologies.
      (Drekmeier, North, Rogow, Triska), units by arrangement

332. Colloquium in International Political Theory.
      5 units, winter, (North), by arrangement

333. Research Seminar in International Political Theory.
      5 units, autumn, (North), to be given in 1964-65

334. Directed Reading and Research in International Political Theory.
      (Staff), units by arrangement

335. Research Seminar in American Constitutional Law.
      5 units, spring, (Horn, Shapiro), M 4

336. Directed Reading and Research in American Constitutional Law.
      (Horn, Shapiro), units by arrangement

337. Colloquium in Comparative Law.
      5 units, (Shapiro), to be given in 1964-65

338. Research Seminar in Comparative Law.
      5 units, autumn, (Shapiro), by arrangement

339. Directed Reading and Research in Comparative Law.
      (Staff), units by arrangement

340. Colloquium in International Law.
      5 units, (———), to be given in 1964-65

341. Research Seminar in International Law.
      5 units, (———), to be given in 1964-65

342. Directed Reading and Research in International Law.
      (Staff), units by arrangement
361. Essentials of Political Theory.
5 units, autumn, (Rogov, Drekmeier), by arrangement

400. Method and Scope of Political Science—Required of A.M. candidates in first graduate year. History of political science as an academic discipline; scope of the subject; relationship to the other social sciences; political theory and political research; research strategy and tactics: initiation of inquiry, formulation of research questions, and research design; problems of data requirements and techniques of data collection: the use of documentary sources in various fields; census materials; construction of bibliography; observation and interviewing; organization and classification of information.
5 units, autumn, (Rogov), F 2-5

401. Method and Scope of Political Science—Required of Ph.D. candidates in first graduate year at Stanford. Review of different modes of political analysis and research designs.
5 units, autumn, (Eulau), MW 2-4, tutorial hours by arrangement

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 degrees of Bachelor of Arts and Master of Arts. 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.

Students expecting to pursue graduate study beyond the Master of Arts degree are advised to familiarize themselves at an early date with the requirements of the disciplines of their preference: economics, history, or political science.

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 with a C average in all requirements for the major of

   a) The required courses:

      Economics 1. Elementary Economics
      Geography 4. Economic Geography (or equivalent)
      History 31. Europe in the Nineteenth Century
      History 32. Europe Since 1914
      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 130. Introduction to International Law
Political Science 147. The United Nations and Its Antecedents
Political Science 150. 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 in one of the following concentrations:

I. International Organization and Administration
II. World Politics
III. International Economic Relations
IV. Regional Studies (Western Europe, British Commonwealth, Middle East, Soviet Union and Communist Bloc, Latin America, Asia, or another Regional Group approved by the Director).

Master of Arts

Provisional enrollment for the degree of Master of Arts in the International Relations Program will be made on presentation of a creditable record of undergraduate work (with average grade of B) equivalent to the subject-matter requirements of the degree of Bachelor of Arts stated above. Subject-matter deficiencies in the undergraduate record have to be made up before the degree is granted. Faculty advisers will provide guidance in course work and in choice and direction of thesis, and will approve application for formal admission to candidacy to the University Committee on the Graduate Division.

Candidates will be recommended for the degree upon satisfactory completion (with average grade of B) of at least one full academic year as a graduate student with 45 units of work, not more than 15 units of which may be fulfilled by the required thesis. The candidate must also demonstrate a satisfactory reading knowledge of one modern foreign language, competence to be established by two quarters of second-year reading courses with average grade of C, certification of adviser, or examination, at discretion of committee in charge; and, if he offers a regional field of study, the language must be appropriate to that field.

Work for the degree must be concentrated in three of the four fields of study (groups) given above under "Bachelor of Arts." One field requirement may be satisfied by presentation of the required thesis on a subject lying within that field; the other two field requirements must be met by work in courses of an advanced character. It is recommended that a course in the theory of International Relations (Political Science 141 or Political Science 232) be selected in partial fulfillment of these requirements.

PSYCHOLOGY

Emeriti: Maud Merrill James, Lois Meek Stolz, Edward Kellogg Strong, Jr.,
(Professors)

Executive Head: Albert H. Hastorf
Associate Executive Head: Paul Randolph Farnsworth
ASSOCIATE PROFESSORS: Richard Chatham Atkinson, Albert Bandura (on leave 1963-64), Kenneth M. Colby, J. Anthony Deutsch, Edith Mary Dowley (Director, Stanford Nursery Schools), John D. Krumboltz, Frederick Joseph McDonald, Eleanor E. Maccoby, Walter Mischel

ASSISTANT PROFESSORS: Gordon H. Bower, Edward Joe Crothers, Jonathan L. Freedman, Leonard M. Horowitz, Robert D. Singer

LECTURER: Max M. Levin

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 SCHOOLS

The Department maintains two nursery schools, one in Stanford Village and one in the Escondido married students' housing area. These provide 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, 1964.

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, and 103c. 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 1, General Anthropology</td>
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<td>Anthropology 130, Social Anthropology</td>
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<td>Anthropology 163, Cultural Dynamics</td>
<td>5</td>
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<td>Anthropology 164, Culture and Personality</td>
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<tr>
<td>Biology 25, Genetics</td>
<td>3</td>
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<tr>
<td>Statistics 27, Introduction to Probability Theory</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>Physiology 101, Principles of Human Physiology</td>
<td>5</td>
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<tr>
<td>Sociology 60, Introduction to Social Psychology</td>
<td>5</td>
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<tr>
<td>Sociology 61, Introduction to Small Groups</td>
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</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 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 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 psychological study. 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 150a must be elected as well as three other courses or seminars from the content areas, one to be selected from among 208, 209, 210, 260, 263, and 264, one from among 211, 212, 213, 214, 215, 261, 266, 267, 268, and 269, and a third from either of these groups. No two of the courses may be from the same general area (e.g., 211 and 266). The student must spend half his time in research and present a thesis based on a portion of his research. Holders of half-time 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, in addition to 150b must be met by all candidates for the doctorate. 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. Holders of the Master’s degree may be excused from the first year research requirement if the faculty feel that the previous research has been sufficient.

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 208–215, 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) a Departmental committee of three members and to the University Committee on the Graduate Division, the latter to be appointed after the dissertation is completed, or b) a Departmental committee of two or more members and an outside reader (approved by the Dean of the Graduate Division) who aids in the supervision of the research.

Ph.D. candidacy expires five years after admission to candidacy by the University Committee on the Graduate Division. Reapplication will require Departmental re-examination.

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 first-hand 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 Nursery Schools 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 in a Veterans Administration installation will require about two academic years of practicum work during his doctoral training because he will need to have a variety of skills immediately available when he enters his hospital, position. 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 post-doctoral 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, and the nursery schools. 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 and National Defense Education Act Fellowships can be assigned.

COURSES OPEN TO ALL STUDENTS

#1. General Psychology—Introduction, survey.
5 units, autumn, (Atkinson, Freedman), MWThF 2 and sections
or winter, (Hilgard, Crothers), MWThF 10 and sections
or spring, (Horowitz, Pribram), TWThF 2 and sections
or 4 or 5 units, summer, (Farnsworth), MTWTh 9 and sections

#60. Statistical Methods.
5 units, autumn, (McNemar), (I) MTWThF 8; (Horowitz), (II) MTWThF 11
or winter, (McNemar), MTWThF 8
or spring, (Lawrence), MTWThF 10
or 4 or 5 units, summer, (———), MTWThF 8

100. Individual Differences Laboratory—Prerequisites: 1 and 60.
3 units, autumn, (———), lec. TTh 1; lab. (I) T 2-4 or (II) Th 2-4

103a. Experimental Psychology: Higher Mental Processes—Prerequisites: 1 and 60.
4 units, autumn, (Horowitz), MWF 2 and three hours by arrangement

103b. Experimental Psychology: Perception—Prerequisites: 1 and 60.
4 units, winter, (Lawrence), MWF 3 and three hours by arrangement

103c. Experimental Psychology: Animal Learning—Prerequisites: 1 and 60.
4 units, spring, (Bower), MWF 11 and three hours by arrangement

104. Special Laboratory Projects—Prerequisites: 100, 103, or 133, and consent of instructor.
3 units, each quarter, (Staff), by arrangement

111. Child Psychology—Prerequisite: 1 or equivalent.
4 units, autumn, (Maccoby), MWF 9

112. Social Psychology—Prerequisite: 1 or equivalent.
3 units, autumn, (Farnsworth), MWF 11
or summer, (Farnsworth), MTWTh 11
113. Industrial Psychology—Prerequisite: 1 or equivalent.
3 units, spring, (Bavelas), MWF 8

114. Psychology of Music—Prerequisites: 1, and some knowledge of music. Students who have taken SC 170 may take this course for only 2 hours of credit.
3 units, spring, (Farnsworth) MWF 9

115. Psychological Foundations of Education—Prerequisite: 1 or equivalent.
4 units, autumn, (McDonald), MTWTh 11
or spring, (Gage), MTWTh 9
or summer, (McDonald), MTWTh 8 and one hour by arrangement

116. Development in Middle Childhood—(Enroll in Education 116.) Prerequisite: 11f.
4 units, winter, (P. Sears), MWF 9 and one 3-hour block by arrangement

117. Observation of Children—Prerequisites: 111 or equivalent, and permission of instructor. Enrollment limited to 16.
3 to 5 units, autumn, winter, or spring, (Dowley), Th 2-4 and by arrangement

119. Adolescent Development—Prerequisite: 111.
3 units, spring, (——), MWF 10
or summer, (——), MTWTh 10

127. Physiological Psychology—Prerequisites: 1 and a course in zoology or physiology.
3 units, winter, (Pribram), MWF 8

130: Comparative Psychology—Prerequisite: 1.
3 units, autumn, (Deutsch), MWF 1

133. Experimental Animal Behavior—Student may undertake series of experiments or one minor research. Prerequisite: 60 or special permission.
1 to 3 units, autumn, winter, or spring, (Lawrence, Bower, Pribram, Deutsch), by arrangement

135. Intermediate Social Psychology—Prerequisite: consent of instructor.
3 units, winter, (Freedman), MW 1:00-2:30

136. Senior Research in Social Psychology—Designing, performing experiments. Limited to 10 students. Registration for two quarters preferred. Prerequisite: 135 or concurrent registration.
2 to 5 units, winter and spring, (Festinger), by arrangement

150a. Advanced Statistical Methods—Correlational analysis for continuous variables, categorical data. Prerequisite: 60, or calculus.
3 units, winter, (McNemar), MWF 11

3 units, spring, (Atkinson), MWF 9

152. Measurement of Intelligence—Basic concepts, tests of intellectual abilities. Prerequisites: 1 and 60.
3 units, autumn, (McNemar), MWF 10

155. Measurement of Personality—Prerequisites: 1 and 60.
3 units, winter, (———), to be given in 1964-65

160. Abnormal Psychology—Psychopathology and behavior deviations. Concepts and theories regarding these conditions. Two half-day clinics to be arranged. Prerequisites: 1 and at least second-year standing.
4 units, autumn, (Mischel), MWF 2
or winter, (Singer), MWF 1

169. Nursery School Practice—Supervised experience with the nursery school child. Prerequisites: 111, 117, and consent of instructor.
3 to 5 units, autumn, winter, or spring, (Dowley), T 2-4 and by arrangement

189. Honors Seminar—Limited to students in the Psychology Honors Program.
3 units, autumn, winter, and spring, (Lawrence, Maccoby), by arrangement

190. Exceptional Children—The study of children with deviant patterns of devel-
opment; includes gifted, retarded, sensory defects, emotional problems. Prerequisite: 111.

3 units, spring, (———), TTh 9 and by arrangement
or summer, (———), MTWTh 1

191. Seminar in Behavioral Change—Application of social learning principles to the modification of prosocial and deviant behavior. Prerequisite: consent of instructor.

2 units, spring, (———), M 2-4

192. Industrial Relations—Meaning of industrial relations; scope, variety of problems that may be considered under it; policies of labor organizations, industrial relations programs of management; trade agreements, grievance procedures, other phases of collective bargaining.

4 units, autumn, (Troxell), MTWTh 11
or winter, (Troxell), MTWF 11

193a. Quantitative Learning Theory—Prerequisite: 1 and 60 or equivalent.

3 units, autumn, (Atkinson), TTh 11

193b. Quantitative Theories of Perception—Prerequisite: 1 and 60 or equivalent.

3 units, winter, (Atkinson), TTh 11

194. Honors Research—Limited to students in the Psychology Honors Program.

3 units, autumn, winter, and spring, (Estes, Staff), by arrangement

195. Personality—Prerequisite: 1 or equivalent.

3 units, winter, (Sanford), MWF 10

196. History of Psychology—Prerequisites: Four courses in psychology and senior standing.

3 units, autumn, (Farnsworth), MWF 9

197. Dynamic Psychology—Personality development, emotional adjustment; emphasis on psychoanalytic theory. Prerequisites: 111 and 160, and senior or graduate standing.

4 units, spring, (Hilgard), MWF 11

198. Trends in Cognitive Theory—Prerequisite: junior standing or better.

3 units, winter, (Hastorf), MWF 11

199. Reading and Special Work—Independent study.

1 to 3 units, each quarter, (Staff), by arrangement

For further courses on psychological topics see section on Senior Colloquia.

COURSES PRIMARILY FOR GRADUATE STUDENTS
Undergraduate students may be admitted only by special permission.

208. Advanced Physiological Psychology—Prerequisite: 127.

3 units, winter, (Pribram), by arrangement

209. Advanced Perception—Prerequisite: consent of instructor.

3 units, spring, (Hastorf), M 1:00-3:30


3 units, autumn, (Lawrence), MWF 9

211. Advanced Child Psychology—Prerequisite: 111 or equivalent.

3 units, winter, (Sears), to be given in 1964-65

212. Advanced Social Psychology—Prerequisite: permission of instructor.

3 units, autumn, (Festinger), Th 3:00-5:30

213. Organizational Processes and Task Performance—Prerequisite: consent of instructor.

3 units, winter, (Bavelas), M 2; W 2-4

214. Motivation.

3 units, autumn, (Hilgard), by arrangement

215. Advanced Personality.

3 units, winter, (———), by arrangement, to be given in 1964-65
217. Child Research Practicum—Prerequisites: 117 and permission of instructor.  
3 to 5 units, winter, (Dowley), TTh 1

250. Advanced Statistical Methods—Factor analysis, statistical theory of psychological tests. Prerequisites: 150a and 152, or 155.  
3 units, spring (McNemar), to be given in 1964-65

251. Personality Assessment I—Assumptions and principles underlying the development of measuring instruments for the prediction and classification of behavior.  
3 units, autumn, (Mischel), Th 9–12

252. Personality Assessment II—Applications of representative types of assessment devices to the measurement of personality dimensions.  
3 units, winter, (Mischel), Th 9–12

253. Personality Assessment Practicum—Supervised experience in the administration, interpretation and validation of personality assessment methods. Must be taken concurrently with Psychology 251 and 252. Prerequisite: consent of instructor.  
3 units, autumn, winter, spring, (———), T 9–11

254. Psychopathology—Review and analysis of research literature and theory in the area of behavior deviation. Prerequisite: consent of instructor.  
3 units, spring, (Singer), M 10–12

255. Behavioristic Psychotherapy—Application of social learning principles to the modification of deviant behavior. Prerequisite: consent of instructor.  
3 units, autumn, (———), M 9–12

256 Psychotherapy with Children.—Review of specialized procedures for the treatment of childhood behavior disorders. Prerequisites: 255 and consent of instructor.  
2 units, winter, (———), M 9–12

257. Behavior Change Laboratory—Supervised experience in the application of psychotherapeutic procedures. Prerequisites: 255 and consent of instructor.  
2 units, autumn, winter, spring, (Singer), by arrangement

258. Psychoanalytic Psychotherapy—A discussion of general principles of exploratory psychotherapy. Prerequisite: consent of instructor.  
2 units, spring, (Colby), by arrangement

259. Clinical Practicum—Laboratory, field work in selected clinical training facilities. Registration by permission.  
3 units, each quarter, (Clinical Staff), by arrangement

260. Seminar in Physiological Psychology—Prerequisite: consent of instructor.  
2 or 3 units, spring, (Deutsch), by arrangement

261. Seminar in Social Psychology—Prerequisite: consent of instructor.  
2 or 3 units, winter or spring, (Festinger), Th 2–4

262. Seminar in Verbal Behavior—Prerequisite: consent of instructor.  
2 or 3 units, winter, (Horowitz), T 1–3

263. Seminar in Perception—Prerequisite: consent of instructor.  
2 or 3 units, (———), to be given in 1964–65

264. Seminar in Learning Psychology—Prerequisite: consent of instructor.  
2 or 3 units, winter, (———), TTh 1

265a. Seminar in Mathematical Psychology—Prerequisite: consent of instructor.  
2 or 3 units, autumn, (Estes), TTh 10:00–11:30

265b. Seminar in Mathematical Psychology—Prerequisite: consent of instructor.  
2 or 3 units, winter, (Bower), TTh 10:00–11:30

265c. Seminar in Mathematical Psychology—Prerequisite: consent of instructor.  
2 or 3 units, spring, (Atkinson), TTh 10:00–11:30

266. Seminar in Child Psychology—Prerequisite: consent of instructor.  
2 or 3 units, spring, (Maccoby), TTh 1
267. Seminar in Interpersonal Processes—Prerequisite: 213 and consent of instructor.
   2 or 3 units, autumn, (Hastorf), by arrangement.
268. Seminar in Motivation—Prerequisite: consent of instructor.
   2 or 3 units, winter, (Hilgard), to be given in 1964–65.
269. Seminar in Personality—Prerequisite: consent of instructor.
   2 or 3 units, autumn, (Sears), M 3:30-5:30.
270. Psychoanalytic Procedures—Prerequisite: consent of instructor.
   2 units, autumn, winter, or spring, (Colby), by arrangement.
272. Foundations of Mathematical Behavior Theory—Prerequisite: consent of instructors. (Same as Philosophy 243.)
   2 or 3 units, spring, (Estes, Suppes), by arrangement.
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.
   (Staff), by arrangement.
Counseling Techniques: The Interview—See Education 333a.
Counseling Techniques: Testing—See Education 333b.
Seminar in Educational Psychology—See Education 415.

SOCIAL SCIENCES (SPECIAL PROGRAM)

HONORS PROGRAM IN SOCIAL THOUGHT AND INSTITUTIONS

Committee in Charge: Charles A. Drekmeier (Chairman), Max Levin, Richard W. Lyman, William M. McCord, Bernard J. Siegel, Richard A. Wasserstrom

Statement of Purpose
The Honors Program in Social Thought and Institutions is designed to meet the needs of students wishing special preparation in areas of 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 3.0 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 stu-
A student is required to take the interdisciplinary seminar series (Social Sciences 101, 102, 103) during his junior year. The seminar is organized around a specific 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 ten 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**

**101. Interdisciplinary Seminar**—Designed to familiarize the student with philosophical and methodological problems of the social sciences.

3 units, autumn, (Staff), by arrangement

**102. Interdisciplinary Seminar**—Continuation of 101.

3 units, winter, (Staff), by arrangement

**103. Interdisciplinary Seminar**—Continuation of 102.

3 units, spring, (Staff), by arrangement

**199. Senior Thesis and Directed Reading.**

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

**SOCIOMETRY**

Emeritus: Charles Nathan Reynolds (Professor)

Executive Head: Sanford M. Dornbusch
Associate Executive Head: Morris Zelditch, Jr.
Professors: Sanford M. Dornbusch, Richard Tracy LaPiere, Paul Wallin
Assistant Professors: Bo Anderson, Santo F. Camilleri, Adam Haber, W. Richard Scott
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 four 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 participation 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 thirty of the forty-five 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: Backgrounds of Contemporary Sociological Theory, Problems in Conceptualization and 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 Problems of 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 preparation. 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

INTRODUCTORY

#1. Introduction to Sociology—Basic concepts; theories; emphasizes group aspects of human behavior.
5 units, autumn, (Dornbusch), MTWThF 11
or spring, (Scott), MTWThF 11
or summer, (——), MTWThF 11 and by arrangement

7. Introduction to Statistics—Especially designed for students in economics, sociology, and other social sciences. (Same as Statistics 7.)
5 units, autumn, (Olkin), MTWThF 1:15

FUNDAMENTAL PROGRAM

10. Introduction to Sociological Research.
5 units, autumn, (Camilleri, Cohen), MW 11, labs. T or Th 2:15–5:05

51. Introduction to Sociological Theory—Critical analysis of the ideas of major sociological thinkers.
5 units, winter, (Anderson), MWF 9

60. Introduction to Social Psychology—Special attention to the social basis of personality development, socialization, social deviance.
5 units, spring, (McCord), MWF 10

61. Introduction to Small Groups.
5 units, winter, (——), MWF 11

62. Introduction to Formal Organization—Prerequisite: 1 or consent of instructor.
5 units, autumn, (Scott), MTWThF 9

COURSES OPEN TO UNDERGRADUATES AND GRADUATES

108. Stratification.
5 units, spring, (Anderson), MWF 10

110. Religious Institutions and Behavior.
5 units, winter, (Dornbusch), MWF 10

112. Individual in a Changing Society—An analysis of the adjustment problems experienced by the individual in a society that is undergoing rapid change. Attention will be directed mainly to members of the middle class in contemporary American society.
5 units, autumn, (LaPiere), MTWTh 9

123. Political Institutions and Behavior.
5 units, spring, (Haber), MWF 9

130. Social Psychology of Family Relations.
5 units, winter, (Wallin), TTh 4:00–5:30

131. Advanced Social Psychology—Prerequisite: 60.
5 units, winter, (——), MWF 1

137. Advanced Formal Organization—Prerequisite: 62 or consent of instructor.
5 units, (——), alternate years, to be given in 1964–65

138. Occupations and Professions—Prerequisite: 1 or consent of instructor.
5 units, autumn, (Becker), TTh 10–12

145. Survey Methods—Prerequisite: 10 or consent of instructor.
5 units, (——), alternate years, to be given in 1964–65

146. Field Methods—Prerequisite: 10 or consent of instructor.
5 units, (——), alternate years, to be given in 1964–65

147. Laboratory Methods—Prerequisite: 10 or 61 or consent of instructor.
5 units, winter, (Cohen), TTh 2–4
148. Social Change—Societal adjustments to changes in technology, ideology, social organization.
   5 units, spring, (LaPiere), MWF 10

175. The Evolution of Underdeveloped Societies—A discussion of social, economic, and political development of emergent countries (e.g., Ghana, Nigeria, India).
   5 units, winter, (McCord), MWF 11

180. Honors Seminar—Basic readings in sociology and current faculty research.
   2 units, autumn, (McCord), by arrangement

185. Honors Seminar—Basic readings in sociology and current faculty research.
   2 units, winter, (McCord), by arrangement

190. Individual Study.
   (Staff), by arrangement

   2 units, spring, (Staff), by arrangement

192. Senior Thesis.
   3 to 10 units, (Staff), by arrangement

COURSES PRIMARILY FOR GRADUATES

206. Comparative Institutional Analysis—Prerequisite: consent of instructor.
   5 units, spring, (Zelditch), M 2–5

212. Advanced Small Group Behavior—Prerequisite: consent of instructor.
   5 units, spring, (Cohen), W 2–5

249. Advanced Social Statistics—Prerequisite: consent of instructor.
   5 units, winter, (Camilleri), TTh 10–12

250. Backgrounds of Contemporary Sociological Theory—Prerequisite: consent of instructor.
   5 units, autumn, (Haber), T 2–5

253. Theory Construction—Prerequisite: 250.
   5 units, (———), to be given in 1964–65

   5 units, (———), to be given in 1964–65

255. Logic of Social Research—Logic of scientific research, methods commonly used for collection and analysis of social data. Prerequisites: 249 and 260.
   5 units, spring, (Wallin), T 2–5

260. Research Design—Prerequisite: 249.
   5 units, spring, (Camilleri), TTh 10–12

267. Problems of Sociological Measurement—Prerequisite: 249.
   5 units, (———), alternate years, to be given in 1964–65

The Nature of American Society—See Graduate Division Special Programs 323.

GRADUATE SEMINARS ON SPECIAL TOPICS

209. Political Socialization—Prerequisite: consent of instructor.
   5 units, winter, (Haber), M 2–5

211. Comparative Research on Political Parties—Prerequisite: consent of instructor.
   5 units, autumn, (Anderson), M 2–5

215. The Individual and Social Change—Prerequisite: consent of instructor.
   5 units, winter, (LaPiere), MTW 9

257. Social Structure of Hospitals—Prerequisite: consent of instructor.
   5 units, winter, (Scott), W 2–5

258. Education and Social Class—Prerequisite: consent of instructor.
   5 units, autumn, (Wallin), W 2–5
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 Gordon Emerson (Professor); Helene Blattner, Elisabeth Lee Buckingham (Associate Professors)

Acting Executive Head: Robert Loper
Professors: Robert Loper, Norman Philbrick, H. Donald Winbigler
Associate Professor: Wendell Cole

CURRICULUM

Courses in the Department of Speech and Drama are designed to give intensive instruction in two major fields—rhetoric and public speaking, and dramatic literature and theater arts. Emphasis is placed both on professional skills and on liberal arts instruction. A training program for teachers is also offered.

First- and second-year students who are planning to major in Speech and Drama should take the following required basic courses:

1. Characteristics of Spoken Language
20. Public Speaking: Practice and Criticism
30. Oral Interpretation

TUTORIALS IN THEATER AND DRAMA

All students electing theater and drama as a major program will be given special tutorials of approximately one hour per week based on a reading list which will be supplied the student when he declares his major. These tutorials, given by the Departmental staff, normally continue through the junior and senior years and culminate in an oral examination in the fields of dramatic literature and theater arts. These tutorials are designed to give the student individual help in bringing focus and clarity to his regular course work.

PRODUCTION PROGRAM

The Department of Speech and Drama presents productions during the regular academic year. These plays, staged in both Little Theater and the main stage of Memorial Auditorium, are designed to provide the student with direct experience in acting and technical production. All registered students are welcome to participate
in these productions, but they are selected to provide the theater major with a wide range of creative opportunity. In addition to the regular season of plays, the Studio Theater will produce at least one play of an experimental nature. While the theater staff will direct a major portion of both series, a few directing assignments will be open to qualified graduate students.

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 the widest possible latitude in the development of his special aptitudes and interests. A minimum program is required of all students. Beyond this minimum requirement, the student is permitted to choose electives with the guidance of the adviser in accordance with his interests. The requirements for the degree of Bachelor of Arts may be summarized as follows:

1. The satisfactory completion, with an average grade of C or better, of not less than 45 units in Speech and Drama courses, including the following minimum general requirement: 1, 20, and 30.

2. The satisfactory completion of one of the following programs:

I. Teaching Training—These courses are listed elsewhere in this Bulletin under teaching credentials.

II. Theater and Drama

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<thead>
<tr>
<th>Requirement</th>
<th>Units</th>
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<tr>
<td>Basic Skills: 1, 20, 30</td>
<td>9</td>
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<tr>
<td>Acting; Directing: 164a, 164b, 164c</td>
<td>12</td>
</tr>
<tr>
<td>Technical Skills: Lighting (174c), Costuming (174b), Construction (174a)</td>
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<td>Dramatic Literature: 90, 91, 92</td>
<td>12</td>
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<td>Principles of Criticism: 95</td>
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<tr>
<td>Tutorial</td>
<td>6</td>
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<td><strong>Total</strong></td>
<td><strong>52</strong></td>
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Approved Electives: Playwriting (294a), American Drama (291, 292), Contemporary Drama (194), Design (175), History of Costume (170), Advanced Stage Lighting (176), Contemporary Theater (60)

3. The satisfactory completion, with an average grade of C or better, of a minor program of not less than 20 units of advanced course work chosen from courses offered in a department or departments other than Speech and Drama. The minor program must be chosen with the advice and approval of the student's faculty adviser from among those programs approved by the faculty of the Department.

4. Speech Pathology and Audiology 110 and 130 may be used as approved electives in this Department for completion of a major.

*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 their major in Speech and Drama by the following:

Satisfactory completion of the following program:

Theater and Drama: Acting and Directing (164a, b, c), Dramatic Literature (90, 91, 92), American Drama (291, 292), Shakespeare (English 25) and 6 units of electives in theater and drama

(Honor students are not held to the prerequisite of completing 1, 20, 30)
Honors and Graduate Programs in Humanities

For acceptable majors in Speech and Drama, an Honor Programs in Humanities is offered, a description of which will be found under “Humanities (Special Programs).”

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.

General Secondary Credential—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 in the Department of Speech and Drama for Departmental requirements. Candidates for the General Secondary Credential with a teaching major in Speech and Drama should select two of the following programs in consultation with the teacher training adviser (Schrader).

Public Speaking—30, 32, 112, 120b, 120c, 220a, 220c, Speech Pathology and Audiology 130.

Theater and Drama—60, 90, 91, 92, 164a, 174, 297, 298.

Speech Correction—Speech Pathology and Audiology 110, 130, 140, 141, 180, 220, 281.

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.

It is assumed that the teaching major in Speech and Drama will also complete courses in English composition and literature. All candidates with a teaching major in Speech and Drama are required to take at least three courses in residence; for the teaching minor, two such courses are required. All majors are expected to meet the general Departmental requirements.

It is recognized that in some instances the total number of units represented by the courses listed above may exceed 60. The student may, in consultation with the teacher training adviser, substitute the nine units of general Departmental requirements for certain of the above courses. Candidates for the General Secondary Credential with a teaching minor in Speech and Drama will take Speech and Drama 20 and 30, and will select an additional minimum of 24 units in consultation with the adviser for teacher training.

Junior College Credential—Graduate students in Speech and Drama may plan a Junior College Credential; for information about this program, consult the teacher training adviser (Schrader).

Special Credential in Speech Correction—For information regarding requirements for the Special Credential in Speech Correction and Lipreading, please refer to the Division of Speech Pathology and Audiology listed in the section “Allied Medical Sciences” in this Bulletin.

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. Admission to courses of advanced standing does not, however, imply admission to candidacy for an advanced degree. Students who are deficient in their undergraduate training in the fields of speech and drama will be required to make up such deficiencies. Graduate students, when applying for admission, must furnish record of taking the Aptitude Test of the Graduate Records Examination and must submit also a sample of their best written scholarly work. All graduate students must be degree candidates.

Master of Arts

Before admission to candidacy for the Master of Arts degree, a student may be required by the faculty of his specific area of interest to take in his first quarter of residence written diagnostic or program-planning tests, consisting of written examinations. The written examinations covering the specific field of the student’s major interest are normally given on the weekend prior to fall registration.

The new graduate student will be interviewed by a committee of Department faculty members. Following this interview a permanent faculty adviser will be chosen for the student.

On the basis of the results of the interview and possible diagnostic tests, the student in consultation with a faculty adviser plans a complete program of study and selects a thesis subject. This program of study and the outline of the proposed research for the thesis should be submitted on proper forms to the Departmental Committee on Graduate Study for approval. There is no set program of graduate courses rigidly required of all prospective candidates for the Master of Arts degree. Each student with his adviser plans, in terms of his previous training and in terms of his goals, an individual program to meet the requirements of the Department.

Admission to candidacy is granted by the University Committee on the Graduate Division on the basis of a formal application approved in writing by the Department. Upon securing from the Department the approval of his program and thesis subject, the student should immediately file an application for admission to candidacy with the University Committee. This application must be filed not later than the fourth week of the quarter preceding that in which the candidate expects to receive his degree.

Requirements for the Degree—Candidates for the degree of Master of Arts in Speech and Drama must present a minimum of 40 units of graduate work and must spend at least one year (three quarters) or three summer quarters in full-time residence study. This program may include course work offered in other departments of the University. Of these units, not less than 4 nor more than 6 may be devoted to a thesis or project. If more than 6 units are desired, however, the candidate may petition the Departmental Committee on Graduate Study. Students are required to maintain a satisfactory scholastic rating in all course work. Candidates are normally required to plan their programs to include a major from one of the two fields of Speech and Drama: public speaking or theater and drama; and to include a minor from a second one of these fields or from a related field in another department of the University. The minor program consists of 12 units; these 12 units are included in the 40 required units of graduate work. First- and second-year courses required of a candidate because of deficiencies in undergraduate preparation, as revealed by a preliminary examination or interview, may not be used in satisfying the requirement of 40 units of advanced work. Full instructions concerning the Master of Arts program and review bibliographies should be obtained from the office of the Department.

Examinations—At the end of the last quarter of residence each candidate will be required to pass satisfactory comprehensive written examinations, demonstrating his command of that field or those fields of speech in which he has elected to study. A first draft of the thesis must be submitted before taking the examinations. Candidates who fail to pass these examinations may take them again but are disqualified by a second failure.
Candidates who fail to present an approved thesis in final form within one calendar year after passing the comprehensive examinations may be required to repeat the comprehensive examinations before being recommended for a degree. If the length of time intervening is beyond one calendar year, additional course work may be required before repetition of the examinations.

**Thesis or Project**—The thesis or research project must be carried on under the direction of a member of the faculty of the Department of Speech and Drama or under the direction of a member of the faculty of an allied department at the discretion of the adviser. Choice of subject and first steps in the work should be begun immediately after completion of the preliminary examination or interview and normally should not be delayed beyond the first quarter in residence. An adequate first draft must be submitted to the adviser not later than the end of the fourth week of the last quarter of resident study. The final draft must be submitted three weeks prior to the end of the quarter in which the degree is expected. After acceptance by the Department, three copies of the thesis or project must be presented for acceptance by the University Committee on the Graduate Division. The thesis form and time of presentation prescribed by that Committee must be adhered to.

A limited number of students with major interest in theater and drama may, upon selection by the theater and drama staff, present a production project in lieu of the regular research thesis. Such a project consists of the selection and direction or design of a production for public presentation. The production book in proper form is presented in lieu of the regular thesis. Students who elect this production program must plan to spend six quarters in residence. Full particulars of the program may be obtained from the Executive Secretary of the Department.

**Doctor of Philosophy**

In the program leading to the doctorate in Speech and Drama, primary emphasis is placed upon training for research. A prospective candidate may plan a program with a concentration in one of the following two fields: theater and drama; rhetoric and public address. The University requirements defining the requirements for the Ph.D. degree apply to students in either field. The program of courses and research is individually planned for each student. A full outline of procedures and requirements may be obtained upon application to the Executive Secretary of the Department.

**Theater and Drama:**

The graduate student who is a candidate for the Ph.D. degree in theater and drama must offer, in addition to the emphasis in theater history and dramatic literature, at least one concentration in theater arts (acting-directing; costumes; scenery design; lighting). All theater and drama candidates must take at least 6 units of Speech and Drama 160 (Theater Practice). With certain dissertation subjects the student may work under "Plan B" in which the dissertation committee consists of two members from Speech and Drama and one from outside this Department, material from whose field is important to the dissertation area. The outside faculty member will be suggested by the student's departmental adviser and submitted to the Executive Head for approval and recommendation to the Dean of the Graduate Division.

The Department of Speech and Drama requires the candidate to complete the dissertation before taking the departmental and University oral examinations. The following areas will be covered in the University oral examinations: (1) background of dissertation; (2) doctoral reading list; (3) area of specialization determined by consultation with department. The written comprehensive examinations in theater and drama, which are taken upon completion of formal course work, will emphasize theater history, dramatic literature, criticism and one area of theater arts concentration.
Rhetorical Studies:

The Ph.D. program in rhetoric and public address is individually planned for unusually well-qualified students. Inasmuch as rhetoric gains significance as it draws from and contributes to other fields of knowledge, the program, while founded in traditional rhetorical studies, is interdepartmental and interdisciplinary in character.

Prior to formal application for candidacy, the student will complete most of the course work within the Department, pass at least one of his language requirements, write a satisfactory qualifying examination, and develop a tentative dissertation proposal. Then, with his departmental adviser, the student will formalize his program according to the requirements of the Graduate Division Special Programs, described elsewhere in this Bulletin.

An interdisciplinary program in rhetoric studies might include, for example, studies in such areas as: communication research, religion, philosophy, literature, history, social studies, or other areas. In all cases the candidate will develop a unified program leading to the Ph.D. degree.

SEMINARS

Attention of graduate students is directed to the series of seminars numbered 300 and above. These seminars cover the areas of public address, dramatic literature, and theater history. At least two seminars are offered each quarter in theater and drama, while at least one is offered each quarter in the other departmental areas.

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

The Summer Session courses regularly scheduled in the speech and drama curriculum are listed below. Additional courses will be published in the Summer Session Bulletin in February 1964.

Some courses which are repeated in the summer session carry decreased credit.

COURSES

General

General first- and second-year courses open to all interested students without prerequisites include Speech and Drama 1, 20, 30. Special courses for foreign students interested in improving their pronunciation and understanding of English speech and their use of the written language are Speech and Drama 47, 48, 49, 58, 59.

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, winter, spring, (Bush, Staff), 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, autumn, winter, and spring, (———), MWF 9 or 11

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, autumn, (Bush, 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, autumn, winter, (Bush, 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. Prerequisite: consent of instructor. Upon recommendation of the adviser, the course may be repeated for a total of 6 units.

1 to 3 units, autumn, winter, spring, (Bush, Staff), TTh 4:15 and one hour by arrangement

58. English Communication for Foreign Students IIa—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, autumn, winter, (Bush, Staff), TTh 4:15

59. English Communication for Foreign Students IIIa—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Prerequisite: consent of instructor. Upon recommendation of the adviser, the course may be repeated for a total of 6 units.

1 to 3 units, autumn, winter, spring, (Bush, Staff), MWF 4:15

#60. Introduction to the Contemporary Theater—Survey of the arts of the theater; lectures, and discussion of readings in contemporary drama and of current plays to be seen by the class.

3 units, winter, (Kerans), MWF 9

100. Individual Instruction—Continued study under direction and guidance in fields or subjects of special interest. Credit limited to 6 units.

2 to 3 units, any quarter, (Staff), by arrangement

308. Research—Special problems in dramatic literature, rhetoric and public address, theater arts. May be repeated for total of 8 units.

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


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

400. Doctoral Research.

Any quarter, (Staff), by arrangement

RHETORIC AND PUBLIC SPEAKING

#20. Public Speaking: Practice and Criticism—Includes practice in the delivery of original speeches and the analysis, discussion, and written criticism of significant public addresses.

3 units, any quarter, (Ericson, Heimbeck). General sessions (1 hour): T 8, 10; M 9; Th 11. Section meetings (2 hours): MW 8, 9, 10, 11, 1, 2; TTh 8, 9, 10, 11, 1, 2

120. Modes of Oral Discourse—The processes of exposition, argumentation, and group discussion.

120a. Exposition—Recommended for candidates for teaching credentials.

3 units, autumn, winter, and spring, (Schrader, Staff), MWF 10 or 1:15

120b. Argumentation.

3 units, autumn, winter, spring, (Ericson), MWF 9

120c. Discussion.

3 units, winter, spring, and summer, (Schrader), MWF 10

220. The Rhetorical Tradition.

#220a. Classical Rhetoric—Theory, practice, and criticism from the Greeks through the Renaissance.

5 units, autumn, (Heimbeck), by arrangement
220b. **Modern Rhetoric**—Theory, practice, and criticism in Europe and America from the sixteenth century to the present.
5 units, winter, (Schrader, Staff), by arrangement

225. **Rhetoric and Contemporary Thought.**
225a. **Rhetoric and Literature**—Canons differentiating rhetorical and literary criticism.
4 units, autumn, (Schrader), by arrangement

225b. **Rhetoric and History**—Studies that illuminate the role of rhetoric in the historical process.
4 units, winter, (Ericson), by arrangement

225c. **Rhetoric and Philosophy**—Papers in semantics and philosophical logic that ramify the traditional notions of style and invention.
4 units, spring (Heimbeck), by arrangement

225d. **Rhetoric and Social Science**—Rhetoric as ritual, symbol, and myth; the speaker's role in social, religious, and political institutions.
4 units, spring, (Schrader), by arrangement

320. **Research in Rhetoric and Public Address.**
320a. **Proseminar**—Introduction to bibliography, research methodologies, and scholarly writing.
4 units, autumn, (Ericson, Staff), by arrangement, to be given in 1964–65

320b. **Research Seminar in Classical Rhetoric.**
4 units, winter, (Heimbeck, Ericson), by arrangement

320c. **Research Seminar in Modern Rhetoric.**
4 units, spring, (Schrader), by arrangement

**Intercollegiate Debate**—A program of speech activities open to all students. Group activity credit offered. Report to Mr. Ericson in m103.

**Business and Professional Speaking**—See Business 301, *Graduate School of Business Bulletin.*

**THEATER AND DRAMA**

#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, autumn, (——), MTWF 9

#91. **Development of Drama (Renaissance and Baroque)**—Survey of the art of drama from the Renaissance to Ibsen.
4 units, winter, (——), MTWF 9

92. **Development of Drama (Modern)**—Ibsen, subsequent dramatists, English and Continental. Lectures, discussions; critical papers.
4 units, spring, (——), MTWF 9

95. **Principles of Dramatic Criticism**—Introduction to the major modern critical techniques with special reference to their use in the study of drama. Readings in the New Critical, Archetypal, Marxist, Freudian and Neo-Aristotelian schools. Applied analysis of selected plays. No prerequisites; undergraduates only.
4 units, autumn, (Kerans), MTWF 1

160. **Theater Practice**—Credit for participation in productions in acting or stagecraft. May be repeated for total of 9 units. Consent of instructor.
1 to 3 units, any quarter, (Staff), by arrangement

164. **Techniques of Acting and Directing**—All three quarters recommended, but 164a may be taken separately.
164a. **Fundamental Principles of Acting and Directing**—Play analysis, actor's resources and methods, basic bodily movement, voice articulation.
164b. Advanced Acting and Directing—Techniques of composition, balance, and rhythm in acting and direction.

4 units, winter, (Loper, Crowder), TTh 10 and TTh 1-3

164c. Styles of Acting and Directing—Intensive theory and practice in historical and non-realistic modern drama.

4 units, spring, (Loper, Crowder), TTh 10 and TTh 1-3

170. History of Costume—Historical costume for the stage from ancient times to the present.

3 units, autumn, (Russell), MWF 9

172. Costume Design—Design techniques for theater and television. Intensive sketching of costumes. Prerequisites: 170 and consent of instructor.

3 units, winter, (Russell), MWF 9

173. Theatrical Makeup—Laboratory course in the art of stage makeup. Required of all undergraduate theater and drama students.

1 unit, autumn, (Russell), F 1-3

174. Stage Production Survey—Training in (a) scenery construction, (b) costuming, (c) theatrical lighting, (d) makeup. Lectures, demonstrations, laboratories, and crew assignments. Required of all graduate students who fail to demonstrate adequate previous training in these fields. May be taken in any sequence or in separate sections by those who can show previous training in one or more of these areas.

174a. Scenery construction.

3 units, autumn, (Easley), MW 11; 3-hour lab. and crew by arrangement

174b. Costume Construction.

3 units, spring, (Russell), TTh 11; 3-hour lab. and crew by arrangement

174c. Lighting.

3 units, winter, (Landry), TTh 11; 3-hour lab. and crew by arrangement

175a. Stage Design I—Perspective and mechanical drawing for the stage; principles of design; limitations of the stage. Prerequisites: 174a and 174c, and consent of instructor.

4 units, autumn, (Easley), MWF 11; painting crew by arrangement

175b. Stage Design II—Practice in stage design; analysis and expression of the play in scenic terms. Prerequisites: 175a and 164a, or equivalent work, and consent of instructor.

1 unit, winter, (Easley), MWF 11; painting crew by arrangement

176. Advanced Stage Lighting—Theory and practice in design, execution of lighting plot; theory of control board design, operation. Prerequisite: 174c.

3 units, spring, (Landry), MWF 10; lab. by arrangement

194. Contemporary Drama—Readings, discussion, lectures. The course will concentrate upon recent post-World War II developments in drama in Europe and America, with attention to both artistic and intellectual backgrounds. Playwrights include Beckett, Ionesco, Behan, Genet, Duerrenmatt, Williams, and Osborne. No prerequisites.

4 units, spring, (Kerans), by arrangement

260. Projects in Theater Arts.

260a. Projects in Directing—Intensive analysis, rehearsal and production of a one-act play or a dramatic work of similar length. Prerequisite: 164 or equivalent. May be repeated for a total of 9 units. Consent of instructor.

3 units, any quarter, (Loper), by arrangement

260b. Projects in Stage Costume—Individual work in design, creating costumes, accessories for various productions. Prerequisite: 172 or consent of instructor.

3 to 5 units, any quarter, (Russell), by arrangement

260c. Projects in Stage Design—Advanced work and projects in areas of spe-
cial interest to the student. Circumstances permitting, the design of a setting for actual production. Prerequisites: 176 and 175b and consent of instructor.

3 units, any quarter, (Easley), by arrangement

260d. Projects in Stage Lighting—Advanced work in styles of production, or special lighting and model projects. Designing for productions. Prerequisite: 176 or consent of instructor.

3 units, any quarter, (Landry), by arrangement

260e. Projects in Technical Production—Advanced work involving technical direction, stage management of departmental productions. Theater, house management. Prerequisites: 77 and 177, or 174 and 177, consent of instructor.

3 units, any quarter, (Landry), by arrangement

260f. Projects in Playwriting—Seminar in composition of full-length play. Open to students who have completed advanced playwriting or its equivalent, or who have through submission of original plays demonstrated an aptitude for advanced technical qualifications in playwriting. Consent of instructor. May be repeated for total of 8 units.

2 to 4 units, winter, spring, (Philbrick, Kerans), by arrangement

291. Early American Drama—History of theater, dramatic literature of America from Colonial days to Civil War.

4 units, winter, (Philbrick), MTWF 10

292. Modern American Drama—History of theater, dramatic literature of America from the Civil War to the present.

4 units, spring, (Cole), MTWF 10

#294a. Playwriting and Dramatic Structure—Critical analysis of dramatic structure and technique for students interested in dramatic literature, play directing, or writing of original plays for theater or television. May be taken for graduate credit.

4 units, autumn, (Philbrick), MTWF 11

297. Theaters and Staging I (Classical)—Survey of theaters, staging methods, scenic design in relation to social, dramatic values, styles of theatrical production, from Greeks through Neo-Classical.

4 units, winter, (Cole), TTh 4-6

298. Theaters and Staging II (Modern)—Survey of theaters, staging methods, scenic design in relation to social, dramatic values, styles of theatrical production, from Neo-Classical to Modern.

4 units, spring, (Cole), TTh 4-6

360. Proseminar in Theater and Drama.

360a. Theater and Drama—Introduction to various types of research, research methods in theater, drama. Required of graduate students specializing in theater and drama.

3 units, autumn, (Kerans), by arrangement

360b. History of Dramatic Criticism—Readings, discussion, term paper in dramatic criticism, from Aristotle through the 19th century. Required of candidates for the Ph.D.

3 units, winter, (Kerans), by arrangement


3 units, spring, (Kerans), by arrangement

361. Seminar in Directing.

361a. Problems in Directing—Intensive analysis, discussion and class performance of selected scenes.

4 units, autumn, (Kerans, Loper), by arrangement

361b. Experiments in Directing

4 units, winter, (Kerans, Loper), by arrangement
390. Seminar in Theatrical History and Dramatic Literature—A sequence of six seminars, one per quarter, covering a span of two years. In each quarter the seminar will investigate a special problem in one of the six major areas of the study of dramatic literature: Classical, Medieval, Renaissance, Neo-Classic, 19th Century, Contemporary. Material for study will vary from year to year, hence may be repeated for credit.
   4 units, any quarter, (Staff), MW 1–3

391. Seminar in Comedy—Comedy as a dramatic form; emphasis on trends in American comedy, various historical theories of comedy.
   4 units, autumn, (Philbrick), MW 1–3

397. Seminar in Stage Arts and Techniques—Reading, research in fields of design, lighting, acting and directing, and costume. Limited to ten students.
   4 units, spring, (Staff), MW 3–5, alternate years, to be given in 1963–64
See also Senior Colloquia.

STATISTICS

Executive Head: Herbert Solomon
Professors: Kenneth Joseph Arrow, Albert Hosmer Bowker, Herman Chernoff, Gerald J. Lieberman, Quinn McNemar, Lincoln E. Moses, Ingram Olkin, Herbert Solomon, Charles Stein, Patrick Suppes
Associate Professors: Milton Vernon Johns, Rupert Griel Miller, Emanuel Parzen, Hirofumi Uzawa, Harvey M. Wagner

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 220.

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 24 or equivalent.
2. 40 units of work in statistics, including:
   a) 50, or equivalent
   b) 116, 119, 120
   c) Additional units to complete the 40 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 at least 30 units of the work at Stanford be chosen from the offerings in the Statistics Department or from authorized courses in other departments.

Programs are ordinarily arranged to provide specialization in mathematical statistics, mathematics in behavioral science, industrial statistics, or data processing and operations research.

The mathematical statistics option is flexible; depending on the background of the candidate; ordinarily it will include 136, 217a, b, 221, or more advanced courses if the student has had the equivalent of these as an undergraduate.

The program in mathematics in behavioral science is flexible; ordinarily it will include 116, 136, 206, 207, 208, 209, 217a, b, 219, 220 or more advanced courses if the student has had the equivalent of these previously.

The program in industrial statistics is directed toward students with undergraduate training in engineering or science. Students will take 110, 111, 116, 216, 219, 220, and Industrial Engineering 120 and 220.

The operations research and data processing option is for students who are interested in the application of quantitative techniques to business and industrial technology. The program requires Statistics 110, 116, 219, 220, 252, 253, and Industrial Engineering 261, 263. Mathematics 114, 137, 138 are strongly recommended. Students who do not have undergraduate work in calculus find it necessary to spend additional time obtaining a mathematical background.

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. The degree of
proficiency ordinarily required is that which an able graduate student might be expected to acquire in 30 hours of graduate work in statistics, its applications, and relevant mathematics. Ordinarily, about one-third of the minor will be in areas directly related to the major, one-third will consist of the basic sequence in mathematical statistics (116, 219, and 220), and the remainder will be chosen from courses in the Department and certain courses in other departments. A written examination to establish proficiency will be required and must be taken before the University oral examination.

FELLOWSHIPS AND ASSISTANTSHIPS

Fellowships and research assistantships carry stipends of $3,000 to $3,600 for the academic year of three quarters (nine months). Teaching assistants, who teach one section of elementary statistics per quarter, receive $2,000 for the academic year and scholarships covering tuition for nine units of course work per quarter. If qualified, they are awarded additional stipends of up to $1,600 as research assistants. Fellows and teaching assistants are also eligible for research assistantships during the fourth or summer quarter. Application for University fellowships should be made to the Office of Admissions by February 1; applications for teaching and research assistantships should be made to the Executive Head of the Department. Predoctoral fellowships for study in this department are offered by outside agencies such as the National Science Foundation, the Woodrow Wilson Foundation, etc. Because of early deadlines, application should be made directly to these agencies in the early fall of the year preceding that in which admission is desired.

COURSES

7. Introduction to Statistics—Especially designed for students in economics, sociology, and other social sciences. (Same as Economics 7 and Sociology 7.)
   5 units, autumn, (Olkin), MTWThF 1:15

   3 units, autumn, (Johns), MWF 2:15
   or winter, (Stein), MWF 2:15
   or spring, (Solomon), 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, autumn, (Chernoff), MTWThF 11
   or spring, (Miller), 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, winter, (———), MTWThF 10

#63. Mathematics for Social Scientists—Continuation of 62. Special version of Mathematics 43 primarily for students majoring in a behavioral science.
   5 units, spring, (———), MTWThF 10

64. Mathematics for Social Scientists—Continuation of 63. Partial derivatives, multiple integrals; joint distributions of random variables; infinite series; discrete probability distributions; Laplace transforms; introduction to differential equations.
   3 units, autumn, (———), MWF 2:15

or more means, curve fitting, correlation, design of engineering experiments. Prerequisite: Calculus.

4 units, autumn, (Lieberman), MW 4 and TTh 10
or winter, (Lieberman), MTWF 9
or spring, (Johns), MTWF 10
or summer, (________), MTWThF 11

111. Experimental Statistics—Continuation of 110. Multivariate normal distribution; multiple correlation, regression; estimation, tests of hypotheses about regression coefficients; analysis of variance; selected topics. Prerequisite: 110.

3 units, winter, (Miller), MWF 1:15

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 24 or equivalent.

4 units, autumn, (Parzen), MTWF 11
or winter, (Stein), MTWF 11
or spring, (________), MTWThF 1:15

119. Elementary Statistical Inference—Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. (Same as Economics 271.) Prerequisite: 116.

4 units, winter, (Parzen), MW 9

120. Statistical Inference—Point estimation; interval estimation; tests of hypothesis; linear hypothesis; distribution free methods; sequential analysis. Prerequisite: 119.

4 units, spring, (Parzen), MW 9

136. Introduction to the Theory of Games and Linear Programming—Two person-zero sum games; strategy; minimax solutions; simplex methods in programming; applications. Prerequisite: 27 or equivalent.

3 units, autumn, (Johns), MWF 10

151. Statistical Methodology—Tests of significance and estimation, with emphasis on the application and rationale of the most common methods. Chi-square, least squares, regression, non-parametric methods, and analysis of variance. Prerequisite: Statistics 50 or equivalent.

3 units, winter, (Chernoff), MWF 11

152. Introduction to Operations Research—Application of mathematical models to industrial problems; such topics as linear programming, queuing, game theory, inventory. Discussion, solution of actual problems encountered in management, production, economics of industry. (Same as Industrial Engineering 152.) Prerequisite: 110.

3 units, autumn, (Veinott), MW 4:15
or winter, (Lieberman), MW 4:15
or spring, (Veinott), MWF 10

199. Independent study—For undergraduates.

(Staff)

204. Sampling from Human Populations—Theory of sampling from finite populations; efficiency of various survey designs; application.

3 units, spring, (________), MWF 1:15

206. Mathematical Models in Behavioral Sciences: Measurement and Utility Theory—After a general introduction to the theory of models in the empirical sciences, the course will concentrate on the general theory of measurement and scaling. The last part of the course will deal with utility theory and related topics like subjective probability and decision criteria. (Same as Philosophy 206.)

3 units, autumn, (Suppes), Th 2:15 and one hour by arrangement
207. Mathematical Models in Behavioral Sciences: Learning Theory — 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. (Same as Philosophy 207.)

3 units, winter, (Suppes), Th 2:15 and one hour by arrangement


3 units, autumn, (Solomon), TTh 11


3 units, winter, (Solomon), TTh 11

216. Sampling Inspection — Review of principles of lot-by-lot acceptance inspection; variable inspection; general principles of sequential sampling plans; sampling plans for continuous production which control average outgoing quality. Prerequisite: 110.

3 units, winter, (Lieberman), MWF 2:15

217a, b. Introduction to Stochastic Processes — The theory and application of stochastic processes as models for empirical phenomena, with special emphasis on the following processes: Wiener, Poisson, Stationary, normal, counting, renewal, Markov, birth and death. Prerequisite: 116 or 27.

3 units, winter, (Johns), MWF 1:15
or spring, (Stein), MWF 1:15


3 units, winter, (Parsen), MWF 9

220. Statistical Inference — For graduate students. Lectures same as Statistics 120.

3 units, spring, (Parsen), MWF 9

221. Analysis of Variance — Theory of general linear hypotheses; important special cases of analysis of variance; case of unequal class frequencies. Prerequisite: 120 and some knowledge of matrix algebra, or consent of the instructor.

3 units, autumn, (Stein), MWF 2:15

230a, b. 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, b.) Prerequisite: Mathematics 205a.

3 units, winter and spring, (Karlin), TTh 1:30-3:00

236a, b, c. Mathematical Statistics — A survey of classical and modern statistics from an advanced mathematical point of view. Probability, games and decision theory, estimation, testing hypotheses, confidence intervals, Neyman-Pearson theory, large sample theory, non-parametric inference, sequential analysis, design of experiments. Prerequisite: 220. Corequisites: 221, Mathematics 205a.

3 units, autumn, winter, and spring, (Chernoff), MWF 2:15

242. 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. Prerequisite: 217a.

3 units, spring, (Parsen), MW 4:15

252. Operations Research — A rigorous treatment of linear programming, queuing, inventory theory, and other techniques used in Operations Research. (Same as Industrial Engineering 252.) Prerequisite: 152.

3 units, winter, (Veinott), MW 4:15
or spring, (Veinott), MW 4:15

253. Seminar in Operations Research — Case studies 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. (Same as Industrial Engineering 253.) Prerequisite: I.E. 252.

3 units, spring, (Lieberman), MW 4:15

255. Linear Programming—Fundamental theorems; variations of the simplex method; parametric programming; standard model formulations; quadratic programming; discussion of current developments. (Same as Economics 286.) Prerequisite: Mathematics 114 or equivalent.

3 units, winter, (———), MWF 3:15

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: 116.

3 units, spring, (Lieberman), MWF 2:15

257. Data Processing in Operations Research—Selected topics in the application of electronic computers to operations research activities. (Same as Industrial Engineering 257.)

3 units, spring, (Hillier), MTW 3:15

259a, b, c. Workshop in Management Science—Selected topics in management science, drawn from current literature. Consent of instructors required for admission.

3 units, autumn, winter, and spring, (Staff), by arrangement

260a, b, c. Workshop in Biostatistics—Techniques useful in biological applications including bioassay, quantal response, epidemiology. Informal training in medical science by medical school faculty.

2 to 5 units, autumn, winter, spring, (Miller, Moses), Th 1:15-3:00 and by arrangement

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

301. Colloquium Statistics—Reports on current literature; discussion, presentation by graduate students, faculty interested in statistics; emphasis on theory of games, statistical decisions.

2 to 5 units, autumn, winter, or spring, (Staff), by arrangement

324a, b. Multivariate Analysis—Likelihood ratio tests for hypotheses involving the multivariate normal distribution. Derivation of generalized $T^2$ and Wishart distribution. Factor analysis and relation between sets of variates.

3 units, winter, (Olkin), TTh 1:15

or spring, (Olkin), TTh 1:15

326. Sequential Analysis—The Wald sequential probability ratio test, operating characteristics and applications; Bayes sequential decision problems; asymptotic shapes; sequential design of experiments; special topics. Prerequisites: 217a, and 220.

3 units, spring, (Johns), MWF 2:15

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, autumn, (Moses), MWF 3:15

or winter, (Moses), MWF 3:15


3 units, to be given in 1964-65

336a, b. Decision Theory and Statistical Inference—Minimax theorem, admissibility and complete class theorem, formulation of statistical decision problems,
sufficient statistics, testing hypotheses, estimation, comparison of experiments, and sequential problems.

3 units, to be given in 1964–65

343a, b. Foundations of Time Series Analysis—Hilbert space and function space methods of studying the probabilistic structure and statistical theory of time series. Emphasis on the use of probability density functionals and reproducing kernel Hilbert spaces. Prerequisites: 242 and Mathematics 205a.

3 units, to be given in 1964–65

381. Special Topics in Decision Theory.

3 units, autumn, (Stein), TTh 10

399. Research—Research work as distinguished from independent study of nonresearch character listed in Statistics 199 and 299.

Any quarter, (Staff), by arrangement
SCHOOL of LAW

Acting Dean: John R. McDonough, Jr.

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 the Science of Law is also offered. (For Law School Curriculum see the Law School Bulletin.)

NONPROFESSIONAL COURSE

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—The course is designed for students who do not intend to take up 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. For this purpose, cases and other materials related to the general theme of freedom of contract are studied critically and in considerable detail. The materials are employed as a vehicle by which 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 units, autumn, (Franklin), MTWTh 11
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 Bulletin of the School.

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 first-hand 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 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 seriously consider their usefulness.

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 per se 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 is a unit of the Department of Allied Medical Sciences of the School of Medicine. The curriculum leads to a Bachelor of Science degree and certification as a Public Health Nurse. See the separate School of Nursing Bulletin for details.

DIVISION OF PHYSICAL THERAPY

Director: Lucille Daniels
Associate Professors: Lucille Daniels, Marian Williams
Clinical Associate Professors: Herbert Browne, Helen Hardenbergh
Assistant Professors: Sarah Semans. Acting: Catharine Graham
Clinical Assistant Professors: Ruth Cook, Maurice Grossman
Instructor: Barbara Kent
Clinical Instructors: Marguerite G. Dilley, Anne Janett Marshall, Donna J. Jensen, Michael Keropian

OFFERINGS AND FACILITIES

The following programs in physical therapy are offered:

I. A four-year course leading to the Bachelor of Arts degree.
II. A four-quarter, 12-month course for students with the Bachelor's degree and adequate background in the basic sciences.
III. The Master of Arts degree.
IV. A minor for the Doctor of Philosophy degree

Program I, plus an additional quarter of clinical training, and Program II 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 new Medical Center which houses lecture, laboratory and research rooms, a library, and clinics.

Following initial directed clinical experience in the University's integrated re-
habilitation 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, FELLOWSHIPS, LOAN FUNDS**

General University scholarships and fellowships are available and are listed in the *Information Bulletin*. In addition, a number of special scholarships for physical therapy students are offered by such organizations as the United Cerebral Palsy Association, 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 Mary McMillan scholarships are awarded by the American Physical Therapy Association.

The U.S. Government offers scholarships and fellowships through the Vocational Rehabilitation Administration.

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 Air Force and the Navy offer commissions to senior women in the Bachelor's degree program, and to graduating women who are accepted for the 12-month course. Students pay tuition and maintenance from their officers' salaries.

**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; of these, at least one should be taken in chemistry. Courses in physics or mathematics or both may be used to fulfill the additional two-quarter requirement (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 101 and 102. Principles of Human Physiology.
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
Education 169, Kinesiology, courses in health education, 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 additional courses in human anatomy and social science including psychology.

Courses in this program include Physiology 101, 102, 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 and Hospitals 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 and field trips to facilities in the area.

2 units, winter, (Daniels), T 3-5

150. **Elements of Pathology**—Basic medical terminology; the causes, process, and effects of disease; repair of tissues following injury.

2 to 3 units, autumn, (Hardenbergh), W 8-10

155. **Ethics and Clinic Procedures**—Professional ethics, administration of physical therapy departments. General clinic procedures analyzed; students are given opportunity to observe, assist in treatment of patients.

3 units, autumn or spring, (Daniels, Graham), by arrangement

162. **Physical Agents**—Analysis of the principles underlying the use of hydrotherapy and massage; practice of essential techniques.

3 units, autumn, (Staff), by arrangement

170. **Clinical Medicine I**—Basic lectures in orthopedics, medicine, and surgery.

3 units, winter, (Browne and special lecturers), by arrangement

172. **Clinical Medicine II**—Basic lectures in medicine, neurology and pediatrics.

2 units, spring, (Staff and special lecturers), by arrangement

175. **Electrotherapy and Light Therapy**—Principles underlying the use of high- and low-frequency currents, ultraviolet and infrared radiation in treatment of injury, disease; laboratory work included.

4 units, winter, (Staff), by arrangement

180. **Advanced Kinesiology**—Joint motion, muscle function in relation to normal, abnormal conditions and biomechanics of motion.

4 units, autumn, (Semans, Kent), by arrangement

188. **Basic Therapeutic Exercise**—Theory, practice of neuromuscular re-education. Posture, body mechanics, gait training and manual muscle testing.

4 units, winter, (Staff), by arrangement
189. **Applied Therapeutic Exercise**—Application of exercise procedures in treatment of orthopedic, neurological and other physical disabilities.

2 to 3 units, spring, (Staff), by arrangement

192. **Clinical Problems in Physical Therapy.**

2 units, summer, (Daniels, Graham), by arrangement

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, spring, (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, (Staff), 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, (Staff), 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. **Principles of Kinesiology and Therapeutic Exercise**—Fundamental considerations in body movement with emphasis on the musculoskeletal system, joint physiology, and pathology. Appropriate research technics, including electromyography, dynamometry; practice with equipment. Biomechanics in physical therapy.

5 units, autumn, (Williams, Staff), by arrangement

221. **Physical Therapy for Musculoskeletal Disorders**—Clinical application of material in 220. Regional approach to anatomy and kinesiology of limbs and trunk, with consideration of more common disabilities; current orthopedic treatment, and analysis of related therapeutic exercise procedures. Review of prosected anatomical material.

5 units, winter, (Williams, Staff), by arrangement


5 units, spring or summer, (Semans, Staff), by arrangement

230. **Clinical Testing Procedures**—Presentation, discussion of principles and techniques of testing procedures, newer developments in the field and in related clinical areas.

3 units, spring, (Staff), by arrangement

232. **Curriculum Development and Instruction**—Objectives, organization, content, techniques in teaching courses in physical therapy.

3 units, winter, (Daniels), by arrangement

234. **Seminar in Administration**—Administrative problems in hospitals, clinics, schools of physical therapy; interprofessional relationships in comprehensive patient care (rehabilitation).

3 units, autumn, (Daniels), by arrangement

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), by arrangement

244. **Directed Clinical Experience in Special Areas of the Field**—For thera-
pists 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

245. Clinical Supervision of Students—Methods of orientation, analysis of performance, and evaluation of students in the clinic.

2 to 3 units, any quarter, (Staff), by arrangement

246. Individual Work.

1 to 8 units, any quarter, (Staff), by arrangement

240. Seminar in Research and Thesis Problems—Basic principles of research with emphasis on material applied to physical therapy. Elementary statistics including selected non-parametric techniques.

3 units, autumn, (Williams, Staff), by arrangement


5 to 8 units, (Williams, Staff), by arrangement

295. Research.

(Staff), by arrangement

DIVISION OF SPEECH PATHOLOGY AND AUDIOLOGY

Director: Hayes A. Newby
Professors: Virgil A. Anderson, Jon Eisenson, Hayes A. Newby
Associate Professor: Dorothy A. Huntington
Assistant Professor: Richard F. Dixon
Instructor: Virginia Puich
Clinical Instructor: Lyman S. Barrett

Offerings and Facilities

The chief purpose of the Division of Speech Pathology and Audiology is to prepare students for professional careers in the fields of speech pathology, audiology, and the 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 prepares one for careers in public school speech and hearing work, for private practice, for teaching at various academic levels, and for research positions.

The program of the Division is so organized, however, as to make ample provision for electives outside of 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 provides 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. While 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)

Candidates for the A.M. and Ph.D. degrees are allowed credit toward graduation for only those courses in the Division numbered 200 and above. In order to graduate they must maintain a grade point average of 3.0 or better in all courses in the Division taken for graduate credit, and their over-all point average will be considered by the Division in recommending them for graduation.

Programs of Study

Bachelor of Arts

The Bachelor of Arts program in Speech Pathology and Audiology is designed to fulfill the academic requirements for Basic Certification in the American Speech and Hearing Association. It thus prepares a student professionally to accept certain positions in speech therapy or in hearing. While additional work at the graduate level is recommended for more adequate preparation in these fields, some positions are open to students with only the Bachelor's degree. With moderate additional course work and clinical practice, it is possible for the student to satisfy Basic Certification requirements in both speech and hearing.

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>Units</th>
<th>Course Title</th>
</tr>
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<tbody>
<tr>
<td>110.</td>
<td>Principles of Phonetics</td>
</tr>
<tr>
<td>130.</td>
<td>Introduction to Speech Science</td>
</tr>
<tr>
<td>140.</td>
<td>Speech Re-education</td>
</tr>
<tr>
<td>141.</td>
<td>Speech Correction</td>
</tr>
<tr>
<td>180.</td>
<td>Introduction to Audiology</td>
</tr>
<tr>
<td>220.</td>
<td>The Psychology of Speech</td>
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<tr>
<td>232.</td>
<td>Principles of Voice Training</td>
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<td>281.</td>
<td>Hearing Measurements and Interpretation</td>
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<td>Electives</td>
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<tr>
<td>Speech and Drama 20. Public Speaking: Practice and Criticism</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 1. Characteristics of Spoken Language</td>
<td>3</td>
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<tr>
<td>or Speech and Drama 30. Oral Interpretation</td>
<td>3</td>
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Completion of either of the following programs:

a) 168. Clinical Methods                  3
    241. Advanced Speech Correction         4
    270. Clinical Practice in Speech and Hearing  1*

b) 289. Aural Rehabilitation             4
    284. Advanced Clinical Audiology        4
    or 291. Hearing Aids and Residual Hearing 3
    270. Clinical Practice in Speech and Hearing 1*

*Additional Clinical Practice should be elected if academic requirements for Basic Certification are to be fulfilled.

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), 360 (Medical Backgrounds of Speech and Hearing Disorders), and one of the following: 330 (Seminar in Speech Sciences), 340 (Seminar in Speech Pathology), or 380 (Seminar in Audiology).

Except for these courses, there is no set program that is rigidly required of all Master's degree candidates. Within limits, each program is planned individually to fit the needs, interests, and previous background of the student. In general, if the candidate expects to complete his degree within the minimum residence period of three quarters, his previous training should have included substantially the equivalent of the A.B. requirements outlined above. Deficiencies here will add somewhat to the amount of time required to complete the A.M. degree.

In terms of units, minimum requirements for the Master's degree are interpreted as being 45 units of graduate work. Where the student's previous background is deemed adequate, this program may include course work offered in other departments of the University. Four of these 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 the various subjects involved in his specialty. 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 program at the doctoral level in the Division of Speech Pathology and Audiology prepares the student academically for Advanced Certification in the American Speech and Hearing Association. He may specialize in any one of the three fields—speech pathology, audiology, or speech and hearing sciences—but 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. The basic University residence requirement is nine quarters, or the equivalent thereof, beyond the Bachelor's degree. This includes the minor program if elected and the units allowed for dissertation. 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. He also takes an additional higher-level examination covering these same five subjects to be used as a basis for program planning. 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 covering the three fields: speech pathology, audiology, and speech and hearing sciences, with the major emphasis being placed upon the candidate's area of specialization. This is followed by an oral examination administered by the staff of the Division as a further preparation for the University oral examination.

Teaching Credentials

In cooperation with the School of Education, the Division of Speech Pathology and Audiology offers a program leading to the Special Credential in Speech Correction and Lipreading, which authorizes the holder to work as speech therapist and hearing specialist in the public schools of California.

Requirements for the Special Credential are as follows:

<table>
<thead>
<tr>
<th>Units</th>
<th>Education 230 or 230a. Guidance</th>
<th>3</th>
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<tr>
<td>Units</td>
<td>Education 242. Student Teaching in Speech Correction</td>
<td>6</td>
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<tr>
<td>Units</td>
<td>Psychology 190. Exceptional Children</td>
<td>3</td>
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<tr>
<td>Units</td>
<td>And the following courses in Speech Pathology and Audiology:</td>
<td></td>
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<tr>
<td>Units</td>
<td>110. Phonetics</td>
<td>4</td>
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<tr>
<td>Units</td>
<td>140. Speech Re-education</td>
<td>4</td>
</tr>
<tr>
<td>Units</td>
<td>141. Speech Correction</td>
<td>5</td>
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<tr>
<td>Units</td>
<td>168. Clinical Methods</td>
<td>3</td>
</tr>
<tr>
<td>Units</td>
<td>180. Introduction to Audiology</td>
<td>4</td>
</tr>
<tr>
<td>Units</td>
<td>241. Advanced Speech Correction</td>
<td>4</td>
</tr>
<tr>
<td>Units</td>
<td>270. Clinical Practice</td>
<td>5</td>
</tr>
<tr>
<td>Units</td>
<td>281. Hearing Measurements and Interpretation</td>
<td>4</td>
</tr>
<tr>
<td>Units</td>
<td>289. Aural Rehabilitation</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
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</tbody>
</table>

This Special Credential is based upon a teaching credential of General grade, such as a General Elementary or General Secondary, which means that the candidate for the Special Credential must already have, or must obtain, a General Credential.

A special program developed in cooperation with the School of Education makes it possible to obtain the Special Credential in Speech Correction and Lipreading together with the General Elementary Credential at the end of the fifth year, within the period usually devoted to the General Elementary alone. Information concerning this combined program may be obtained from the Director of Speech Pathology and Audiology.

In cooperation with the Department of Speech and Drama, the Division of Speech Pathology and Audiology offers one of the sequence of courses required for the General Secondary Credential with a teaching major in Speech and Drama. For information concerning this program, please consult the section under Speech and Drama elsewhere in this Bulletin.

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. The services of the Clinic are available without charge to students within the University by registering for Speech Pathology and Audiology 1. Clinical work with children and adults is performed on both an individual and a group basis. 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. Particulars are to be found in the annual Information Bulletin distributed from the Registrar's Office. In addition, the Phi Chapter of Kappa Alpha Theta Fund and the J. D. Zellerbach Fund provide scholarships specifically for graduate students in Speech Correction and Hearing. 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 internships in near-by medical 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 are available for graduate students with the proper qualifications.

**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 student with subject matter, vocational opportunities, in fields of speech therapy and hearing. Lectures, demonstrations, films.
   
   *2 units, spring, (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, autumn, (Newby), MTWF 1*

112. **Introduction to Phonetic Theory**—Descriptive and historical phonetics as applied to English. Prerequisite: some acquaintance with phonetic transcription.
   
   *2 units, autumn, (Bush), MW 1*

130. **Introduction to Speech Science**—Anatomy and physiology of voice and speech, with application to theories of voice production and vocal therapy.
   
   *4 units, winter, (Bush), MTWF 2*
   *or summer, (Anderson), MTWThF 1*

140. **Speech Re-education**—Fundamental training in recognition, treatment of more common types of vocal, articulatory disorders.
   
   *4 units, autumn, (Anderson), MTWF 11*

141. **Speech Correction**—Classification, diagnosis, treatment of speech disorders. Supervised observation in Speech Clinic.
   
   *5 units, winter, (Anderson), MTWF 10 and one hour by arrangement*
   *or summer, (Staff), MTWThF 9 and one hour by arrangement*
168. Clinical Methods—Theory, practical demonstrations of materials, techniques applicable to speech and hearing therapy.
   3 units, spring, (Puich), M 3–5 and W 3

180. Introduction to Audiology—Anatomy, physiology, acoustics of hearing; survey of field of audiology.
   4 units, autumn, (Newby), MTWF 10
   or summer, (Newby), MTWThF 11

ADVANCED UNDERGRADUATE AND GRADUATE COURSES

220. The Psychology of Speech—Origin, development of speech, semantics; relation of speech to thought, emotion, personality.
   4 units, winter, (Eisenson), MTWF 9

230. Advanced Speech Science—Acoustic characteristics of voice and speech.
   3 units, spring, (Huntington), MWF 1

   3 units, spring, (Anderson), MWF 2

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, spring, (Anderson), MTWF 10

250. Stuttering.
   3 units, winter, (———), MWF 1

252. Aphasia—Historical survey, pathology; methods of testing, diagnosis, therapy.
   3 units, autumn, (Eisenson), MWF 9
   or summer, (Eisenson), MTWF 9

   3 units, spring, (Eisenson), MWF 9

254. Speech Problems in Cerebral Palsy.
   3 units, winter, (Puich), TTh 8 and W 11

264. Clinical Testing and Diagnosis—Theory, practice in use of tests, other diagnostic techniques that can be applied to speech correction.
   4 units, autumn, (———), MWF 11 and one hour by arrangement
   or summer, (———), MTWF 8 and one hour by arrangement

270. Clinical Practice in Speech and Hearing—Prerequisite: 141 or equivalent, or permission of instructor.
   1 to 3 units, any quarter, (Puich, Staff), Th 4 and by arrangement

281. Hearing Measurements and Interpretation—Theory, practice in administering individual and group hearing tests. Prerequisite: 180 or equivalent. Unless otherwise arranged, the student is expected to register for 1 unit of 270 concurrently with this course.
   4 units, winter, (Dixon), MWF 8 and one hour by arrangement

284. Advanced Clinical Audiology—Differential diagnostic procedures. Prerequisite: 281 or equivalent.
   4 units, spring, (Dixon), MTWF 8
   or summer, (Dixon), MTWThF 11

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, spring, (Newby), TTh 9

289. Aural Rehabilitation—Speechreading, auditory training, and speech training for the acoustically handicapped.
   4 units, spring, (———), 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. Registration by permission.

4 units, autumn, (Puich), MTWF 10
or summer, (Puich), MTWThF 2

291. Hearing Aids and Residual Hearing—Amplification as a rehabilitative measure. Counseling and training the hearing-aid user. Registration by permission.

3 units, autumn, (Dixon), MWF 8
or summer, (Dixon), MTWF 8

300. Introduction to Graduate Study—Required of all candidates for graduate degrees.

3 units, autumn, (Huntington), MWF 2
or summer, (———), MTWF 10

301. Research—Independent study for graduate students. Credit limited to total of 8 units.

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.

2 units, winter, (Huntington), T 10-12

310. Experimental Phonetics I—Study of experimental work in physiological characteristics of speech. Lectures, demonstrations, laboratory.

4 units, autumn, (Huntington), T 9-11 and two hours by arrangement

311. Experimental Phonetics II—Study of experimental work in acoustic characteristics of speech. Lectures, demonstrations, laboratory.

4 units, winter, (Huntington), Th 9-11 and two hours by arrangement

320. Psychoacoustics—Study of the literature on nature of auditory stimuli, their perception. Special emphasis on speech. Lectures, demonstrations, laboratory.

4 units, spring, (Huntington), T 2-4 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, spring, (Bush), MW 3-5

340. Seminar in Speech Pathology—Material will vary from year to year; hence, may be repeated for credit.

4 units, autumn, (Anderson), MW 3-5
or 3 units, summer, (Newby), MW 3-5

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, winter, (Newby, Medical Staff), MF 11 and W 4-6

370. Clinical Internship—In-service clinical practice and observation in selected speech and hearing centers. Registration by permission.

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, winter, (Newby), MF 3-5
or 3 units, summer, (Dixon), MW 3-5

400. Doctoral Research.

1 to 15 units, any quarter, (Staff), T 4
ANATOMY

Emeriti: Charles Haskell Danforth, Arthur William Meyer (Professors)

Professors: Donald James Gray, William Walter Greulich (on leave 1963–64), Hadley Kirkman, Robert Stuart Turner
Associate Professor: Donald L. Stilwell, Jr.
Assistant Professors: F. Thomas Algard, A. Kent Christensen, Marian Williams
Instructors: Masako Akimoto Baba, Jean A. Foster, Harriett B. Peckham
Clinical Instructors: Dean T. Clark, Burt Lincoln Davis, Jr., Mitchell A. Madison, Harold M. Malkin, Robert Wiepking Meyer, Reuben Stutch
Lecturer: Bernard O. A. Thomas
Research Associates: Elizabeth M. Center, Philip E. Smith, Theodore A. Willis

PROGRAMS OF STUDY

Instruction in the Department of Anatomy is planned primarily to meet the needs of students in medicine, but, in so far as facilities permit, all of the courses are open to other properly qualified third- and fourth-year undergraduate and graduate students. Those who are not registered in medicine but wish to take work in the Department should make arrangements in advance with the instructors concerned.

Facilities are available for a limited number of doctors of medicine, or others with equivalent training, who may wish to do special dissections or pursue work on problems within the scope of the Department. Graduate study may be undertaken in such aspects of anatomy as are indicated by the courses listed. Programs combining work in anatomy and other fields of biology or medicine may be arranged.

ADVANCED DEGREES

Students desiring to become candidates for advanced degrees in anatomy should consult the general University regulations regarding such degrees, which are summarized in the section “Degrees” in this Bulletin. 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, spring, (Algard), TThF 4

#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, autumn, (Peckham, Williams), TWTThF 1-4

121. Dissection of the Human Body—Lectures, demonstrations. A few non-medical students may be admitted by special arrangement.
3 units, winter, (Gray, Baba, Peckham), Th 1-4 (first 8 weeks), S 8-12
or 5 units, spring, (Stilwell, Turner, Christensen, Peckham), W 2-5, ThF 1-4

122. Normal Histology and Microscopic Anatomy—Elementary structure, ac-
tivities of the animal cell; histology; development of tissues, their combination into
the organs of vertebrates, with special reference to man.

1 unit, autumn, (Kirkman, Algard, ———), S 9–12
or winter, (Kirkman, Algard, ———), Th 1–4 (last 2 weeks)
or spring, (Kirkman, Christensen, ———), S 8–11

221. Dissection of the Human Body.
3 units, autumn, (Gray, Baba, ———), M 8–12, S 9–12
or winter, (Gray, Baba, Foster), M 8–12, F 9–12
or 2 units, spring, (Stilwell, Turner, Baba), S 9–12

222. Normal Histology and Microscopic Anatomy.
1 unit, autumn, (Kirkman, Algard, ———), F 9–12
or 2 units, winter, (Kirkman, Algard, ———), S 9–12

145. Individual Work—When circumstances warrant, work not specifically pro-
vided 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 cadav-
ers; dissected and specially injected preparations, student reports relevant to this
material. Prerequisites: 121, 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, prerequi-
sites: 121 and a course in embryology.

Any quarter, (Gray, Algard), by arrangement

207. Histological and Cytological Technique—General principles of micro-
technique, practice in their application. Introduction to some of the more precise
cytological techniques. Enrollment limited. For medical and graduate students only.
3 to 6 units, any quarter, (Kirkman), by arrangement

208. Special Cytology — Practical laboratory introduction to special phases of
nuclear, cytoplasmic cytology. Chief emphasis on use of technical methods for study
of cytoplasmic organoids, inclusions. Enrollment limited. Prerequisites: 122 and 207
3 to 6 units, any quarter, (Kirkman), by arrangement

209. Fine Structure of Cells—Lectures on the structure and function of cells as
revealed by the electron microscope. Prerequisites: Biology 103 or Anatomy 122, and
permission of instructor.
3 units, autumn, (Christensen), TThF 4

323. Neuroanatomy—structure of central nervous system of man, dissections, pre-
pared slides, dissections of central nervous systems of other mammals. Prerequisite: 122.
5 units, autumn, (Turner, Stilwell, Foster), MWF 9–12

BIOCHEMISTRY

Executive Head: Arthur Kornberg
Professors: Paul Berg, Arthur Kornberg
Associate Professors: Robert L. Baldwin, David S. Hogness, A. Dale Kaiser, I.
Robert Lehman

PROGRAMS OF STUDY

The Department offers a first-year course in modern biochemistry which is re-
quired of medical students and open to qualified graduate students and senior under-
graduates. 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. A. D. Kaiser. 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 I, and open to graduate and advanced undergraduate students.

4 units, autumn, (Staff), MTWTh 11
or winter, (Staff), MTWTh 11

**102a. Biochemistry Laboratory**—Required of medical students in Year I, and open to graduate and advanced undergraduate students.

4 units, winter, (Staff), MW 1–5 and T 1–4

**201. Research and Special Advanced Work.**

By arrangement

**202. Seminar.**

By arrangement

**211. Biochemical Genetics**—The structure of genes and chromosomes and viruses; the mechanisms of mutation and recombination; virus multiplication. Prerequisites: 101, 102, and a knowledge of elementary genetics.

2 units, winter, (Kaiser), offered triennially; to be given in 1963–64


2 units, autumn, (Lehman), offered triennially; to be given in 1964–65

**213. Biosynthesis of Proteins**—Aspects of peptide bond formation; the factors determining amino acid sequence, secondary and tertiary structure; induction and repression of protein synthesis. Prerequisites: 101–102 and consent of the instructor.

2 units, winter, (Hogness), offered triennially; to be given in 1964–65

**214. Physical Chemistry of Proteins and Nucleic Acids**—Theory and interpretation of physical measurements on macromolecules; structures of proteins and nucleic acids. Prerequisites: 101–102, first-year physical chemistry, and knowledge of calculus. Consent of instructor required both for auditors and students enrolling for credit.

2 units, autumn, (Baldwin), offered triennially; to be given in 1965–66

**215. Problems of Current Interest in Biochemistry**—Detailed analyses of subjects of current interest in biochemistry and related fields. Will include discussions
on such subjects as biosynthetic mechanisms, mechanism of enzyme action, and enzyme kinetics. Prerequisites: 101–102 and 3 quarters of organic chemistry; first-year physical chemistry recommended also. Consent of instructor required both for auditors and students enrolling for credit.

2 units, winter, (Berg), offered triennially; to be given in 1965–66

GENETICS

Executive Head: Joshua Lederberg*
Professor: Joshua Lederberg
Associate Professor: Eric M. Shooter (on leave 1963–64)
Assistant Professors: Walter F. Bodmer, Leonard A. Herzenberg
Research Physicist: Elliott C. Levinthal

* Director, Kennedy Laboratories for Molecular Medicine.

PROGRAMS OF STUDY

The Department of Genetics offers training in three categories: required and elective courses for medical students; courses and research training for graduate students in candidacy for the Ph.D. degree; research training for graduates holding the M.D. or Ph.D. degree. A number of traineeships including full tuition and personal stipend at current national levels are available to graduate students and postgraduates under a research training grant from the National Institutes of Health. The Department is particularly interested in receiving applications from students who have concentrated on chemistry or physics and are now interested in establishing research competence in the applications of physical sciences to problems of molecular biology. Well-qualified students are invited to apply to the departmental executive for further information on these opportunities. The principal lines of genetic research conducted in the department at the present time are the genetic function of DNA in bacteria, tissue immunology and the genetics of somatic cells, and the investigation of extraterrestrial life.

The Lt. Joseph P. Kennedy, Jr. Laboratories for Molecular Medicine are under construction to further basic research in the etiology of mental retardation, 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.

Through cooperation with other departments, opportunities also exist for training in biometrical genetics, biomedical instrumentation, radiobiology, and other interdepartment fields. 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

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.

1 unit each quarter, (Lederberg), by arrangement

301. Medical Genetics—Continuation of 201.

1 unit each quarter, (Lederberg), by arrangement
302. Genetics Seminar—With the cooperation of the staff of several departments. Credit available by registration in Genetics 199 with consent of instructor, (Herzenberg), alternate F 4, (alternating with Biochemistry 202)

306. Genetics of Somatic Cells and Tissues—Genetic studies of somatic cells in vivo and in culture. Genetics of transplantation. Prerequisite: one genetics course, or Genetics 302, or consent of the instructor.
2 units, winter, (Herzenberg), by arrangement, alternate years, to be given in 1963–64

MEDICAL MICROBIOLOGY

Emeritus: Edwin William Schultz (Professor)

Executive Head: Sidney Raffel
Professors: Charles Egolf Clifton, Windsor C. Cutting, Sidney Raffel, Carlton E. Schwerdt
Clinical Associate Professor: Emmett L. Durrum
Assistant Professors: Robert J. Roantree, Leon T. Rosenberg
Instructor: Helen Sharp Thayer

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 or the first year of graduate work: Medical Microbiology 101, 225, 231, 238, 240, 250, 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, 250, 315 and Biochemistry 101, 102. (Biochemistry 102a or Chemistry 142 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 25, 29, 124, 148a and b; 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; Chemistry 142, 171, 173, 175, 246; 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 1, 2, 3, and Chemistry 1, 2, 3.

   5 units, autumn, (Clifton, Staff), MF 11; lab. MW 1-4

221. Basic Medical Microbiology—An introduction to the principles of bacteriology and immunology, primarily for first-year medical students.

   2 units, spring, (Staff), T 1-4, W 1

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 or 221.

   5 units, spring, (Staff), M 8-12, WF 9-12

231. Immunology and Serology—Advanced lectures, demonstrations, laboratory exercises covering infection, immunity, antigen-antibody reactions. Prerequisites: Biology 103, MM 101, Biochemistry 101.

   3 units, winter, (Raffel, Roantree, Rosenberg, Thayer), MW 1, F 2

231a. Immunology and Serology Laboratory.

   3 units, winter, (Raffel, Roantree, Rosenberg, Thayer), MW 2-5, F 3-5

238. Bacterial Physiology—Lectures on physical, chemical aspects of bacterial growth, behavior. Prerequisites: 101 and Biochemistry 101.

   5 units, spring, (Clifton), MTWThF 1

240. Virology—Lectures, demonstrations, laboratory exercises on general nature of plant, animal viruses, their relationships with their hosts. Prerequisites: 101 and 231, Biochemistry 101.

   3 units, winter, (Schwerdt, Thayer), TTh F 1

240a. Virology Laboratory.

   2 units, winter, (Schwerdt, Thayer), TTh 2-5

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.

   5 to 10 units, any quarter, (Clifton, Cutting, Rosenberg, Raffel, Roantree, Schwerdt), 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) viro-
OBSTETRICS AND GYNECOLOGY

ogy. Grade average of B in bacteriological subjects required for admission to research or thesis work.

5 to 10 units, any quarter, (Clifton, Cutting, Rosenberg, Raffel, Roantree, Schwerdt), by arrangement

315. Seminar—Reports, discussions on selected topics. Required of all graduate students.

1 unit, autumn, winter, spring, (Staff), by arrangement

316. Literature Reviews—Review of literature on special topics assigned by instructor.

3 to 5 units, any quarter, (Clifton, Cutting, Rosenberg, Raffel, Roantree, Schwerdt), 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, winter, (Rosenberg, Raffel, Roantree), by arrangement

400. Experimental Therapeutics—For fourth- and fifth-year medical students. Systematic review of therapeutic agents with emphasis on mechanism of action of drugs. Given as a continuous course, but any quarter may be taken separately.

1 unit, any quarter, (Cutting), W'12

OBSTETRICS AND GYNECOLOGY

Executive Head: Charles E. McLennan
Professor: Charles E. McLennan
Associate Professor: Lyman M. Stowe
Assistant Professors: Robert C. Goodlin, Eugene C. Sandberg, Emmet J. Lamb
Instructor: Davis W. Baldwin
Research Associates: Allen H. Gates, 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, 143, 152, 168; Physiology 102, 207, 208; Statistics 50, 151; and 30 units of research in reproduction (Obstetrics-Gynecology 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 Programs. Detailed study of particular topics in reproduction planned for the individual student by the appropriate staff member, supervised laboratory experiments, weekly 1-hour seminar. Prerequisites: Biology 22, 23, and 25 or their equivalents.

(Staff), by arrangement
401. Physiology of Reproduction—Open to first-, second-, and third-year medical students, upper division students majoring in biology, and graduate students. Limited to 8 students per quarter. Project research using experimental animals 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

PATHOLOGY

Executive Head: Alvin J. Cox, Jr.
Professors: Alvin J. Cox, Jr., David Glick, Lelland J. Rather
Associate Professors: Stanton L. Eversole, Bruno Gerstl
Assistant Professors: Charles O. Frake (Anthropology)
Instructors: Jon Craig Kosek, P. Richard Ruffolo, Alexander M. Saunders
Teaching Assistant: Don B. Singer

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, winter, (Glick, Staff), M 12:15

PHARMACOLOGY

Emeritus: Leon Kolb (Clinical Associate Professor)

Executive Head: Avram Goldstein
Professors: Robert Hastings Dreisbach, Avram Goldstein
Associate Professors: Lewis Aronow, Sumner Myron Kalman, Keith F. Killam, Jr., Tag E. Mansour
Assistant Professor: John D. Gabourel
Instructor: 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. Consult Time Schedule for additional elective courses.
COURSES

Pharmacology 101, 201, 301—In the curriculum for medical students pharmacology is taught over a three-year period in the interdepartmental course in the Basic Medical Sciences. Students not enrolled in the School of Medicine may take part or all of this course for credit, by special arrangement. For details see the School of Medicine Bulletin.

202. Biological Transfer Processes—Lectures and seminar discussion concerning current knowledge about the movement of materials across cell boundaries.
   2 units, autumn, (Kalman), T 4-6, to be given in 1964-65

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 on cellular and subcellular level. Prerequisite: Biochemistry 101 (first quarter) or equivalent.
   1 unit, winter, (Mansour), T 4-5

204. Current Advances in Molecular Pharmacology—Assigned readings and discussion of selected topics in the current literature. Students should be conversant with modern biochemistry and genetics, and should have taken (or be taking) courses in physiology and general pharmacology.
   2 units, spring, (Goldstein), W 7-9 p.m.

205. Drug Metabolism.
   1 unit, autumn, (Gabourel), T 4-5

207. The Anti-Cancer Drugs—The biochemical mechanism of action of the important cancer chemotherapeutic agents will be discussed, with special emphasis on the problem of drug resistance. The clinical use of these drugs will not be included.
   1 unit, winter, (Aronow), T 4-5, to be given in 1964-65

208. Neuropharmacology—Fundamental considerations in the study of drug action on the central nervous system.
   1 unit, spring, (Killam), T 4-5, to be given in 1964-65

   1 unit, any quarter, (Staff), by arrangement

210. Literature Review—Individual or group reading of the literature in any area of pharmacology. A critical review paper may be required.
   Units and time to be arranged, any quarter, (Staff)

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 Percy Baumberger (Professor)

Executive Head: Jefferson Martineau Crismon
Professors: Jefferson Martineau Crismon, Ronald Grant
Associate Professors: George A. Feigen (on leave 1963-64), F. Eugene Yates
Assistant Professors: Emil Aschheim, Geronimo Terres, Jr., Hugh D. VanLiew

PROGRAMS OF STUDY

The Department of Physiology offers, in addition to the courses required of students of medicine, programs of study for students who wish to specialize in
various aspects of physiology. Degree programs for medical students are described in the *School of Medicine Bulletin*.

**Bachelor of Science**

Appropriate courses of study leading to the degree of Bachelor of Science will vary somewhat depending upon the major field of interest and should be determined in consultation with the Department, preferably before completion of General Studies requirements so that full advantage may be taken of opportunities for elective studies. Requirements normally include one year each of college chemistry, physics, and biology with passing grades. Students with substantial background in other sciences may arrange suitable programs toward the B.S. in Physiology.

The following example of a curriculum for undergraduates includes, in addition to the General Studies requirement:

Any three of the following Biology courses or equivalent:

- Biology 20. Introduction to Botany ........................................ 5 units
- Biology 21. Introduction to Invertebrate Zoology ......................... 5 units
- Biology 22. Biology of the Vertebrates .................................. 5 units
- Biology 23. Introductory Embryology ....................................... 5 units
- Biology 24. Cell Physiology .................................................. 5 units
- Biology 25. Genetics .......................................................... 3 units
- Biology 166. Physiology of the Nervous System .......................... 4 units

All of the following Physical Science courses or equivalent:

- Chemistry 1, 2, 3 ................................................................. 14 units
- Chemistry 121, 123 ............................................................. 6 units
- Physics 21, 23, 29 ............................................................... 13 units
  (Mathematics A, C or 10, 11 may be substituted for 10 units of Physics)

Required Courses in Physiology:

- 100. Principles of Human Physiology ........................................ 3 units
- 101. Principles of Human Physiology ....................................... 5 units
- 102. Principles of Human Physiology ....................................... 4 units
  (These three courses together will cover all major aspects of Human Physiology. They should be taken in the above order whenever possible.)
- 103. General Physiology ..................................................... 3 units
  (Biology 24 may be substituted for this requirement but if possible both courses should be taken.)
- 201. Colloquium in Physiology ............................................. (1 unit each quarter)

Elective Courses in Physiology (9 units):

- 113. Physiology of Adaptation ............................................. 3 units
- 167. Undergraduate Problems by arrangement

**Master of Science** (see the section “Degrees” in this Bulletin)

The requirements for the M.S. degree in Physiology are as follows:

1. The equivalent of one year (three normal academic quarters) totaling 36 to 45 units of registration at Stanford in graduate status, with an average grade of B.
2. Completion of one year each of college biology, chemistry, and physics or mathematics with passing grades.
3. Completion of any of the courses in Physiology listed above as requirements for the B.S. degree if not taken previously or covered by equivalent work elsewhere, plus courses chosen from the graduate course offerings (course numbers in the 200 or 300 series) in individually designed programs.
4. An M.S. thesis based upon an original investigation carried out in a field agreed upon by the faculty sponsor.
Doctor of Philosophy (consult "Degrees" section of this Bulletin)

Although no rigid prerequisites are prescribed as conditions of acceptance by the Department of Physiology, preparation for graduate work should include a substantial background in mathematics through integral calculus, statistics, physical chemistry, and, wherever possible, additional training in physics or electronics.

The minimum registration requirement for Ph.D. candidates is nine academic quarters; however, the actual time-span for the completion of the doctoral requirements is variable and depends upon the preparation of the student and the nature of the dissertation problem. All of the courses in the "200" and six of the "300" series are normally required of Ph.D. candidates. The course programs, including courses taken in other Departments, are planned for the individual student, with the guidance of the faculty sponsor, and must be approved by the Department.

The Ph.D. Qualifying Examination—After completion of at least three of the courses in the "300" series and following examinations validating command of subject matter, the candidates will be required to pass a qualifying examination before being admitted to candidacy for the Ph.D. degree.

Language Examinations—Proficiency in reading two foreign languages must be validated by examination. Admission to candidacy may be accomplished after one of the two language examinations has been passed.

Dissertation—Research work on an original contribution to knowledge presented in satisfactory form in keeping with University regulations is an essential part of the total requirement. Students are encouraged, with the concurrence of their advisor, to make early arrangements for an interdepartmental dissertation advisory committee (see "Degrees" section in this Bulletin).

University Oral Examination—An oral examination not longer than three hours in length will be administered by a committee appointed by the Chairman of the University Committee on the Graduate Division. The examination time is arranged upon application to the Graduate Study Secretary and shall be held after completion of the foreign language requirement and not later than the fourth week of the last quarter of candidacy.

SCHOLARSHIPS, FELLOWSHIPS AND ASSISTANTSHIPS

Applications for Scholarships or Fellowships administered by the University must be received by the Financial Awards office not later than February 15 for the coming year. Teaching Assistantships and Research Assistantships are ordinarily awarded only after applicants have been registered as graduate students for at least one quarter. Usually courses 100, 101, and 102 or equivalent must have been completed to establish eligibility. Students with satisfactory records in advanced mammalian physiology courses taken elsewhere may be appointed to assistantships during the first quarter of graduate residence. Qualified students may apply for a tuition scholarship covering up to half-time tuition and fees during the time they hold a Teaching Assistantship (details are given in the Information Bulletin).

Predoctoral Fellowships—Qualified applicants are urged to take the initiative in applying for predoctoral fellowships from the National Science Foundation (for forms and information write: National Science Foundation Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D.C. Deadline: early January) and the U.S. Public Health Service (for forms and information write: Research Fellowships Branch, Division of Research Grants, National Institutes of Health, Bethesda 14, Maryland. 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.

COURSES

#90. Elementary Human Physiology—Survey of human physiology for undergraduate students, including those in nursing and physical education.
4 units, winter, (——), MWF 9; lab. T 1-4

#91. Elementary Human Physiology Laboratory—Prerequisite: previous or concurrent enrollment in Physiology 90.
2 units, winter, (Staff), TTh 1-4

100. Principles of Human Physiology—The first quarter of a 3-quarter sequence open to students in the biological, physical, social and medical sciences with sufficient background in cognate sciences. Prerequisites: completion of one year each of college chemistry and college biology with passing grades. College courses in physics or mathematics may be substituted for two quarters of chemistry. Subject matter: control mechanisms, the cell and its environment, body fluids, circulation and respiration.
3 units, autumn, (Grant, Staff), MW 10; lab. W 1-4

101. Principles of Human Physiology—Prerequisites as for 100. Intended to follow 100 but students in physical therapy and psychology (also other students with consent of the instructor) may register without having completed 100. Subject matter: the neuromuscular system, autonomic nervous system, sensory system, central nervous system.
5 units, winter, (Grant, Staff), MWF 10; lab. MW 1-4

102. Principles of Human Physiology—Prerequisites as for 100. Intended to follow 100-101; students may register without this preparation only with consent of instructor. Subject matter: gastrointestinal physiology, metabolism and nutrition, temperature regulation, kidney function, endocrinology, reproduction.
4 units, spring, (Grant, Staff), MWF 9; lab. W 1-4

103. General Physiology—Applications of physical chemistry to basic physiological phenomena. Lectures on elementary thermodynamics and chemical kinetics, demonstrations and analysis of results by mathematical methods. Topics usually treated experimentally include colligative properties, pH, ion transport in relation to bioelectric phenomena and hemolysis, surface phenomena, blood coagulation, and muscular contraction. Prerequisites: one year of college chemistry or physics and Math 10 or equivalent. Open to all students, required of Physiology majors.
3 units, autumn, (Feigen), MWF 9, to be given in 1964-65

113. Physiology of Adaptation—Physiological responses of man to changes in environment and to activity. Prerequisite: 100, 101, 102 or equivalent.
3 units, autumn, (Staff), MWF 9, alternate years, to be given in 1964-65

167. Undergraduate Problems—Advanced exercises in Physiology. May be taken before completion of the 100-102 sequence with appropriate choice of problems.
Any quarter, (Staff), by arrangement

201. Colloquium in Physiology—Reports on current literature; presentation, discussion by graduate students and faculty. Required of all graduate students in physiology and recommended for undergraduate majors in physiology who have completed 100-102.
1 unit, autumn, winter or spring, (Staff), T 4

203. Isotopic Analyses in Physiology—Theory and application of isotopes to biophysical and metabolic problems in physiology. Lectures and lab. exercises.
3 units, spring, (Terres), Th 1-5 and by arrangement

207. Research—Advanced course for graduate students. Detailed study of particular topics in physiology, usually by original laboratory research planned for the individual by the appropriate staff member.
Any quarter, (Staff), by arrangement
PHYSIOLOGY

208. Medical Physics—Discussion of some basic physical principles applied to physiological problems, e.g., thermal transfer; transduction of energy in sense organs; hemodynamics; diffusion, osmosis and tissue clearance; bioelectric phenomena, etc. Minimum registration: 10 students.

2 units, winter, (Yates), W 4-6

ADVANCED COURSES FOR GRADUATE STUDENTS

301. Physiology of Water and Electrolytes—Metabolism of water and electrolytes especially in mammals. Detailed consideration of mechanisms of water and electrolyte economy and distribution.

2 units, autumn, (Aschheim), M 1-3, alternate years, to be given in 1964-65

332. Physiological Control Systems—Use of differential equations to describe performance of mechanical, thermal, electrical or biological systems. Solutions of equations by use of the Laplace transform.

2 units, winter, (Yates), Th 4-6

304. Immune Reactions—A laboratory course in quantitative chemical immunology and immunophsiology emphasizing basic immunological phenomena such as isolation and preparation of purified antigens and antibodies; quantitative analysis of specific precipitates; immunoelectrophoresis; immune hemolysis; isotopic labelling; identification of reactants by gel-diffusion; and the application of quantitative methods to tissue anaphylaxis. Prerequisites: Biology 105 or equivalent or consent of instructor. Limited to 15 students.

4 units, autumn, (Feigen, Terres), M 4; lab. Th 9-4, to be given in 1964-65

307. Current Problems in Neurophysiology—A seminar on recent research in neurophysiology, including neurochemical, neuropharmacological and biophysical aspects. Open to students qualified in any of these areas and also to qualified students in comparative and physiological psychology.

2 units, spring, (Grant), to be scheduled as a 2-hour session, one evening per week; alternate years, to be given in 1963-64

308. Special Topics—Topics to be chosen by minimum of eight students from subject matter within the areas listed below. The topic agreed upon by the students will be given as a seminar to be scheduled during the 4-5 hour Tuesday, Thursday or Friday, within the six- or twelve-week block of free time or on an evening. Ordinarily the topic selected will determine the staff member who conducts the seminar. Subject areas: Molecular Biology, including physiology of smooth, striated, and cardiac muscle and physiology of responses to antigens (Feigen or Terres); Electrophysiology, including the physiological basis of electrocardiography, electroencephalography, and peripheral nerve (Grant); Central Nervous System and Autonomic Nervous System (Grant); Temperature Regulation and Fever (Grant); Physiological Effects of Low Temperature, including hypothermia, and cold injury (Crismon); Kidney, Water, and Electrolyte (Crismon or Yates); Circulation: Hemodynamics and General Circulation (Yates); Peripheral Blood Flow (Crismon); Respiration (Van Liew); Isotopic Analysis in Physiology (Terres).

350. Neural Sciences—Taught conjointly with the Departments of Biology, Medicine (Neurology), Pharmacology, Psychiatry and Psychology. Anatomy 323 (Neuroanatomy) should be taken previously if possible but is not essential.

6 units, winter, (Grant), by arrangement
BIOPHYSICS LABORATORY

Acting Director: Marsden S. Blois, Jr.
Assistant Professors: Kendric C. Smith (Radiobiology), Mitchel Weissbluth (Radiologic Physics)
Research Associates: John E. Maling, Kurt Rosenheck, Roderic E. Steele, Ellen Weaver, Antoine Zahlan.

OFFERINGS AND FACILITIES

The Biophysics Laboratory offers instruction and research opportunities leading to the degree of Doctor of Philosophy in Biophysics. Through special arrangements, students from other University departments may perform their graduate research in the Biophysics Laboratory.

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, abiogenic molecular evolution, thermoluminescence, Mossbauer resonance, photosynthesis, mitochondrial electron transport and oxidative phosphorylations.

PROGRAMS 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 the minimum requirements are Physics 51, 52, 61, 100, 101, 110, 111, 120, 121, 122, 130, 131, 132, 172, 200, 201. Students with a comparable background will automatically satisfy this requirement; others will need to take only those courses in which deficiencies exist.

2. A minor in one field selected from biology, chemistry or physics. The requirements for the minor, as specified by the respective departments are as follows:
   - **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.
   - **Minors in chemistry** must complete, with a grade point average of 3.0 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, 271, 273, or 275.
   - **Minors in biology** must complete the departmental course requirements for the Ph.D. degree with a 3.0 average, or must pass the departmental qualifying examina-tion.

   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 3.0 or better:
   a) Physical chemistry (Chemistry 171, 173, 175)
   b) Biochemistry (Biochemistry 101, 102, 102a)
   c) Cell physiology (Biology 24) and Genetics (Biology 25)
   d) Biophysics 200, 210, 220, 230, 231, 232, 240, 245
   e) Four units of any other life science courses which include laboratory work.
4. After fulfilling requirements (1), (2) and (3) the student will normally be advanced to candidacy and will concentrate on his research. Upon substantial completion of his research, the student will take the departmental examination to be followed within a period of three months by the University oral examination.

5. Students must satisfy the University requirements for the Ph.D. degree (see Bulletin), including reading ability in one language selected from French, German or Russian.

6. The satisfactory completion of research and acceptance of the resulting dissertation conclude the requirements.

COURSES

200. Introductory Molecular Biophysics—Lectures, assigned readings, discussions and problems relating to the application of physical methods and viewpoints to the understanding of living systems. Classical considerations of molecular biology (structural and energetic aspects of living systems) and physical properties of biological materials. Prerequisites: familiarity with basic physics, one year each of general chemistry and biology.

2 units, autumn, (Blois), TTh 10

210. Cellular Biophysics—Physical and mathematical approaches to an understanding of the function and regulation of the cell and its component processes. Metabolic control systems in cells, application of chemical kinetics and absolute rate theory to cellular processes, application of theories developed for (mechanical) communication and control systems such as cybernetics, information theory, transfer function theory, etc. Prerequisites: Biophysics 200 or cell physiology and elementary chemical thermodynamics.

2 units, winter, (Burns), TTh 10

220. Energy Sources and Transformations—A lecture course covering the thermodynamics of energy and entropy transformations of living systems and including a detailed consideration of energy-rich compounds and their participation in the energy transformation processes of cell metabolism (glycolysis, oxidative phosphorylations, photosynthesis, etc.). Prerequisites: familiarity with basic physics and biochemistry.

3 units, spring, (Jacobs), by arrangement

230, 231, 232. Advanced Molecular Biophysics—Application of quantum mechanics to the properties and structure of biomolecules. Molecular orbital theory, energy bond calculations, mechanisms of energy and charge transfer, interaction with light, magnetic properties, and interpretation of magnetic resonance spectra. Prerequisite: Physics 132 (may be taken concurrently).

230. 2 units, spring, (Weissbluth), TTh 11
231. 2 units, autumn, (Weissbluth), TTh 11
232. 2 units, winter, (Weissbluth), TTh 11


3 units, autumn, (Pattee), MWF 1


1 unit, autumn, (Pattee), by arrangement

250. Molecular Photobiology—Lecture topics include photochemistry of mole-
cules of biological interest, effects of ultraviolet light on simple biological systems, photoreactivation, photodynamic action, etc.

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
The Stanford Computation Center was established in 1953 to provide high-speed automatic computing facilities for research work at the University. Its present mission is to provide University-wide service for both education and research. The facilities of the Computation Center are available to students in connection with any course, and are also available to members of the University staff in connection with their research work.

The Computation Center is mostly located in Pine Hall and Polya Hall in the Jordan Science Quadrangle, together with the Computer Science Division, but some equipment is located in the basement of the east wing of Encina Hall and in room 128b of the Graduate School of Business. The principal computing machine is now an IBM 7090/1401 Data Processing System, with 32,000 words of core storage and 14 magnetic tape transports, located in Pine Hall. A Burroughs 220 Electronic Data Processing System is located in Encina Hall. Later in 1963, a Burroughs B 5000 Information Processing System is expected to be added to the installation at Pine Hall. These machines supply abundant computing power for both the research and education needs of the University.

Most of Stanford’s computing programs are written in a dialect of ALGOL, the international standard algorithmic language, and the present machines can receive programs in that language. Programs in LISP, FORTRAN, IPL-V, and some other languages are also being run.

It is the desire and aim of the Computation Center to assist actual and potential users of the laboratory as much as possible. To this end the staff stands ready to describe what kinds of things can be done with modern data-processing equipment. The staff of the Computation Center maintains and operates the computer system, and furnishes descriptions of selected programs. It is nevertheless expected that students and staff will furnish their own programs to adapt the system to the solution of their own problems. With special arrangements for reimbursement, personnel of the Computation Center may assist with analysis and programming for Stanford research problems.

INSTRUCTION

1. Use of the Computation Center—Introduction to the computation facilities. Emphasis on major problem-oriented languages. This course is offered several times a year for those persons desirous of solving their own problems in 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:

**Use of Automatic Digital Computers**—See Computer Science 5 and 136.

**Introduction to Electronic Data Processing**—See Industrial Engineering 161 or Business 367.
FOOD RESEARCH INSTITUTE

Emeriti: Merrill Kelley Bennett, Joseph Stancliffe Davis (Directors), Holbrook Working, Vladimir P. Timoshenko (Professors)

Director: Karl Brandt
Administrative Associate Director: Charles L. Dickinson
Professors: Karl Brandt, Helen Cherington Farnsworth, Roger Winks Gray, Richard James Hammond, Bruce Foster Johnston, William Orville Jones, S. Daniel Neumark, E. Louise Peffer, Vernon D. Wickizer
Assistant Professor: Charles O. Meiburg
Research Associates: James O. Bray, Jacques J. Dumont, John A. Jamison, Philippe P. Leurquin, Klaus Poser, Arndt Uhlig
Associate Statistician: Rosamond H. Peirce

OFFERINGS AND FACILITIES

The Food Research Institute, founded in 1921, is concerned with problems of food supply, distribution, and consumption in their economic, social, and political aspects on a world-wide scale. The range of its investigations comprises world agriculture, international trade in primary products, rural development and economic growth, food-consumption levels, and marketing questions. Its research staff includes members trained in agricultural economics and agricultural policy, economics and economic history.

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. It has produced or sponsored over the years a large number of specialized books, as well as articles in professional journals.

PROGRAMS OF STUDY

As a joint product along with its research activities, the Institute offers a number of specialized courses of instruction, some of them unique in character. With one or two exceptions, these are addressed to graduate students. 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.

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. Such students may expect to fulfill the requirements for the Master’s degree within one year, and those for the Doctorate in a minimum of three years after having received an A.M. degree.

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.

Inquiries from seriously interested advanced students wishing to pursue research in the Institute's field are welcomed.

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 Office of Financial Awards, Stanford University.

COURSES

103. Economics of Food Consumption—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. (May be taken as 203 by graduate students.)
   5 units, autumn, (Johnston), MW 2-4

105. Commodity Futures Markets and Prices—See Food Research 205.

160. Tropical African Economies—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.
   3 units, winter, (Jones), MWF 11

170. Economic History of Agriculture in the United States—A survey of agricultural development in the United States from colonial times to the present, with special emphasis on factors contributing to increased productivity.
   3 units, winter, (Meiburg), MW 2-4

COURSES PRIMARILY FOR GRADUATE STUDENTS

203. Economics of Food Consumption—See Food Research 103.

205. Commodity Futures Markets and Prices—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. Other 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, winter, (Gray), MW 4-6

210. Agriculture in Tropical Economies—Tropical regions, resources, and potentialities; organization for crop production; products of tropical agriculture and their markets; problems of development.
   3 units, winter, (Wickiser), by arrangement

   3 units, spring, (Neumark), by arrangement

215. Readings in Problems of Tropical Agriculture—Enrollment limited to doctoral candidates in Food Research.
   3 units, winter, (Wickiser), by arrangement

232. Industrial Economics of Major Food, Feed, and Fiber Commodities—Economic survey of chemical, biological, and industrial interrelationships between major agricultural commodities and problems of production, transportation, storage,
processing, and utilization. Competition under the impact of chemistry. Price relationships. Trends in production and consumption. Five obligatory field trips to processing plants and commodity-marketing firms. Permission of the instructor required.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Instructor</th>
<th>Time</th>
<th>Units</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>Methods of Analyzing Commodity Problems</td>
<td>Brandt</td>
<td>TTh 4-6</td>
<td>5</td>
<td>Autumn</td>
</tr>
<tr>
<td>260</td>
<td>Seminar: Contemporary African Problems</td>
<td>Jones</td>
<td>T 4-6</td>
<td>3</td>
<td>Spring</td>
</tr>
<tr>
<td>261</td>
<td>Seminar: Economics of Tropical Agriculture</td>
<td>Jones</td>
<td>T 4-6</td>
<td>2</td>
<td>Winter</td>
</tr>
<tr>
<td>270</td>
<td>Seminar: United States Agricultural Development</td>
<td>Meiburg</td>
<td>MW 4-6</td>
<td>2</td>
<td>Winter</td>
</tr>
<tr>
<td>275</td>
<td>Land Economics in Developing Economies</td>
<td>Poser</td>
<td>MW 4-6</td>
<td>4</td>
<td>Spring</td>
</tr>
<tr>
<td>303</td>
<td>Seminar: Food Supply and Agriculture in Relation to Economic Growth</td>
<td>Johnston</td>
<td>T 4-6</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>305</td>
<td>Seminar: The Economic Theory of Futures Trading</td>
<td>Gray</td>
<td>T 4-6</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>350</td>
<td>Seminar: National and International Grain Problems and Policies</td>
<td>Staff</td>
<td>T 4-6</td>
<td>3</td>
<td>Winter</td>
</tr>
<tr>
<td>371, 372, 373, 374</td>
<td>Directed Reading and Research</td>
<td>Staff</td>
<td>T 4-6</td>
<td>2</td>
<td>Autumn, Winter, Spring, Summer</td>
</tr>
<tr>
<td>401, 402, 403, 404</td>
<td>Advanced Directed Reading and Research</td>
<td>Staff</td>
<td>T 4-6</td>
<td>2</td>
<td>Autumn, Winter, Spring, Summer</td>
</tr>
</tbody>
</table>
GRADUATE DIVISION SPECIAL PROGRAMS

Dean of the Graduate Division: Albert H. Bowker
Associate Deans: E. Howard Brooks, Robert M. Rosenzweig

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 programs are individually planned for unusually well-qualified students.

A graduate student with a well-considered program not now provided for in the existing departments or special programs of the University may 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.

COURSES FOR GRADUATE STUDENTS OF ALL DEPARTMENTS

As part of breadth of training at the graduate level, the following special courses are provided. There are no specific prerequisites for any of these courses:

287. Minerals in World Affairs—Mineral resources of the world; their political, economic effects.
   3 units, winter, (Park), MWF 9

305. Introduction to Contemporary American Life—For new students from abroad who wish to study contemporary American life in the light of historical developments. Readings on American history, and class discussions about selected aspects of contemporary American life. Primarily for new graduate students from abroad. Enrollment limited to 15. See instructor.
   2 units, autumn, (Warmbrunn), W 7-10 p.m.

308. Introduction to American Higher Education—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, planning for future.
   4 units, autumn, (Cowley), TTh 2-4
   or spring, (Cowley), MW 2-4

   2 units, winter, (LaPiere), M 4-6

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, autumn, spring, (Harman), MW 4-6*

See also the courses listed by the Hoover Institution. The Food Research Institute, the School of Law, and many departments offer non-prerequisite courses and seminars that are open to graduate students.

**COURSES FOR PH.D. CANDIDATES IN GRADUATE DIVISION SPECIAL PROGRAMS**

400. Research.

*By arrangement*


*By arrangement*

**COMMITTEE ON EAST ASIAN RESEARCH**

The Committee on East Asian Research is an interdepartmental body which has as one of its functions the advising of graduate students who have particular interests in the study of China or Japan. The usual graduate degree program is worked out by the student's departmental adviser. This Committee can assist such a student in planning a supporting program with a regional concentration in Eastern Asia. The Committee also stands ready to advise the exceptional student in the development of an interdepartmental program leading to the Ph.D. under Graduate Division Special Programs. The Committee sponsors a regular research seminar on East Asian Thought and Society.

Inquiries concerning Stanford's resources for the graduate study of China or Japan may be directed to the Chairman of the Committee on East Asian Research, c/o Graduate Overseas and Special Programs, Room 2P, Inner Quad, Stanford University, Stanford, California.
HOOVER INSTITUTION
on WAR, REVOLUTION, and PEACE

Emeriti: Harold H. Fisher (Chairman); Nina Almond (Librarian and Consultant in Research); Joseph S. Davis, Edgar E. Robinson, Graham H. Stuart (Councillors).

Director: W. Glenn Campbell
Assistant Director and Associate Professor: Witold S. Sworakowski
Executive Secretary: Peter Duignan
International Political Studies Program Director: Stefan T. Possony
Senior Staff Members: Milorad M. Drachkovitch, Roger A. Freeman
Assistant to the Director: Edith S. Fabinyi
Administrative Assistant: Winifred A. Teague
Head, Publications Department: Karol Maichel
Curators: Peter Duignan (African and Middle East Collections), Franz Lassner (Special Collections), Karol Maichel (Eastern European Collection), Agnes F. Peterson (Western European Collection), Eugene Wu (East Asian Collection)
Assistant Curators: Kenneth M. Glazier (Africa), Michel Nabti (Middle East)
Deputy Curator: Tamotsu Takase (East Asian Collection)
Honorary Curator: Richard W. Lyman (British Labor Collection)
Archivist, Herbert Hoover Archives: Rita R. Campbell
Librarian: Philip T. McLean
Assistant Librarian for Technical Services: Joseph Bingaman
Head, Catalog Department: Ina E. Nelson
Head, Reference Department: Arline B. Paul

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 founda-
tion upon which new knowledge is built. The Institution is, however, concerned with
dynamic rather than static research, that is, with studying problems where the find-
ings can make important contributions to national policy. Over the years 68 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 interna-
tional affairs, organizing and making them available for use, fostering their utiliza-
tion, 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, economic problems of
the area. Prerequisites: two background courses in modern European history or
international relations. Seniors and graduate students by permission.

5 units, autumn, (Sworakowski)

151. Historical Background to Modern Africa—With emphasis on the period
before 1900.

3 units, spring, (Duignan)

161. A Survey of the Strategy of Communist Revolutions—The operational
concepts of revolution and conquest in the writings of Marx, Engels, Kautsky and
Lenin. The techniques of 1905 and 1917. Concepts of revolution by early soviet stra-
tegists, e.g., Stalin, Trotsky, Tukhachevsky, Frunze. The Comintern concept. The
techniques of World War II. Soviet post-World War II strategy. Wars of libera-
tion. The impact of nucleonics and technology. Disarmament policy. Malinovsky and
Sokolovsky. The Khrushchev synthesis.

5 units, winter, (Possony)

299. Directed Reading and/or Special Research in Hoover Institution
Fields—Advanced individual work by arrangement.

Any quarter, (Staff or authorized faculty member)

See also Senior Colloquia.
# COMMITTEE ON HYDROLOGY

## 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>Geol.185</td>
<td>Hydro-geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol.186</td>
<td>Development of Groundwater</td>
<td>3</td>
</tr>
<tr>
<td>Stat.110</td>
<td>Statistical Methods in Engineering</td>
<td>4</td>
</tr>
<tr>
<td>Stat.116</td>
<td>Theory of Probability</td>
<td></td>
</tr>
</tbody>
</table>

In addition, the M.S. program will include 17 units of restricted electives from the following list and 6 units of free electives.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<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.230</td>
<td>Engineering Economy of Public Works and Public Utilities</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>2</td>
</tr>
<tr>
<td>C.E.272</td>
<td>Water Resources Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>C.E.273</td>
<td>Water Resources Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>Geol.116</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.361</td>
<td>Permafrost</td>
<td>2</td>
</tr>
<tr>
<td>Geol.70</td>
<td>Introduction to Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Biol.176</td>
<td>Limnology</td>
<td>4</td>
</tr>
<tr>
<td>C.S.136</td>
<td>Use of Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>Petroleum Engr. 150a, b. Formation Evaluation</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Mineral Engr. 220. Drilling and Blasting</td>
<td>2</td>
<td></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 exam specified by the Committee and have a grade point average in graduate work of at least 3.0. 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.
LIBRARIES

Emeriti: Elizabeth Hadden, William Owens, 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: Elmer M. Grieder
Associate Director: David C. Weber
Assistant to the Director: Fred John Priddle
Division Chiefs: Julius P. Barclay (Special Collections); Joseph A. Belloli (Humanities and Social Sciences); Wolfgang M. Freitag (Undergraduate Book Selection); Jennette E. Hitchcock (Catalog); Mary Elizabeth Hughes (Government Documents); Richard D. Johnson (Acquisition); Jack Plotkin (Circulation); Jack Pooler (Science)
Curator of the Frederick E. Brasch Collection on Sir Isaac Newton: Frederick E. Brasch
Honorary Curators: George T. Keating (Music Bibliography); Irving Whittemore Robbins, Jr. (Rare Books and Manuscripts); Elmer E. Robinson (American); Albert Sperisen (Typography)

Food Research Library:
Librarian:

Hoover Institution: See listing elsewhere in this catalog

Jackson Library of Business:
Director: Marion M. Smith
Reference Librarian: Michael Doerr; 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: John Henry Merryman
Acquisition Librarian: Howard W. Sugarman; Head Catalog Librarian: Rosalee Long; Reference Librarian: George Torzsay-Biber

Linear Accelerator Center Library:
Chief Librarian: George Owens

FACILITIES

All faculty, staff, and registered students of the University are entitled to use the University Libraries. Information is available in the booklet Your Library or in special leaflets about general borrowing regulations, book stack access, interlibrary loans, photocopies, microtext reading machines, the Listening Room, etc. Tours are given for the freshman students during autumn quarter through their Freshman English classes. Others 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. Spe-
cial 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 Insti-
tution on War, Revolution, and Peace; Law Library; Lane Medical Library; Jack-
son Library of Business; and Food Research Institute. 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 in-
formation. 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,
450,000 manuscripts, 95,000 sheet maps, 85,000 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 700,000 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.

**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 5:00 p.m. The Reserve Book Room is open Monday
through Friday from 8:00 a.m. to 11:00 p.m., Saturday from 8:00 a.m. to 5:00 p.m.,
and Sunday from 1:00 to 11:00 p.m. Hours of opening for other rooms and other
libraries on the campus are listed in *Your Library*. 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 Collec-
tion is located in a room adjacent to the Shainwald Room for the social sciences. The
Microtext and Newspaper Reading Room is in the basement.

- The Listening Room provides facilities for the study of foreign languages and
  contains recordings used in several of the introductory music courses. The Reserve
Book Room houses the books recommended and required for undergraduate courses.
  (The Western Civilization Library performs a similar function for the History of
  Western Civilization courses.)

- The Government Documents Library brings together most of the Library's col-
  lection of municipal, state, federal, foreign, and international documents. It is espe-
  cially strong in the publications of the United States, Great Britain, Canada, Aus-

- The Division of Special Collections, with the main reading room being 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 im-
  portant of these are: the Antoine Borel Collection, manuscript material on California
  political history; the Frederick E. Brasch Collection on Sir Isaac Newton, 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 Brit-
  ish and American literature of the nineteenth and twentieth centuries (published
  works, first editions, variant editions, bibliographies, criticisms, and biographical ma-
  terial of selected authors, supplemented where possible with manuscripts, proofs, let-
  ters, 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 Timo-
  shenko Collection on engineering mechanics; and the Typographical Collection, com-
posed of examples of fine modern 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 120,000 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: Briggs Memorial (English), Classics, Communication and Journalism, Hispanic American Studies, 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 five major groups of departmental libraries—biology, chemistry, engineering, geology, and physics-mathematics-statistics.

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 Division of 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 Electronics Research Laboratory Library, 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 Physics-Mathematics-Statistics Library is located in Room 301 of the Varian Physics Laboratory. Its branches are the Hansen Microwave Laboratory Library, specializing in microwave physics and engineering, and the Computer Science Library, Room 170, Polya Hall.

**BUSINESS**

The Jackson Library of Business, located in Room 135, Outer Quadrangle, is primarily a working laboratory available to students in the Graduate School of Business
in the daily preparation of their assigned work. Other graduate students may use the library upon identification, but undergraduate students are requested to contact the Director of the Jackson Library to make special arrangements for use of material from the collection. The library contains over 75,000 cataloged items and additional miscellaneous pamphlets and reports. It receives in excess of 1200 trade, financial, labor, and general business periodicals. In addition it subscribes to the leading labor, financial, marketing, and business research services. A branch library serves the International Center for Advanced Management Education.

FOOD RESEARCH INSTITUTE

The Food Research Institute Library, located in Room 35, Inner Quadrangle, has over 30,000 items intended primarily for the use of the staff of the Institute but also available to other qualified readers.

LAW

The Law School and Crothers Hall Law Libraries contain over 119,000 volumes. In addition to extensive holdings in Anglo-American law, there are important special collections of French, 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. In foreign law there are notable French, German and Indian collections.

The Law Libraries are primarily intended for use by students, faculty, and research staff of the Law School, although other faculty, attorneys, and visiting scholars are welcome. Students not enrolled in the Law School whose course work or research requires access to the Law Libraries should ask their professors to make appropriate arrangements with the Law Librarian.

MEDICINE

The Lane Medical Library, located at Room 100 in the Lane Building of the Medical Center, contains about 180,000 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, which have over 50,000 volumes.

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, autumn, winter, or spring, (Plotkin), T 11

See also Senior Colloquia.
OPERATIONS RESEARCH PROGRAM

Committee in Charge:

Chairman: Gerald J. Lieberman

Professors: Kenneth J. Arrow (Economics and Statistics), Samuel Karlin (Mathematics), Gerald J. Lieberman (Industrial Engineering and Statistics), Alan S. Manne, Daniel Teichroew (Graduate School of Business)

Associate Professors: James E. Howell (Graduate School of Business), Herbert E. Scarf (Statistics), Harvey M. Wagner (Graduate School of Business, Industrial Engineering and Statistics)

Affiliated Faculty: Hollis B. Chenery, Roy E. Murphy, Marc Nerlove, Hirofumi Uzawa (Economics and Statistics); John W. Fondahl (Civil Engineering); Norman M. Abramson, Gene F. Franklin, William K. Linvill, Bernard Widrow (Electrical Engineering); Fred Hillier, Arthur F. Veinott, Jr. (Industrial Engineering); Herman Chernoff, M. V. Johns, Jr., Herbert Solomon; Alex Bavelas, Charles P. Bonini, Henry B. Eyring, John Haldi, Robert K. Jaedicke, William F. Massy, Richard D. Young (Graduate School of Business)

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 Economics, Electrical Engineering, Industrial Engineering, Mathematics, and Statistics, and from the Graduate School of Business. There will be distinguished visitors appointed to the Committee.

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. Application for admission should be made directly to the Chairman of the Committee. 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

<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics 116. Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>Statistics 119. Elementary Statistical Inference</td>
<td>4</td>
</tr>
<tr>
<td>Statistics 120. Statistical Inference</td>
<td>4</td>
</tr>
<tr>
<td>Mathematics 45. Advanced Calculus I</td>
<td>3</td>
</tr>
<tr>
<td>Subject</td>
<td>Units</td>
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<tr>
<td>-------------------------------------------</td>
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</tr>
<tr>
<td>Mathematics 46. Advanced Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>Economics 106. Price Theory and Policy</td>
<td>5</td>
</tr>
<tr>
<td>Economics 109. Income and Employment</td>
<td>5</td>
</tr>
<tr>
<td>Accounting. Elementary Accounting</td>
<td>3-5</td>
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</tbody>
</table>

**Requirements**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 113. Industrial Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 255. Linear Programming</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 256. Inventory and Production Control</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 217a. Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Statistics 217b. Introduction to Stochastic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 114a. Linear Algebra and Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 114b. Linear Algebra and Matrix Theory</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 115. Fundamental Concepts of Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 116. Fundamental Concepts of Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Ind. Engineering 252. Operations Research</td>
<td>3</td>
</tr>
<tr>
<td>Either of the following two courses:</td>
<td></td>
</tr>
<tr>
<td>Ind. Engineering 257. Data Processing in Operations Research</td>
<td></td>
</tr>
<tr>
<td>Business 368. Seminar in Business Decision Theory</td>
<td>3</td>
</tr>
<tr>
<td>Two courses from the following five:</td>
<td></td>
</tr>
<tr>
<td>Business 366. Introduction to Electronic Data Processing</td>
<td></td>
</tr>
<tr>
<td>Ind. Engineering 161. Introduction to Data Processing</td>
<td></td>
</tr>
<tr>
<td>Mathematics 136. Use of Automatic Digital Computers</td>
<td>6</td>
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<tr>
<td>Mathematics 137. Numerical Analysis</td>
<td></td>
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<tr>
<td>Mathematics 138. Numerical Analysis</td>
<td></td>
</tr>
<tr>
<td>Electives in Operations Research</td>
<td>9</td>
</tr>
<tr>
<td>Integrated courses in one or more related subject fields</td>
<td>30</td>
</tr>
</tbody>
</table>

**Total Units of Requirements** 81

**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 fellowship should be made to the Office of Admissions by February 1. Applications for research assistantship should be made to the Chairman, Committee on Operations Research.
PHYSICAL EDUCATION

Emeriti: Ernst Brandsten, Allen Henry Elward, Henry W. Maloney, Alfred R. Masters, Edward M. Twiggs, Harry Meiggs Wolter (Directors); C. Myron Sprague (Associate Director); Ernest Paul Hunt (Associate Professor)

Executive Head and Director of Athletics: Charles A. Taylor
Directors: Howard Dallmar (Basketball), William Paul Fehring (Baseball and Football), Charles Finger (Golf), James Gaughran (Swimming and Water Polo), Payton Jordan (Track), Raymond E. Lunny, Jr. (Boxing and Weight Training), John Ralston (Football), Robert Renker (Tennis), Colonel A. Sysin (Equitation)
Assistant Directors: Carmen Jess Bova (Track), Robert Gambold (Football), Joseph Higgins (Aquatics), Peter Kmetovic (Rugby), Leon McLaughlin (Football), Rodney Rust (Football), William T. Turner (Basketball), William Walsh (Football), Frank Williams (Football), Ray J. Young (Basketball)
Associate Professors: John E. Nixon, Wesley K. Ruff
Assistant Professor: Elwyn Bugge

OFFERINGS AND FACILITIES

Athletics

Stanford University is a member of the National Collegiate Athletic Association, and as such competes with other major universities and colleges in most generally recognized collegiate sports. It is also a member of the United States Golf Association, the Pacific Association of the Amateur Athletic Union, the Northern California Rugby Union, the Northern California Intercollegiate Soccer Association, the Western Intercollegiate Fencing Conference, the Northern California Tennis Association, the Northern California Golf Association, the California Intercollegiate Baseball Association, the Pacific Coast Intercollegiate Wrestling Association, and the Pacific Coast Intercollegiate Boxing Association. 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 running. University teams also complete on a scheduled basis in crew, skiing, volleyball, and rifleshotting. Policy governing the University's participation in intercollegiate athletics is determined by the Stanford Athletic Board, composed of students, administration, and alumni members, and by the faculty committee on athletics.

Physical Education

Activity courses for men, the men's intramural sports program, and intercollegiate competition for men are administered by the Department of Athletics and Physical Education. The intramural program for men includes seven-man touch football, two-man volleyball, six-man volleyball, bowling, table tennis, horseshoes, handball, wrestling, basketball, softball, tennis, swimming, boxing, gymnastics, and track and field. Instruction is given by the Department in swimming, diving, golf, tennis, equitation, boxing, wrestling, basketball, baseball, gymnastics, weight lifting, track and field, bowling, water polo, conditioning, crew, soccer, rugby football, rifle marksmanship, officiating methods for various sports, and several courses in physical education theory.
Women's activities are conducted by the Department of Physical Education for Women. Activity courses, such as equitation, folk and square dancing, riflery, ski conditioning, and archery are offered coeducationally.

**Major in Physical Education**

A major is offered in the School of Education with a concentration in Physical Education for Men (see School of Education section) leading to

a) the bachelor of arts degree,
b) the secondary teaching credential,
c) advanced degrees in education.

**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. It was opened in 1921.

*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 laid out in the larger area from which was taken the fill for the Stadium embankments. Its bleachers seat 3,000.

*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 the freshman baseball diamond.

Three varsity tennis courts, hard-surfaced, with stands for spectators, and practice tennis courts.

*Encina Gymnasium*, including a basketball floor, three bleacher-flanked swimming pools, offices, rooms for gymnastics, fencing, and other indoor sports, and an athletics goods store.

*The Pavilion*, 2,700-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.

**UNIVERSITY PHYSICAL EDUCATION REQUIREMENT**

Students except veterans are required to participate in organized activities, to a total value of 6 noncredit units, no more than 2 of such units to be taken in any one quarter. During the freshman and sophomore years at least 2 units of the requirement, 1 each year, must be devoted to a physical activity, including varsity teams, 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 organized group activities such as chorus, band, choir, orchestra, and dramatic productions. A student may participate in two physical education courses during one quarter and receive credit for both. No student may receive more than 12 units of credit for activity courses in Physical Education nor enroll in more than two in any one quarter. Enrollment in ROTC will be accepted, quarter for quarter, in satisfaction of all or part of this requirement.
PHYSICAL EDUCATION

COURSES

2. Modified Programs—Health-habit programs adapted to fit special needs of individual students for whom usual class activities are not suitable. Admission on recommendation of Director of Physical Education and Athletics.

1 unit, autumn, winter, spring, (Masters and Staff), three periods a week


1 unit, autumn, winter, spring, (Turner), MWF 10, 11, 1:15

11a. Basketball, Freshmen.

1 unit, autumn, winter, (Turner), MTWThF 2:15


1 unit, autumn, winter, spring, (Lunny), MWF 10, 2:15, 3:15

14a. Football, Freshmen.

1 unit, autumn, (———), MTWThF 4:15


1 unit, autumn, winter, spring, summer, (Finger), MF or TTh 11 or 1:15, and 9 holes additional

15a. Golf, Freshmen.

1 unit, autumn, winter, spring, (Finger), MTWThF 3:15-5:30


1 unit, autumn, winter, spring, (Ruff), MWF 3:15

17. Volleyball.

1 unit, autumn, winter, spring, (Staff), MWF 11, 1:15


1 unit, autumn, winter, spring, (Staff), MW or TTh 10, 11, 2:15; spring, (Staff)


1 unit, autumn, winter, spring, (Staff), TTh and by arrangement 11; and spring, (Higgins), TTh and by arrangement 2:15

20a. Swimming, Freshmen.

1 unit, autumn, winter, spring, (Gaughran), MTWThF 4:15

21. Tennis, Elementary.

1 unit, autumn, winter, spring, (Bugge, Higgins, Staff), MWF 10, 11, 1:15, 2:15, 3:15, 4:15; TTh and by arrangement 11, 1:15, 2:15, 3:15, 4:15; and summer, (Staff), MWF, TTh and by arrangement 2:15

21a. Tennis, Freshmen.

1 unit, autumn, winter, spring, (Renker), MTWThF 3:15-5:00

22. Track, Elementary.

1 unit, autumn, winter, spring, (Bova), MWF or TTh and by arrangement 10

23. Wrestling, Elementary.

1 unit, autumn, winter (Staff), MWF 3:15

24. Diving, Elementary.

1 unit, autumn, winter, spring, (Higgins), MTTh 3:15; and summer (Higgins), MWF 11

27. Crew, Elementary.

1 unit, autumn, winter, spring, (Staff), MTWThF 4:15; S 9

29. Water Polo.

1 unit, autumn, spring, (Higgins), TTh 2:15

30a. Baseball, Freshmen.

1 unit, autumn, winter, spring, (Young), MTWThF 3:15-5:30

41. Physical Conditioning.

1 unit, winter and spring, (Staff), MWF 4:15

111a. Basketball, Varsity.

1 unit, autumn, winter, (Dallmar), MTWThF 4:15-6:00

112. Boxing, Advanced.

1 unit, autumn, winter, spring, (Lunny), MTTh 4:15

114a. Football, Varsity.

1 unit, autumn, (Ralston), MTWThF 3:15-5:30
115. Golf, Advanced.
   1 unit, autumn, winter, spring, (Finger), MTWThF and by arrangement

   1 unit, autumn, winter, spring, (Finger), MTWThF 3:15-5:30

   1 unit, autumn, winter, spring, (Ruff), MWF 4:15

118. Life Saving.

   1 unit, autumn, winter, spring, (Higgins), MWF 2:15

120. Swimming, Advanced.

120a. Swimming, Varsity.
   1 unit, autumn and winter, (Gaughran), MTWThF 4:15

121. Tennis, Advanced.
   1 unit, autumn, winter, spring, (Staff), MWF 2:15, 3:15, 4:15; TTh 3:15

121a. Tennis, Varsity.
   1 unit, autumn, winter, spring, (Renker), MTWThF 3:15

122a. Track, Varsity.
   1 unit, autumn, winter, spring, (Jordan), MTWThF 3:15

123. Wrestling, Advanced.
   1 unit, autumn, winter, (Staff), MTTh 4:15

123a. Wrestling, Varsity.
   1 unit, autumn, winter, (Staff), MTWThF 4-6

124. Diving, Advanced.
   1 unit, autumn, (Staff), TTh and by arrangement 2:15; winter (Staff), MTTh
   2:15; and summer, (Staff), MWF 1:15

124a. Diving, Varsity.
   1 unit, autumn, winter, (Gaughran), MTWThF 4:15

127. Crew, Varsity.
   1 unit, autumn, winter, spring, (Staff), MTWThF 4:15; S 10

129a. Water Polo.
   1 unit, autumn, spring, (Gaughran), MTWThF 4:15

130. Baseball, Junior Varsity.
   1 unit, spring, (Turner), MTWThF 3:15-5:00

130a. Baseball, Varsity.
   1 unit, autumn, winter, spring, (Fehring and Young), MTWThF 3:15-5:00

139. Soccer.
   1 unit, autumn, winter, spring, (Priddle), MWF 4:15

139a. Soccer, Advanced.
   1 unit, autumn, winter, spring, (Priddle), MWF 4:15

   1 unit, winter, (Kmetovic), MTWThS 4:15

Co51. Rifle and Pistol Marksmanship—Open to all undergraduate students.
   1 unit, autumn, winter, spring, MTWThF by arrangement

153. Weight Training.
   1 unit, autumn, winter, spring, (Ruff, Staff), MWF 11, 1:15, 2:15, 3:15, 4:15

192, 193, 194. Techniques of Athletic Management.
   1 unit, autumn, winter, spring, (Masters and Staff), by arrangement

Co-educational 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: Miriam B. Lidster, Marian S. Ruch, Pamela L. Strathairn
Instructors: Carroll Gordon, Inga Weiss-Lepnis, Adele Wenig, Georgia Williams
Assistant Director of Riding School: Margaret Sysin

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 co-educational 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 are offered in ballet, figure skating, folk and square dancing, modern dance, synchronized swimming, and trail rides.

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 and the National Joint Committee on Extramural Sports for College Women.
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 "Co" and "W" courses listed below may be used to fulfill the remaining 4 of the Group Activity requirements.

1) No more than 2 noncredit 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 to fulfill either the physical activity or Group Activity requirements of the General Studies Program or may be taken for 1 unit of credit for each course.

CO-EDUCATION CLASSES

Courses are open to both men and women students. Normally these courses are given every quarter. See the Time Schedule for preregistration and registration procedures.

Co40. Archery, Elementary.
          autumn, spring, (———)
          autumn, spring, (———)
          autumn, winter, spring, (Staff)
Co49. Horsemanship I.
          autumn, (Sysin), alternate years, to be offered in 1963–64
          autumn, winter, spring, (Weiss-Lepnis)
Co63. Ballet, Elementary.
          autumn, winter, spring, (Weiss-Lepnis)
Co64. Ballet, Intermediate.
          autumn, winter, (Weiss-Lepnis)
Co68. Social Dance, Elementary.
   autumn, winter, spring, (Lidster, Wenig)

Co69. Social Dance, Intermediate.
   autumn, winter, spring, (Lidster, Wenig)

Co70. Ethnic Dance, Elementary.
   winter, (Lidster)

   spring, (Lidster)

Co72. Folk Dance, Elementary.
   autumn, winter, spring, (Lidster)

Co73. Folk Dance, Intermediate.
   autumn, winter, spring, (Lidster)

Co74. Square Dance, Elementary.
   winter, (Lidster)

Co75. Square Dance, Intermediate.
   spring, (Lidster)

Col40. Archery, Advanced.
   autumn, spring, (——)

Col42. Bowling, Advanced.
   autumn, winter, spring, (Staff)

Col48. Equitation, Elementary—English and Western.
   Equitation, Intermediate—English and Western.
   Advanced—English.
   Jumping.
   autumn, winter, spring, (Sysin)

Co149. Horsemanship II.
   autumn, (Sysin), alternate years, to be given in 1964–65

Col51. Rifle and Pistol Marksmanship—Enroll in Physical Education for Men

Col51.

Co161. Modern Dance, Advanced.
   autumn, winter, spring, (Weiss-Lepnis, Wenig)

   spring, (Weiss-Lepnis)

Co165. Improvisation and Fundamentals of Composition.
   autumn, winter, spring, (Weiss-Lepnis)

Co166a. Choreography and Dance Forms.
   autumn, winter, spring, (Weiss-Lepnis)

166b. Choreography and Dance Forms.
   autumn, winter, spring, (Weiss-Lepnis)

Co167a. Choreography and Production.
   winter, spring, (Weiss-Lepnis)

Co167b. Choreography and Production.
   winter, spring, (Weiss-Lepnis)

Co167c. Choreography and Production.
   winter, spring, (Weiss-Lepnis)

Co167d. Choreography and Production.
   winter, spring, (Weiss-Lepnis)

Co168. Social Dance, Advanced.
   autumn, winter, spring, (Lidster, Wenig)

Co172. Folk Dance, Advanced.
   autumn, winter, spring, (Lidster)

Co177. Historic Dance: Primitive and Ancient.
   autumn, (Lidster, Weiss-Lepnis, Wenig)

Co178. Historic Dance: Court Forms.
   winter, (Lidster, Weiss-Lepnis, Wenig)
Co179. Contemporary Dance.  
   spring, (Lidster, Weiss-Lepnis, Wenig)

Courses for Women Students

The following courses are open to women students only. Normally these courses are given every quarter unless otherwise indicated. See the Time Schedule for pre-registration and registration procedures.

W1. Posture  
   autumn, winter, spring, (Ruch)

W2. Conditioning.  
   autumn, winter, spring, (Staff)

   autumn, winter, spring, (———)

   autumn, winter, spring, (———)

W5. Tumbling Gymnastics.  
   spring, (———)

   spring, (Strathairn)

   autumn, winter, spring, (Williams)

   autumn, winter, spring, (Williams)

   autumn, winter, (———)

   autumn, winter, (———)

W14. Tennis, Beginning.  
   autumn, spring, (Strathairn, Williams)

W15. Tennis, Elementary.  
   autumn, winter, spring, (Strathairn, Williams)

   autumn, winter, spring, (Strathairn, Williams)

   winter, (Strathairn)

W23. Field Hockey, Elementary.  
   autumn, spring, (———)

   autumn, spring, (———)

W25. Softball.  
   spring, (Strathairn, Williams)

W27. Volleyball.  
   autumn, winter, spring, (Staff)

W30. Swimming, Beginning.  
   autumn, spring, (Staff)

   autumn, spring, (Staff)

   autumn, spring, (Staff)

W33. Diving, Elementary.  
   spring, (Strathairn)

W34. Diving, Intermediate.  
   autumn, spring, (Strathairn)

W35. Lifesaving and Water Safety, A.R.C.  
   winter, spring, (Strathairn)
   autumn, spring, (Ruch)
   autumn, spring, (Ruch)
Archery, Elementary—(See Co40)
Archery, Intermediate—(See Co41)
W42. Bowling, Elementary.
   autumn, winter, spring, (Staff)
   autumn, winter, spring, (Staff)
W44. Golf, Elementary.
   autumn, winter, spring, (Gordon)
   autumn, winter, spring, (Gordon)
Horsemanship I—(See Co49)
W61. Modern Dance, Elementary.
   autumn, winter, spring, (Wenig)
Modern Dance, Intermediate—(See Co62)
Ballet, Elementary—(See Co63)
Ballet, Intermediate—(See Co64)
Social Dance, Elementary—(See Co68)
Social Dance, Intermediate—(See Co69)
Ethnic Dance, Elementary—(See Co70)
Ethnic Dance, Intermediate—(See Co71)
Folk Dance, Elementary—(See Co72)
Folk Dance, Intermediate—(See Co73)
Square Dance, Elementary—(See Co74)
Square Dance, Intermediate—(See Co75)
W110. Badminton, Advanced.
   winter, spring, (Williams)
W112. Fencing, Advanced.
   autumn, winter, spring, (Bugge)
W113. Fencing, Tournament.
   spring, (———)
W114. Tennis, Advanced.
   autumn, winter, spring, (Guthrie, Strathairn, Williams)
W115. Tennis, Tournament.
   autumn, winter, spring, (Guthrie)
W120. Basketball, Advanced.
   winter, (Strathairn)
W121. Basketball, Tournament.
   winter, spring, (Strathairn)
W123. Field Hockey, Tournament.
   autumn, (———)
W125. Softball, Tournament.
   spring, (Strathairn, Williams)
W127. Volleyball, Tournament.
   autumn, winter, (Staff)
W130. Swimming, Advanced.
   autumn, spring, (Ruch, Strathairn)
W131. Swimming, Competitive.
   autumn, spring, (Strathairn)
W132. General Aquatics.
   summer, (Staff)
W133. Diving, Advanced.
   autumn, spring, (Strathairn)
W134. Diving, Competitive.
    autumn, spring, (Strathairn)

    autumn, spring, (Ruch)

Archery, Advanced—(See Co140)

W142. Bowling, Advanced—(See Co142)
    autumn, winter, spring, (Staff)

W143. Bowling, Tournament.
    autumn, winter, spring, (Staff)

W144. Golf, Advanced.
    autumn, winter, spring, (Gordon)

W145. Golf, Tournament.
    autumn, winter, spring, (Gordon)

Equitation—(See Co148)

Horsemanship II—(See Co149)

Modern Dance, Advanced—(See Co161)

Ballet, Advanced—(See Co163)

Choreography—(See Co165, Co166a, Co166b, Co167a, 167b, 167c and 167d)

Social Dance, Advanced—(See Co168)

Ethnic Dance, Advanced—(See Co170)

Folk Dance, Advanced—(See Co172)

Square Dance, Advanced—(See Co174)

Historic Dance—(See Co177, Co178, and Co179)

COURSES OF RECREATIONAL OR AVOCATIONAL VALUE

The following nonphysical activity “Co” and “W” courses may be taken to fulfill Group Activity requirements, with the exception of the freshman and sophomore physical activity requirement, or may be taken for 1 unit of credit for each course. “Co” courses are open to both men and women; “W” courses are open to women only. Normally these courses are given every quarter unless otherwise indicated. See the Time Schedule for preregistration and registration procedures.

Co116. Tennis Officiating.
    spring, (Guthrie)

W122. Basketball Officiating.
    winter, (Strathairn)

W124. Field Hockey Officiating.
    autumn, ( )

W135. Water Safety Instructor’s Course, A.R.C.
    spring, (Strathairn)

Co138. Aquatics Officiating.
    autumn, spring, (Strathairn)

Co180. Aquatic Leadership.
    spring, (Strathairn)

Co181. Golf Tournament Organization.
    winter, spring, (Gordon)

Co182. Tennis Tournament Organization.
    winter, spring, (Guthrie, Williams)

Co185. Social Recreation for Youth and Young Adults.
    autumn, (Lidster, Wenig)

    winter, (Guthrie)

Co187. Recreational and Organized Camping.
    spring, ( )
SENIOR COLLOQUIA

Committee on General Studies: Robert A. Walker (Chairman), Friedrich W. Strothmann (Vice Chairman), Gordon A. Craig, Sanford Dornbusch, Joseph M. Pettit, Robert R. Sears, 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 Humanities Honors programs. 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.

The reading lists and additional listings can be found in the current General Studies Program Bulletin.

#SC2. American City Planning: Historical Background—The Colloquium will undertake an analysis of the role of aesthetic values found in literature, art, and other sources in forming American attitudes toward the city and city planning. Such topics as the influence of Paris on our planning, Thomas Jefferson’s attitude toward the city and the city as seen by William Dean Howells in his novels will be explored. General reading will be done in such works as Christopher Tunnard and Henry Reed, American Skyline, and Lewis Mumford, The Culture of Cities.
2 units, spring, (McLaughlin, History), Th 7-9 p.m.

2 units, winter, (H. Brooks, General Studies), M 7:45-9:30 p.m.

#SC7. Canada, Nation or State?
2 units, spring, (Allyn, Graduate School of Business), M 4-6

2 units, autumn, (Rogow, Political Science), M 4-6

2 units, summer, (Schmidt, Music), W 2-4

#SC12. Shakespeare.
2 units, spring, (Rebholz, English), T 2-4

#SC13. Tax Reform and Expenditure Policy.
2 units, autumn, (Freeman, Hoover Institution), T 4-6

2 units, spring (Feldman, Medical School), T 4-6

2 units, winter, (Cole, Speech and Drama), T 2-4

#SC16. The Thought of Reinhold Niebuhr—Through an examination of certain of Niebuhr’s writings, an attempt will be made to indicate the relationship of love and justice, theology and politics.
2 units, spring, (Brown, Religion), Th 8-10

2 units, autumn, (McCluney, Modern European Languages), T 2-4
  2 units, winter, (Minott, History), F 2-4

  2 units, autumn, (Jones, Food Research), T 4-6

  2 units, spring, (J. A. Tirrell, Assistant Chaplain of the University), M 7:45-9:30 p.m.

#SC22. The Bernard De Voto Papers: Manuscript Sources as an Aid to Research.
  2 units, winter, (J. Barclay, Library), T 4-6

  2 units, winter, (Singer, Psychology), T 2-4

#SC25. Deterrence and International Conflict.
  2 units, winter, (O. Holsti, Political Science), T 4:15-6:05

#SC26. The Doctor's Dilemma—Discussion of a number of para-medical topics such as: cost and distribution of medical care, socialized medicine, the doctor-patient relationship, religion and health, euthanasia and eugenics, certain physicians of history and fiction, and doctor and patient in other times. Individual students will be responsible for leading the discussion on assigned evenings.
  2 units, autumn, (Creger, Medical School), Th 7:30-9:30 p.m.

  2 units, winter, (Blumenthal, Political Science), Th 2-4

#SC30. Nationalism in America, 1865 to the Present.
  2 units, autumn, (Minott, History), F 2-4

#SC33. Concepts of History and Fiction.
  2 units, spring, (Bark, History), W 2-4

#SC35. Theories of War.
  2 units, spring, (O. Holsti, Political Science), T 4:15-6:05

  2 units, spring, (Wolfinger, Political Science), T 2-4

#SC37. Artist, Architect, and Engineer—An introduction to the problems of architectural acoustics and organ design. Field trips to local examples. No technical knowledge necessary.
  2 units, winter, (Hyde, Modern European Languages), T 7-9 p.m.

#SC40. Landscape Architecture—Function and art in environmental design.
  2 units, spring, (Rolfs, Planning Office), W 7-9 p.m.

#SC43. History of Militarism in the West, 1789 to the Present.
  2 units, summer, (Minott, History), F 2-4

#SC46. The Place of Aircraft, Missiles, and Spacecraft in 20th Century Civilization—The topics to be discussed will include the history of human flight; some technical information on air flow, structural design, as well as engines and rockets; the air history of the two world wars; the impact of aviation on military strategy and warfare; the economics and the organization of air transportation; the effect of increased scientific knowledge resulting from aeronautical research in the fields of air flow, combustion, and light construction on technology; and some speculation on space travel and its effects on humanity.
  2 units, winter, (Hoff, Aeronautics and Astronautics), Th 2-4

#SC50. American Foreign Policy: The Public and Congress.
  2 units, autumn, (Brody, Political Science), T 2-4

#SC52. History of Militarism in the West, 1789 to the Present.
  2 units, summer, (Minott, History), F 2-4

#SC57. The Relation of Morals to Politics.
  2 units, winter, (Shapiro, Political Science), Th 4-6
#SC60. The Literature and History of the Organ.
2 units, winter, (Nanney, Music), W 2-4

#SC63. Faith and Freedom: The Thought of Rudolf Bultmann—The Colloquium will use Bultmann's *Essays Philosophical and Theological* discussing his interpretation of Christian faith, its root in historical understanding, and its relevance to men in the contemporary world.
2 units, spring, (Forstman, Religion), T 8-10 p.m.

2 units, summer, (Reinhardt, Modern European Languages), W 4-6

#SC68. Organization Man—Investigation into the psychological problems of adjustment associated with modern society and large business organizations.
2 units, winter, (Romney, Anthropology), W 2-4

#SC69. Critics of Society and Polity—An examination of the recent American literature of criticism which derives from social science. Readings from Mills, Galbraith, Goodman, Swados, Packard, and others.
2 units, winter, (Fagen, Political Science), M 2-4

#SC71. Plants and Their Relation to History—The Colloquium will explore the importance of plants in relation to the course of human history.
2 units, spring, (Thomas, Biological Sciences), Th 2-4

#SC74. Sex Roles in American Culture.
2 units, winter, (Stolz, Psychology), T 2-4

#SC75. Masterpieces of Choral Literature.
2 units, autumn, (Schmidt, Music), Th 2-4

#SC76. The Mind-Body Problem in Medical Thought—A study of ideas on the psychological causation of somatic disease in Greco-Roman, seventeenth and eighteenth century and modern times.
2 units, spring, (Rather, Pathology), Th 2-4

#SC78. The End of All Things—Discussion of various theories of the goal and end of history or what is technically known as Eschatology. Special attention will be given to classical, Christian, liberal, reactionary, and Marxist theories and to the "end of the world" problem at the present time.
2 units, spring, (Otis, Classics), T 8-10 p.m.

#SC79. Leisure in Modern Life.
2 units, winter, (Guthrie, Physical Education), Th 4-6

#SC81. Arms and the American State—Problems of militarism, defense policies and civilian control of the military establishment.
2 units, spring, (Minott, History), F 2-4

#SC82. Dance in Patterns of Culture.
2 units, autumn, (Lidster, Physical Education), W 2-4

#SC85. The History of the Book.
2 units, spring, (Lenkey, Library), T 4-6

#SC87. The Transmission of Recorded Information.
2 units, spring, (Weber, Library), Th 4-6

#SC90. Current Controversies Over American Education—The particular issues to be taken up will depend on the most recent literature of criticism and the special interests of the students. Each controversy considered will be reduced to questions of empirical fact and to questions of viewpoint or philosophic assumptions. In addition to reading, some opportunity may be given, where appropriate, for interviewing professional educators and observing relevant activities in the public schools.
2 units, spring, (L. G. Thomas, Education), W 4-6

#SC91. Food and Hunger in Asia and Latin America.
2 units, spring, (H. Farnsworth, Food Research), W 2-4

#SC92. Bach and Bartok.
2 units, spring, (Salgo, Music), M 2-4

#SC93. The Tragic Sense of Life in Unamuno.
2 units, autumn, (Schevill, Modern European Languages), W 4-6
#SC94. **Post-War Italian Society**—The traditional and new trends of thought of the Italian people in the light of the experiences following the Second World War, as portrayed in literature and in the popular forms of art.

2 units, spring, (Traversa, French and Italian), Th 4–6

#SC97. **Tradition and Social Change: The Case of Japan**—Social change in urban and rural Japan as shown in community studies and as reflected in biographies and novels to be read in translation; an examination of attitudes to social change and of their political significance.

2 units, winter, (Steiner, Political Science), T 4–6

#SC98. **Asia and the West**—An analysis of the interaction of Asian and Western cultures, especially in the 19th and 20th centuries.

2 units, autumn, (Ike, Political Science), Th 2–4

#SC99. **Ceremony and Symbol in Religion and Society**—A discussion of the place of ceremonies, rites, and forms in religious and social life. The renewed interest in religious symbolism will be considered along with an attempt to understand accepted forms and usage in society.

2 units, winter, (R. M. Minto, Chaplain of the University), Th 2–4

#SC100. **Theory of Literature**—Discussion of both extrinsic and intrinsic approaches to literature as demonstrated by René Wellek and Austin Warren.

2 units, winter, (Lohnes, Modern European Languages), Th 7–9 p.m.

#SC101. **Problems and Politics of Southeast Asia.**

2 units, autumn, (Sokol, Political Science), T 4–6

#SC102. **The Outsider in Literature** — The outsider's problem, his attitude toward and treatment by society.

2 units, winter, (Weinstein, French and Italian), T 2–4

#SC103. **The Nihilist Trend in Russian Ideology of the 1860's.**

2 units, winter, (Posin, Modern European Languages), T 4–6

#SC104. **Man as a Factor in Evolution.**

2 units, winter, (Crothers, Psychology), T 2–4

#SC105. **Modern Behavior Theories.**

2 units, spring, (Goheen, Philosophy), T 2–4

#SC106. **The Greek Historian Thucydides**—A reading of Thucydides' *History* (in English translation) with discussion of the major issues which it raises.

2 units, autumn, (Pearson, Classics), Th 4–6

#SC107. **Marxist Ethics**—Ethical implications of current Soviet and Chinese theory as well as of classical Marxism.

2 units, winter, (Nivison, Philosophy), Th 2–4

#SC108. **Contemporary Philosophical Ideas**—A study of a selected group of contemporary philosophers.

2 units, winter, (Goheen, Philosophy), T 2–4

#SC109. **Modern Islam and Islamic Nationalism.**

2 units, spring, (C. Harris, Political Science), W 2–4

#SC110. **Characterization, Self-Revelation, and Disguise in Biographical Writing**—A study of the various forms of biographical writing (diaries and journals, autobiographies, biographies, letters), particularly those of the Restoration and Eighteenth Century, and their effectiveness in creating and revealing character and personality.

2 units, autumn, (Fifer, English), T 2–4

#SC111. **William Faulkner: A Close Reading of Five Novels and Several Short Stories.**

2 units, autumn, (Moser, English), W 4–6

#SC112. **Voltaire and Johnson: Contrasting Spokesmen for the Enlightenment**—Voltaire and Johnson occupy positions in the literary histories of their nations that are in many respects similar: they were, in their separate ways, the wisest and most articulate literary spokesmen respectively for the French and English Enlightenment. Alike in clarity and boldness of thought, if profoundly different in personality and in religious convictions, they were attracted to similar problems—the most
important problems which men faced in the 18th century. This Colloquium will examine their parallel statements on religious, social, and literary issues. Students will be expected to write an essay in which they review a subject treated by both Voltaire and Johnson.

2 units, winter, (Loftis, English), W 2-4

#SC127. Bernard Shaw—A brief survey of Shaw's life and ideas; a discussion of ten principal Shaw plays.

2 units, spring, (Irvine, English), W 2-4

#SC130. Studies in Russian Revolt—Analysis of revolts occurring at various periods in Russian history. Each episode will be carefully examined as to its origins, general nature, aspiring goals, failures, and causes of failure.

2 units, winter, (Masour, History), M 2-4

#SC135. Political Socialization.

2 units, spring, (Haber, Sociology), F 2-4

#SC138. Frank Lloyd Wright—Philosophy, writings, and design of this pioneer of modern architecture. Readings from Greenough, Whitman and Sullivan.

2 units, spring, (V. Thompson, Architecture), Th 7-9 p.m.

#SC139. Modern French Painting—The aims and achievements of the major painters of the past one hundred years will be critically considered with emphasis on the ways in which different painters faced the problems of expression, communication, and composition. Among the painters to be discussed are Manet, Monet, Renoir, Seurat, Cézanne, Gauguin, van Gogh, Matisse, and Picasso.

2 units, autumn and winter, (Faulkner, Art), Th 1-3

#SC141. Foreign Policies of the Soviet Union.

2 units, autumn, (Fisher, History), W 4-6

#SC142. Communism and the American Response.

2 units, spring, (Fisher, History), W 4-6

#SC143. Soviet-American Relations.

2 units, winter, (Fisher, History), W 4-6

#SC146. Mystics and Mysticism.

2 units, spring, (Watkins, Political Science), T 2-4

#SC148. Great Biographies—A study of the nature, methods, and content of biography from ancient times to the present. The work of such biographers as Plutarch, Suetonius, Aubrey, Boswell, Dr. Johnson, Lytton Strachey, and D. S. Freeman will be read and analyzed. The text will be John A. Garraty: The Nature of Biography.

2 units, winter, (J. C. Miller, History), W 2-4

#SC149. Beverage Alcohol and Society—An exploration of the role of alcoholic beverage consumption in society, American and non-American, present and historical. Attention will be given to effects, patterns of drinking, religious attitudes, and alcoholism as a disease; over-all attempt will be to determine the fundamental nature of the issue.

2 units, winter, (Russell, Health Education), T 2-4

#SC150. Creativity—Discussion of what creativity is for artist, thinker, scientist and (especially) the Colloquium members. Reading, participation in discussion (frequently with specific preparation), and a Colloquium essay are required.

2 units, autumn, (Tuttle, Electrical Engineering), W 2-4

#SC151. As Others See Us.

2 units, spring, (Warmbrunn, General Studies), Th 7:30-9:30 p.m.

#SC152. Contemporary Social Philosophy.

2 units, winter, (McCord, Sociology), W 2-4

#SC153. Freedom of Speech—Discussions on free speech and conformity, academic freedom, the right to editorialize on radio and television, access to the microfilm and television camera. Each class period begins with a tape recording, a film, or a kinescope recording or report on the topic which will be the basis of discussion to follow. An attempt is made to relate freedom of speech to the individual, his country, and to the larger community of the world.

2 units, winter and spring, (Donner, Communication), T 4-6
2 units, spring, (Wallin, Sociology), T 4–6

#SC156. Plato’s View of the Ideal Society.
2 units, autumn, (Rhinelander, Philosophy), to be given 1964–65

#SC159. The Pattern of Cities—A Colloquium on City Planning. A review of the history of cities; an analysis of how urban culture has followed the changing needs of man, and an evaluation of the techniques employed by city and regional planners to combat the problems of today and tomorrow.
2 units, winter, (Sanders, Planning and Architecture). W 7:30–9:30 p.m.

#SC160. Man and the State in Modern Drama—This is concerned with a discussion of the struggle between private conscience and public duty in man’s relations to the social order.
2 units, spring, (Cole, Speech and Drama), T 2–4

#SC161. Science, Values, and Anti-Intellectualism.
2 units, spring, (Krauskopf, Geochemistry), T 2–4

#SC162. The Technological Order.
2 units, autumn, (Stover, Political Science), M 8–10 p.m.

#SC165. Government Activity and American Life.
2 units, winter, (David, Economics), day and hour to be announced

#SC166. Technological Change in the Affluent Society.
2 units, spring, (Hartman, Economics), T 2–4

#SC168. The Great Novels of China—The aim of the Colloquium is to give the student an opportunity to read in English translation three of China’s greatest novels, *All Men Are Brothers*, *Chin P’ing Mei*, and *Dream of the Red Chamber*, and to gain an adequate knowledge of Chinese life and thought in the periods during which these novels were written.
2 units, winter, (Chan, Asian Languages), M 2–4

#SC169. Monetary and Fiscal Policy for Stable Growth.
2 units, autumn, (Attiyeh, Economics), day and hour to be announced

#SC170. Deterrence, Arms Control and Disarmament.
2 units, autumn, (O. Holsti, Political Science), T 4:15–6:05 p.m.

#SC171. Hypnosis and Personality.
2 units, spring, (Hilgard, Psychology), M 2–4

#SC172. The Psychology of Mark Twain.
2 units, spring, (Sears, Psychology), T 4–6

2 units, autumn, (Levin, Psychology), M 4–6

#SC176. Psychology and the Law.
2 units, spring, (Freedman, Psychology), M 2–4

#SC179. The Artist and Society—This Colloquium will explore the nature of the relationship between the literary artist and the society in which he creates. Questions of the reading public, levels of taste, critics, etc., will be examined in terms of a number of contemporary American and foreign writers.
2 units, spring, (Naughton, French and Italian), Th 2–4

2 units, winter, (Sworakowski, Hoover Institution), T 2–4

2 units, winter, (Dornbusch, Sociology), M 2–4

2 units, spring, (Colby, Psychology), M 2–4

2 units, autumn, (Hymans, Hoover Institution), W 2–4

2 units, spring, (Buss, History), M 3–5
# SC197. Reason in Politics.
2 units, winter, (Stover, Political Science), M 8–10 p.m.

# SC199. The Political and Social Ideas of George Bernard Shaw—A discussion of Shaw's political and social ideas, in relation to the conditions of his lifetime. A critical assessment of his leading ideas will be attempted, by comparing them with ideas put forward by contemporary social theorists.
2 units, spring, (Buck, Political Science), M 4–6
STANFORD CENTER FOR CHINESE STUDIES
IN TAIPEI

PROGRAM OF STUDY

The program in Taipei provides an opportunity for a select group of advanced undergraduates and graduates to receive for a full calendar year intensive language training, either as such or in connection with research. An integral part of the Stanford curriculum, it is complementary to the instruction and the research training given on campus. By the same token, it also implements similar instruction and training at comparable institutions. All instruction in Taipei is in Chinese.

The Center maintains classrooms and reading room, located in a new building on the campus of National Taiwan University. Students at the Center have the advantages of a University location in the use of libraries and other facilities. They also have the opportunity of knowing Chinese students and professors, and the immeasurable advantage of living in a Chinese cultural environment. While the Center does not provide living arrangements for the student, it renders the service of assisting him in obtaining satisfactory accommodations of his own choosing.

For specific information on courses, tuition fees, acceptance to the program, and other relevant points, write to

Graduate Overseas Centers and Special Programs
Room 2P, Building 1
Stanford University
Stanford, California

ELIGIBILITY

To be accepted for studying at Taipei, a student must have completed two years' work in Chinese at the college level, either at Stanford or at a recognized institution, or the equivalent of such study through summer intensive courses. If the applicant is not a Stanford student, he must be enrolled as a degree candidate at an accredited college or university and be in good standing. He must be recommended by one of his professors in the Asian field. If he is an undergraduate, he must also be recommended by the Dean of Students at his home institution.

Students who do not have the language prerequisite are advised to consider taking the summer session intensive course at Stanford University. These courses provide in eight weeks the equivalent of an academic year, or three quarters, of work in the Chinese language. A limited number of summer tuition scholarships are available for qualified students. Inquiries should be addressed to the Department of Asian Languages, Stanford University.

FELLOWSHIPS AND SCHOLARSHIPS

Stanford students should apply through the Office of Financial Aids. A visiting student should apply through the normal channels of his home institution for such grants as may be applicable for this purpose. He should also check with his academic adviser at his home institution concerning the possibility of applying for inter-university aid which may become available to supplement the existing types of grants in the field of Chinese language and Chinese area studies.
THE STANFORD CENTER FOR JAPANESE STUDIES

Tokyo, Japan

PROGRAM OF STUDY

The Stanford Center for Japanese Studies provides an opportunity for a select group of undergraduate and graduate students to study intensively for a full calendar year (possibly longer in the case of graduate students) in Tokyo, Japan. The location of the Center in the cultural and economic heart of the nation insures optimum conditions for academic work enriched by stimulating relations with Japanese society and with individual Japanese from many walks of life. At the core of the academic program is intensive language instruction. In addition, a few courses in English dealing with such subjects as Japanese politics, history, economics, literature, and philosophy are offered each year by leading specialists. Advanced graduate students will also be afforded the opportunity to participate in regular seminars at Japanese universities and to carry on individual study and research in their fields of interest under the guidance of outstanding Japanese authorities. The Center will further assist qualified students in gaining access to libraries and archives, and will conduct field trips to various areas of Japan as an integral part of the program.

Because instruction in Japan is on the semester system, the first two Stanford quarters (October 1 to the middle of March) and the second two Stanford quarters (April through September) function as instructional units. Terminal grades are given only at the end of the winter and summer quarters. A three-week Christmas and New Year vacation is declared in the first (autumn) semester and a vacation of at least two weeks occurs during the month of March before the beginning of the second (spring) semester.

Calendar

1963

Autumn Quarter

September 30 ............................. Instruction begins
December 2-6 ............................. Examination period for Autumn Quarter

1964

Winter Quarter

December 9-13 ............................. Instruction resumes
December 14-January 5 ........................ Christmas Recess
January 6 ............................. Instruction resumes
March 2-6 ............................. Examination period for Winter Quarter

Spring Quarter

March 7-22 ............................. Spring Vacation
March 23-May 29 ............................. Instruction resumes

Summer Quarter

June 1 ............................. Instruction resumes
August 3-7 ............................. Examination period for Spring and Summer Quarter

Note: Japanese national holidays are observed throughout the year.
Maximum flexibility is observed in arranging programs for individual students to suit their particular interests and needs; language study constitutes the major part of the normal program. Language work is carried on in small classes and in individual tutorial sessions by Japanese instructors under the direction of an experienced Stanford faculty member. Most students will have completed by the end of a year in Tokyo the equivalent of at least two years of language training at the American-university level, plus additional work in composition, conversation, and directed reading. The courses in English are so selected and taught as to take full advantage of the Japanese setting.

All Center courses carry full academic credit and may be counted in fulfillment of unit requirements for Stanford degrees. For students attending the Center who are candidates for degrees at institutions other than Stanford, Center courses yield transfer credit on the same basis as courses taken at Stanford in California. Such students should note, however, that certain advanced graduate courses may be taken only with the specific approval of their own departments or advisory committees. It should be noted further that certain courses required of Stanford degree candidates in the various departments (including Asian Languages) must be met at Stanford in California, and the student must plan his total program accordingly.

ELIGIBILITY

Any student may apply for admission to the Center provided that (a) he is a Stanford student in good standing, or is a degree candidate in good standing at another institution who has been accepted either as a transfer student or on a non-matriculated basis for admission to Stanford for his period of residence at the Center; and (b) he will have successfully completed by the time of departure for the Center a minimum of two years of Japanese or its equivalent at Stanford or elsewhere. Students who wish to attend the Center are urged to do further preparatory work in Japanese beyond the minimum requirement; such additional preparation will weigh heavily in selection. Attention is called to the intensive courses in first, second, and third year modern Japanese given at Stanford during the summer quarter; each of these courses provides the equivalent of one academic year of language work in eight weeks. A limited number of summer tuition scholarships are available for qualified students. Inquiries should be addressed to the Department of Asian Languages, Stanford.

Factors to be considered in selection are past academic performance, a demonstrated interest in Japanese studies, and such personal qualifications as balance, reliability, tolerance, and the ability to live amicably with others. Students who have not yet completed the equivalent of two years of Japanese at the time of application may be accepted provisionally on the basis of general academic excellence. Language requirements are met by successful completion of the course work, not by placement tests.

A one-way tourist fare from San Francisco to Tokyo is included for undergraduates, but students are expected to furnish their own transportation between their homes and San Francisco. Graduate students will be charged tuition on a quarterly basis; they will normally bear transportation and housing costs themselves.

FINANCIAL AID

Financial aid is available from Stanford for both Stanford and non-Stanford students attending the Center in Tokyo. Funds for undergraduates have been made available by grants from the Carnegie Corporation. However, students should make every attempt to secure their own financing through outside scholarships and fellowships. The attention of students is called particularly to the National Defense Modern Foreign Language Fellowships. Students are cautioned to submit applications for financial awards well in advance of the respective deadlines for the various programs.
APPLICATION PROCEDURE

Students wishing to attend the Center should apply to John D. Goheen, Chairman, Stanford Center for Japanese Studies, Graduate Overseas Centers and Special Programs, Room 2P, Building One, Stanford University, Stanford, California. Non-Stanford students must complete the standard Stanford application forms as well as a special form for the Tokyo Center. The deadline for the receipt of applications each year is April 1. Notification of selection will be made by May 15. Graduate students with advanced language competence may be admitted at other times by special arrangement. Students are reminded that they must meet deadlines for financial aid applications considerably in advance of April 1 and that these deadlines vary according to the different programs.

COURSES OFFERED IN JAPANESE

Note: Eligibility for enrollment in the following courses and the number of units allowed for them (in courses where there is unit variation) will be determined by placement examinations.

ADVANCED

J105J. Modern Japanese: Level Three—(Equivalent to J101, J102, J103.)
12 to 15 units, autumn, winter; 12 units, spring, summer, (Staff)

J125J. Modern Japanese: Level Four.
12 to 15 units, autumn, winter; 12 units, spring, summer, (Staff)

5 units, autumn, winter; 5 units, spring, summer, (Staff)

5 units, autumn, winter; 5 units, spring, summer, (Staff)

GRADUATE

J200J. Directed Reading in Japanese—Reading materials to be selected from the student’s disciplinary field. Repeatable for credit.
1 to 8 units, autumn, winter, spring, summer, (Staff)

J299J. Translation—(Equivalent to J299.)
1 unit, autumn, winter, spring, summer, (Staff)

For additional information on Japanese language courses, see the section “Asian Languages” in this Bulletin.

COURSES OFFERED IN CHINESE

C200J. Directed Reading
2 to 3 units, autumn, winter, spring, summer, (Staff)

COURSES OFFERED IN ENGLISH

Art 176J. History of Japanese Fine Arts.
3 units, spring, summer, (Staff)

Econ. 116J. The Development of Japan’s Modern Economy.
3 units, spring, summer, (Tsuru)

3 units, autumn, winter, (Nagai)
Director: Wolfgang K. H. Panofsky
Associate Director, Technical Division: Richard B. Neal
Executive Head, Research Division: Joseph Ballam
Associate Directors: Robert H. Moulton, Jr. (Administrative Services Division); Frederick V. L. Pindar (Business Services Division)
Professors: Sidney D. Drell, Robert F. Mozley (on leave 1963-64), Wolfgang K. H. Panofsky
Associate Professors: Joseph Ballam, Sam M. Berman, H. Pierre Noyes, Burton Richter
Senior Research Associates: Karl L. Brown, Jean V. Lebacqz, Richard B. Neal

The Stanford Linear Accelerator Center (SLAC) is designing and constructing, under contract with the U. S. Atomic Energy Commission, a two-mile-long linear electron accelerator. When completed, the Center will be operated by Stanford as a national facility at which qualified scientists from Stanford and from all over the world will carry out very high energy physics research.

The Center is located on 480 acres of Stanford property, west of the campus, parallel to Sand Hill Road. Several buildings are complete and occupied. When finished, the building complex will house the staff required to operate and maintain the Center. The accelerator itself is under construction and will be operational in 1966-67, providing an electron beam of 20 Bev maximum energy. Facilities are being incorporated to permit optional later doubling of the beam energy.

Graduate students may participate in the work of the Center by arrangement with departments at Stanford or at other universities cooperating with the Center. Graduate students in the Stanford Department of Physics wishing to work toward the Ph.D. degree under the supervision of a member of the SLAC faculty should apply to the Committee on Graduate Studies of the Department of Physics for approval.
Instructor: Rae Olsen Wirtz

Typing and Shorthand are offered to interested Stanford undergraduates. Days and hours will be announced in the Time Schedule each quarter.

1 Shorthand—Beginning Gregg Shorthand theory.
   3 units, autumn or winter, (Wirtz)

2 Shorthand—Completion of Gregg Shorthand theory.
   3 units, winter or spring, (Wirtz)

3 Shorthand—Dictation.
   3 units, spring, (Wirtz)

1 Typing—For beginners.
   2 units, autumn, winter, or spring, (Wirtz)

2 Typing—Typing for business.
   2 units, autumn, winter, or spring, (Wirtz)

3 Typing—Advanced secretarial typing.
   2 units, autumn, winter, or spring, (Wirtz)

Note: A maximum of 4 quarter units in typing may be credited on the college level.
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