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INFORMATION ................................................................. January
SUMMER SESSION ......................................................... February
HOPKINS MARINE STATION ............................................. March
LET'S TALK ABOUT STANFORD ....................................... April
COURSES AND DEGREES .................................................. May
GENERAL STUDIES .......................................................... May
SCHOOL OF LAW ............................................................. May
SCHOOL OF NURSING ....................................................... June
GRADUATE SCHOOL OF BUSINESS .................................... August
SCHOOL OF MEDICINE ....................................................... August

Stanford Engineering News. Published in January, March, May, July, and No-

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STANFORD, CALIFORNIA
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<td>Monday-Tuesday .... Registration</td>
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<td>Sept. 29</td>
<td>Wednesday ............. Instruction begins</td>
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<tr>
<td>Oct. 1</td>
<td>Friday ................. Conferring of degrees</td>
</tr>
<tr>
<td>Oct. 3</td>
<td>Sunday ................. Matriculation Sunday</td>
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<tr>
<td>Oct. 19</td>
<td>Tuesday ............... Last day for registration</td>
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<tr>
<td>Oct. 26</td>
<td>Tuesday ............... Last day for filing advanced degree applications:</td>
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**1966**

**Winter Quarter**

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<td>Jan. 3</td>
<td>Monday ................ Registration</td>
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<tr>
<td>Jan. 4</td>
<td>Tuesday ................. Instruction begins</td>
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<tr>
<td>Jan. 7</td>
<td>Friday ................. Conferring of degrees</td>
</tr>
<tr>
<td>Jan. 14</td>
<td>Friday ................. Last day for filing Fellowship and Graduate Scholarships applications</td>
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<tr>
<td>Jan. 24</td>
<td>Monday ................ Last day for registration</td>
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<tr>
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<tr>
<td>June 2</td>
<td>Thursday ................. Last day for filing A.M., M.S., Engineer theses</td>
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<tr>
<td>June 3-8</td>
<td>Friday-Wednesday ........ End-quarter examinations</td>
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This section describes requirements for degrees which apply to all students at Stanford University. Special departmental or school requirements are described in the section on the school or department itself.

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

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

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

There is a great deal more in the Program which is aimed at enriching the undergraduate’s career. On the academic side, students may be awarded up to 45 units of graduating credit for superior work done in high school. Such advanced credit will be established on the basis of scores achieved on the College Board Advanced Placement Examination, subject to University approval, or on advanced placement tests administered after the student arrives on campus. Honors programs are offered in a number of departments, or cooperatively among several departments. These permit further individual study and development for the capable student. Also, development of the student’s specialization under the direction of a particular department is an essential part of his undergraduate experience. Of general application is the fact that good English is expected in all University course work and is a consideration in grading. It is not just an exercise limited to English classes.

On the extracurricular side, the University is anxious to provide adequate opportunities for the cultural and social activities which can add to the student’s educational experience in an infinite variety of ways. Much of this is up to the student, although Stanford is concerned that he not forget that the primary purpose of a university education is intellectual growth. To help keep intellectual and other activities in some balance, all students are required to participate during six quarters (two academic years) in supervised activities of recreational or 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.

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

1. English 1, 2, 3. Freshman English (Composition and Literature)
2. History 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, 82, German 23, 53, 82, Greek 23, Hebrew 23, Italian 23, 82, Japanese 21, Latin 23, Russian 52, Spanish 23, 53
   b) Mathematics. Completion of the final course of any of the following sequences or the equivalent
      1) Mathematics 10, 11, 21, 22, 23
      2) Mathematics 41, 42, 43
      3) Mathematics 41, 52, 53
      4) Mathematics 41, 62, 63 (Recommended for Social Science majors.)
4. Group Activity. All undergraduate students except veterans, married students, and students over 24 years of age are required to participate in organized activities to a total value of 6 non-credit units. No more than 2 of such units will be counted in any one quarter. During the freshman and sophomore years at least 2 units of this requirement, 1 each year, must be devoted to a physical activity, including varsity teams, supervised intramural sport, organized physical education classes, and other physical activity offerings as listed in the Time Schedule. The remaining 4 units may be fulfilled either in physical activity offerings or in group activities approved by the General Studies Committee. Among these are chorus, band, orchestra, dramatic productions, and some journalistic activities. Enrollment in ROTC will be accepted, quarter for quarter, in satisfaction of all or part of this requirement.

B. AREA REQUIREMENTS FOR ALL STUDENTS

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

1. Humanities. A minimum total of 8 units selected from General Studies courses in at least two of the following three fields:*  
   a) The Fine Arts (including Music, Art and Architecture, Speech and Drama)  
   b) Philosophy, Religion  
   c) Literature

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

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

3. Natural Sciences. Students who have not taken biology in high school will take Biology 1, 2, 3. 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)

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

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

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

C. Additional Requirements for Candidates for the A.B. Degree

1. One of the following
a) Mathematics 1 and 2, Statistics 50, or an advanced mathematics course making use of calculus if mathematics was chosen under "A" above.
b) Philosophy 3 (Logic).
c) 4 units of additional reading in the foreign language which the student took under "A." (This requirement may be fulfilled either in consultation with the student's own major department or by taking Fr54, 84, G54, 84, It84, 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.) This requirement may also be fulfilled by the language instruction at an Overseas Campus if the student has completed the "A3" Basic Language requirement before going overseas.

2. Additional courses in the natural sciences. That number of units which, when added to the work completed under "B3," brings the total to 17 units. This additional work must be selected from the following courses in such a way as not to duplicate subject matter covered under "B3." Courses listed under "a" through "e" may be taken without laboratory in satisfaction of this requirement, but credit will be correspondingly reduced. Requirement "B3" must include laboratory.

a) Biology 1, 2, 3
b) Chemistry 1, 2, 3
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) Physical Sciences 5, 6, 7, 50, 100
3. Senior Colloquia. Two colloquia of 2 units each, as listed in the Time Schedule, under "Senior Colloquia." No more than two may be taken for credit. The following A.B. candidates are exempt from the Senior 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 Honors programs in Humanities, and in Social Thought and Institutions.

U.S. HISTORY AND CONSTITUTION REQUIREMENT

California State law requires that baccalaureate degree programs include instruction in U.S. History and Constitution. For students who come to Stanford as freshmen, material contained in History 2 and 3 satisfies this requirement; transfers may meet this requirement through completion of any of several approved alternatives in Stanford's Departments of Political Science and History or by completing the requirements at other collegiate institutions.

MAJOR REQUIREMENTS

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

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

Forty-five units constitute a normal year's work. The degree is conferred whenever the requirements are met, provided the candidate has spent three quarters in resident study and completed at least 45 units (including the last 15) in this University.
DEGREES

sity. In special cases, students who have obtained at least 135 units in resident work, and who have completed all major requirements and all General Studies requirements, may be exempted from completing the last quarter's work in this University and be permitted to complete the required number of units elsewhere. In these cases the approval of the Subcommittee on Graduation is necessary.

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

Second Bachelor's Degree—The holder of a Bachelor of Arts degree from Stanford may apply to the Subcommittee on Graduation for admission to candidacy for a Bachelor of Science degree, and the holder of a Bachelor of Science degree may apply in like manner for a Bachelor of Arts degree. Application must be filed prior to entry into the Graduate Division and the recommendation of the major school or department to be entered is required. A student approved for this program may re-register as an undergraduate and will be subject to the usual rules and regulations affecting undergraduates. Specific requirements may be obtained at the Registrar's Office.

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

ADVANCED DEGREES

General University requirements for advanced degrees are stated in terms of time devoted to graduate study, or registration for graduate study, rather than in terms of units of credit. In case any of the work done at Stanford is on a part-time registration, its equivalence to full-time study is determined by tuition payments.

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

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

Candidacy for A.M., M.S., Engineer, and Ph.D. degrees must be approved by the University Committee on the Graduate Division. Candidacy is valid for five years from date of such approval and may be renewed by the submission and approval of a new application. All applications or petitions to the University Committee on the Graduate Division must be submitted to the major department for approval before being filed with the Graduate Study Secretary. Communications should be addressed to the Graduate Study Secretary, Registrar's Office, Stanford University, Stanford, California.

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 *Graduate School of Business Bulletin.*)

**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 University deadline. The required time varies with departments.) Candidacy, when granted by the University Committee, is valid for five years and may be renewed by the approval of a new application by the major department and the University Committee.

Thesis—Three bound copies of the thesis, bearing the approval of the instructor under whose supervision it was prepared, must be submitted to the Graduate Study 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.

MASTER OF FINE ARTS

General Regulations—Upon recommendation to the Academic Council by the faculty of the major department and the University Committee on the Graduate Division, the degree of Master of Fine Arts (M.F.A.) is conferred on candidates who have satisfactorily completed six quarters of approved graduate work (of which a minimum of three quarters—36 quarter units—must be in residence at Stanford as a graduate) and fulfilled such other requirements as may be prescribed by the major school or department.

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, 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, 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 com-
pleted the required curriculum in medicine. (Full information concerning require-
ments for the M.D. degree will be found in the School of Medicine Bulletin.)

**Doctor of Philosophy**

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

A minimum of three years (nine quarters) of graduate registration satisfactorily
completed is required of each candidate. The minimum which must be completed as a
graduate at Stanford is three quarters (36 quarter units). This minimum will apply
only if the candidate has earned no other advanced degree at Stanford and has com-
pleted at least two years of acceptable work elsewhere as a graduate.

**Admission to Candidacy**—When a student has completed the major depart-
ment's required preliminary procedures, and has completed the reading require-
ment 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 stu-
dent's program includes a minor, certification by the minor department is also re-
quired. 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 can-
didacy, a certificate must be filed stating that the student possesses a reading knowl-
edge 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 cer-
tificate shall be issued by an examiner designated by the major school or department.

**University Oral Examination**—When a candidate has been admitted to candi-
dacy, 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 exami-
nation. 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 exami-
nation. 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 com-
mittee 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 the chairman and 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. 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.
COURSES OF INSTRUCTION

1965-66

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 1966 will be eight weeks in length, except in certain schools which will offer ten-week courses.

This announcement includes, for the Summer Session of 1966, 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 1966.

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 in other 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 Director, Doctoral Program, Graduate School of Business, Stanford University, for separate bulletins and application forms.
SCHOOL of EARTH SCIENCES

Dean: Richard Henry Jahns
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 Aerospace Studies, Military Science, and Naval Science in this Bulletin). Students enrolled in the School of Earth Sciences who are also enrolled in an ROTC program will usually require more than four years (twelve quarters) in the University to obtain a baccalaureate degree.

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

GRADUATE PROGRAM

The undergraduate curricula offered by the School of Earth Sciences are designed to give broad training, with emphasis on fundamental science. These curricula do not include sufficient specialization to prepare directly for professional work. The School offers graduate programs planned to prepare the student for responsible positions in industry, research, governmental work, and education. These programs lead to the advanced degrees of Master of Science, Engineer, and Doctor of Philosophy. Graduate degrees in Hydrology are also offered. See the section “Hydrology” in this Bulletin.

Admission to the Graduate Program—A student who wishes to enroll for graduate work in the School must be qualified for graduate standing in the University and in addition must be accepted by the School of Earth Sciences. With the limited facilities available, it is not possible to accept all who apply for admission.

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

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

Normally about twenty-two teaching assistantships are awarded to qualified stu-
dents to assist in laboratory instruction.

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GEOLOGY

Emeriti: Eliot Blackwelder, Siemon William Muller (Professors)

Executive Head: Arthur D. Howard

        David Howard, M. King Hubbert (Geology and Geophysics), Colin Osborne
        Hutton (Mineralogy), Richard Henry Jahns, A. Myra Keen, Konrad Bates
        Krauskopf (Geochemistry), Benjamin Markham Page, Charles Frederick
        Park, Jr. Consulting: Harold W. Hoots, Adolph Knopf

Associate Professors: Stanley Nelson Davis, William R. Dickinson (on leave autumn
        quarter), John W. Harbaugh

Assistant Professor: Paul H. Reitan (Mineralogy)

Research Associates (By Courtesy): Weston Bourret, George Leavitt Harrington,
        Donnel Foster Hewett, Eleanora Bliss Knopf, Chester R. Longwell, Earl
        Leroy Packard, Virginia M. Page, Hans Karl Stauffer, J. F. Theodore Sauer
        (Oceanography), Hans Ernst Thalmann, Gerald Ashley Waring

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 Mathe-
matics 23 or a course numbered 23 in a foreign language, but the Department of Geol-
ogy requires completion of a language sequence whether or not Mathematics 23 is
taken. Any modern language is accepted in fulfillment of this requirement, but Ger-
man is recommended.

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

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry 1, 2, 3</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 I)</td>
<td>Summer</td>
<td>15</td>
</tr>
</tbody>
</table>

Total: 62
Note 1—A student who takes Geology 108 and 109 during the summer following his junior year will normally graduate at the end of winter quarter in his senior year.

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

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

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 112. Elementary Paleontology</td>
<td>A</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 171. Introduction to Geochemistry</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>At least 5 additional units in geology</td>
<td>Any</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geophysics 190. General Geophysics</td>
<td>WSA</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>Any</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Mathematics 21, 22. Calculus</td>
<td>Any</td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td>Mathematics 23, or Statistics 50 or 110.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>40-42</td>
<td></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 No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>At least 15 units from courses listed in the section on Paleontology and Stratigraphy. (Qualified students may take 200-level courses.)</td>
<td>Any</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Geology 157. Sedimentary Petrology</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 21, 23, 29. Elementary Physics</td>
<td>AWS</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Statistics 50. Elementary Statistics</td>
<td>AS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>At least 10 units from courses listed under the Department of Biological Sciences</td>
<td>Any</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>45</td>
<td></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 No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 171, 271. Geochemistry</td>
<td>AW</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Geology 209. Physics of Underground Fluids</td>
<td>W</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 106. Physical Oceanography</td>
<td>S</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Geophysics 190. General Geophysics</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mathematics 21, 22, 23, 24. Calculus</td>
<td>Any</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>WSA</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

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

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

Grade requirements—In addition to the University requirement of an 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:

1. The courses required of all geology majors: Chemistry 1, 2, 3; Mathematics 10, 11; Geology 1, 2, 25, 51, 105, 107, 108, 109.
2. The courses in other science departments required for any one of the three regular curricula of the department.
3. Geology 150 a, b, c and 6 units of Geology 155.

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

Master of Science

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

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

1. Be registered in the graduate school for at least three quarters.
2. Complete 45 units, at least 6 of which must be independent work on a research
problem. Units from School of Earth Sciences courses with grades of D will not be counted toward the required 45 units of work, and the average of all grades must be a B or better. No Geology courses numbered below 100, and not more than 10 units of Geology courses numbered below 200, will be counted toward the required 45 units of work.

3. Make up deficiencies in previous training. Previous training should be approximately equivalent to one of the three curricula leading to the B.S. degree in Geology at Stanford. Geology 220 and 221 (or equivalents) and one course in economic geology must be taken, if these courses or equivalents have not previously been completed.

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

5. Demonstrate in one of the following ways his knowledge of basic principles and research methods in his general field of study: (a) By writing a thesis, as may be recommended at the discretion of individual advisers. (b) By preparing a report, ordinarily a term paper written for the 6 units of research, to be submitted to at least two faculty members.

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

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

These courses must be junior, senior, or graduate courses (courses numbered 100 or higher) with the following exceptions: 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 completion of the second year of
graduate study. His record must indicate outstanding scholarship, and deficiencies in previous training must be removed. Although he need not obtain an M.S. degree, the candidate will be expected to have, or to obtain, a training approximately equivalent to the Stanford M.S. program. He must pass the Departmental oral examination. He must fulfill the requirements of the minor department, if a minor is elected. He must prepare under faculty supervision a dissertation which is a contribution to knowledge and the result of independent work. (The dissertation must be reasonably concise, prepared in a form suitable for publication of a part or the whole.) He must pass the University oral examination, which is centered around the dissertation problem.

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

COURSES

GENERAL GEOLOGY

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

1. Physical Geology—Elementary study of the earth, particularly materials, structure, internal condition, physical and chemical processes at work upon it. Lectures, one 3-hour laboratory period per week; field excursion(s). Fee required for excursion expenses. (Students who have taken Physical Science 3 will receive only 3 units credit for Geology 1.)
   5 units, autumn, (Harbaugh), MWF 8; lab., field trips by arrangement
   winter, (Page), MWF 9; lab., field trips by arrangement
   spring, (Davis), MWF 8; lab., field trips by arrangement
   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
   spring, (Harbaugh), MWF 9; lab., field trips by arrangement

5. Elementary Field Studies—Excursions in California Coast Ranges, lectures, discussions of geologic problems. Prerequisites: 1 and 2.
   4 units, spring, (Graham), by arrangement

103. Geologic Problems—Supervised reading, written reports thereon.
    1 to 10 units, any quarter, (Staff), by arrangement

105. Structural Geology—Nature and origin of faults, folds, and structures of metamorphic and plutonic rocks. Deformation of the earth's crust. Prerequisites: 1 and 51.
    5 units, spring, (Page), MWF 9; one lab., field trips by arrangement

106. Physical Oceanography—Prerequisites: Mathematics 22 and Chemistry 3.
    4 units, spring, (———), MTWTh 8

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

108. Field Geology I—First half of summer (mid-June to mid-July) will be spent in an area consisting mainly of sedimentary rocks, generally in one of the California coast ranges. Geology will be plotted on topographic maps and aerial photographs. A report, prepared at Stanford during the latter half of August, will include a complete stratigraphic and structural description of the entire area covered by the class.
24

SCHOOL OF EARTH SCIENCES

(For second half of summer field work, see 109.) (Open to women students if two or more women register.) Prerequisites: 51, 105, and 107.

8 units, 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 rocks. (Open to women students if two or more women register.) Prerequisite: 108.

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

133. Principles of Geomorphology—Land forms; processes which create, modify them. Prerequisite: 1. Recommended: 2, 51, and 171.

4 units, autumn, (Howard), MWF 9; lab. F 1:15-4:05; field trips by arrangement

134. Map Interpretation and the Scientific Method—Topographic maps provide basic data for application of the scientific method in interpretation of geologic structure and local and regional geomorphic development. Prerequisite: 133 (may be taken concurrently).

4 units, winter, (Howard), MWF 10; lab. F 1:15-4:05

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

2 units, 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


3 units, winter, (Harbaugh), by arrangement


5 units, winter, (Hubbert), MTWThF 11

210. Geology of California.

3 units, spring, (Muller), TTh 11 and F 1:15-4:05

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

5 units, spring, (Howard), MWF 10; lab. T 1:15-4:05 and one lab. by arrangement

301. Problems in Various Fields of Geology and Geochemistry.

Each quarter, (Staff), by arrangement

305. Seminar in Theoretical Foundations of Geology.

2 units, winter, (Hubbert), 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 9; seminar W 4:00-5:30

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

2 units, winter, (Muller), W 1:15-3:05

400. Research in Various Fields of Geology and Geochemistry.

Each quarter, (Staff), by arrangement
MINERALOGY, PETROLOGY, AND GEOCHEMISTRY

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

5 units, autumn, (Reitan), TTh 10; lab. TTh 1:15-4:05 and one lab. by arrangement


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


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

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

3 units, autumn, (Krauskopf, Parks), MWF 8

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

4 units, spring, (Dickinson), M 1:15-4:05; two labs. by arrangement

220. Optical Mineralogy—(a) Elementary study of optical properties of crystals; emphasis on polarizing microscope as instrument of research. (b) Systematic study of important minerals, their determination by optical methods. Prerequisites: 25 and Physics 55, or equivalents.

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

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

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

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

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

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

6 units, spring, (Compton), TWTh 9; lab. W 1:15-4:05 and two labs. by arrangement

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

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

227. Mineralogical Chemistry—Systematic introduction to equilibrium phase diagrams in binary and ternary systems. Nucleation, crystal growth, recrystallization, metastability, and distribution of elements between coexisting phases. Prerequisites: 171 and 221, or permission of instructor.

3 units, spring, (Reitan), MWF 11

240. Electron Microprobe Analysis.

3 units, spring, (———), by arrangement
271. Geochemistry—Application of physical chemistry to geologic problems. Distribution of chemical elements in geologic environments. Prerequisites: 51 and 171, or 1 and Chemistry 171.
3 units, winter, (Krauskopf), TTh 9; lab. T 1:15-4:05 or W 1:15-4:05

272. Spectrochemical Analysis—Fundamentals of spectrochemical analysis and its application to study of rocks and minerals. (Enroll in Mineral Engineering 272. Enrollment limited to 6.) Prerequisite: consent of instructor required.
5 units, winter, (Reitan), MW 10; lab. MW 1:15-4:05 and one lab. by arrangement

3 units, spring, (Reitan), three 3-hour labs. by arrangement

1 unit, winter, (Harbaugh), by arrangement, to be given in 1966-67

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

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

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

Paleontology and Stratigraphy

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

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

115. Biological Oceanography.
4 units, winter, (Keen), MTWTh 8

117. Mesozoic Invertebrate Paleontology—Prerequisite: 112.
4 units, winter, (——), TTh 9; two labs. by arrangement, alternate years, to be given in 1966-67

119. Vertebrates of the Past—A survey for nonspecialists. Distinctive characters, specializations for particular modes of life, evolutionary history, distribution in space and time of major vertebrate groups. No prerequisites.
3 units, autumn, (Evitt), MWF 11, alternate years, to be given in 1965-66

160. Elementary Stratigraphy—Classification of stratigraphic units, facies, unconformities, and principles of correlation. Prerequisite: 105. Recommended: 112.
3 units, winter, (Muller), TTh 10; lab. M 1:15-4:05

213. Cenozoic Invertebrate Paleontology—Mollusca, Echinodermata, Coelenterata. Prerequisite: 112.
5 units, spring, (Keen), MWF 11; lab. W 2:15-5:05 and two labs. by arrangement, alternate years, to be given in 1965-66

214. Paleozoic Invertebrate Paleontology—Brachiopods, Graeplotiles, Trilobites. Prerequisite: 112.
4 units, autumn, (Evitt), TTh 9; two labs. by arrangement, alternate years, to be given in 1965-66

218. Introduction to Micropaleontology—Principles, techniques of preparation, classification of various fossil plants and animals. Two lectures and two laboratory periods per week.
5 units, autumn, (Graham), lec. and lab. by arrangement

316. Introduction to Palynology—Introduction to study of microfossils smaller than 200 microns.
5 units, winter, (Evitt), by arrangement
317. Stratigraphic Palynology—Continuation of 316.

5 units, spring, (Evitt), by arrangement, alternate years, to be given in 1965-66


2 units, each quarter, (Staff)

Readings in Paleobotany—See Biology 170.

Biogeography—See Biology 174.

Quantitative Methods in Biology—See Biology 189.

ECONOMIC GEOLOGY

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

4 units, winter, (Just), by arrangement


3 units, winter, (Harbaugh), 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. (Enroll in Mineral Engineering 215.)

3 units, spring, (Just), by arrangement

281. 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


4 units, winter, (———), M 1:15-4:05; two labs. and one seminar by arrangement

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

3 units, autumn, (Davis), TTh 8; lab. by arrangement


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

286. Development of Ground-Water Resources—Numerical, graphical analysis of pumping tests; interpretation of well hydrographs; field techniques used in ground-water surveys. Prerequisite: 285.

3 units, spring, (Davis), TTh 10; lab. by arrangement

287. Minerals, Politics, and Economics—Mineral resources of the world; their political, economic effects.

3 units, winter, (Park), MWF 9

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
GEOPHYSICS

Executive Head: Joshua Lawrence Soske
Professors: Joshua Lawrence Soske, George Albert Thompson
Assistant Professor: To be announced
Research Associates (By Courtesy): William E. Bell, Allan V. Cox, Richard R. Doell, David G. Willis

OFFERINGS AND FACILITIES

Geophysics relates to that phase of earth science dealing with exploration for economic mineral resources and studies of the physics of the earth. The undergraduate and graduate programs are designed to provide (1) the background of fundamentals necessary to the study of geophysics and (2) course work in geophysics to coordinate and organize the required background with the principles of geophysics. The four-year undergraduate program leads to the degree of Bachelor of Science. Qualified students are encouraged to take some graduate study because the broad scope of geophysics includes fundamentals of geology, mathematics, physics and engineering. The objectives of the graduate program are to prepare students for positions in the exploration industry, geophysical research programs, governmental work, and education. The physical facilities for graduate study include the Henry Salvatori Laboratory of Geophysics. Graduate programs lead to the degree of Master of Science, and Doctor of Philosophy.

PROGRAMS OF STUDY

Bachelor of Science

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

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

CURRICULUM

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chemistry 1, 2, 3. General Chemistry</td>
<td>AWS</td>
<td>13</td>
</tr>
<tr>
<td>Mathematics 10, 11, 21, 22, 23, or 41, 42, 43 and 44. Analytical geometry and calculus</td>
<td>Any</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Mathematics 130. Ordinary Differential Equations</td>
<td>A or W</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mathematics 131. Partial Differential Equations</td>
<td>W</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geology 1. Physical Geology</td>
<td>Any</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 2. Historical Geology</td>
<td>W or S</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 25. Mineralogy</td>
<td>A</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Geology 51. Elementary Petrology</td>
<td>W</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 171. Geochemistry</td>
<td>A</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geology 105. Structural Geology</td>
<td>S</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Geology 107. Geologic Field Techniques</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Geology 108, 109. Field Geology (Note 1)</td>
<td>Summer</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Geophysics 190, 191. Elementary Geophysics</td>
<td>AW</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Physics 51, 52, 53, 54, 55, 56. Elementary Physics</td>
<td>WSA</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Physics 57. Atomic Physics</td>
<td>W</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 61. Optics and Wave Motion</td>
<td>S</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Physics 110, 111. Mechanics</td>
<td>WS</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
As electives in the Geophysics Curriculum, the following courses are recommended: Geology 106, 209, 220, 221, 271; Physics 120, 121, 122 and Mathematics 45, 46, 132.

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—Elementary study of gravitational, magnetic, seismic, electrical, and thermal properties of the earth. Potential theory is introduced. Prerequisites: Geology 105, Mathematics 22, and Physics 55; any or all of these courses may be taken concurrently with 190.
3 units, autumn, (Thompson), MWF 11

191. Procedures of Geophysical Exploration—Geological applications, possibilities, limitations of the several methods. Prerequisite: 190.
3 units, winter, (Soske), TTh 10; lab. by arrangement

250. Rock Magnetism and the Geomagnetic Field—Origin of magnetism in rocks, origin of earth’s field; basic background for research in paleomagnetism.
3 units, winter, (----), MWF 11

3 units, autumn, (Soske), TTh 10; 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), MW 10; 3-hour lab. by arrangement


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

295. Principles of Earthquake Seismology—Prerequisite: 190.

3 units, spring, (———), TTh 8; lab. by arrangement

301. Problems in Geophysics.

Each quarter, (Staff), by arrangement

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

328a. 3 units, winter, (Thompson), MW 9; seminar by arrangement

328b. 3 units, spring, (Thompson), MW 9; seminar by arrangement

397. Seminar in Geophysics.

2 units, any quarter, (Soske, 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

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

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

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

Mineral Processing, Chemical and Extractive Metallurgy curricula are combined under the latter name. Some specialization in the several branches of this option is possible by judicious choice of alternate courses and electives.

Courses Taken by All Undergraduates

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 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>
</tr>
<tr>
<td>Humanities (English 7 or 9, Art 1, or Music 1 recommended)</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Group Activities (General Studies Requirement)</td>
<td></td>
<td>(6)</td>
</tr>
<tr>
<td>C.S. 136.</td>
<td>Introduction to Algorithmic Processes</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 11.</td>
<td>Engineering Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Engr. 15.</td>
<td>Mechanics of Materials (See Note 1)</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 21.</td>
<td>Mechanics of Fluids (See Note 2)</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 41 and 42.</td>
<td>Circuits, Electronics and Electromechanics</td>
<td>8</td>
</tr>
<tr>
<td>Speech 20.</td>
<td>Public Speaking: Practice and Criticism</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 1.</td>
<td>Physical Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 25.</td>
<td>Elementary Mineralogy</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 100.</td>
<td>Industrial Report</td>
<td>1</td>
</tr>
<tr>
<td>Min.E. 101.</td>
<td>Elements of Mining</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 103.</td>
<td>Principles of Mineral Processing</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 105.</td>
<td>Extractive Metallurgy Processes</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 175 or 176.</td>
<td>Field Trip</td>
<td>3</td>
</tr>
</tbody>
</table>

Total ........................................ 129

Mining Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<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. 281.</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>3</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. 133.</td>
<td>Industrial Accounting</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

Total ........................................ 51
### 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>9</td>
</tr>
<tr>
<td>Engr. 50</td>
<td>Introductory Science of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Math. 44</td>
<td>Advanced 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>Mass Transport</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 122</td>
<td>Solid State Thermodynamics</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 124</td>
<td>Phase Equilibria</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 125</td>
<td>Structural Transformation in Materials</td>
<td>4</td>
</tr>
<tr>
<td>Mat.Sci. 127</td>
<td>Crystallography and X-Ray Analysis, or Geol. 123</td>
<td>Optical Mineralogy, or Min.E. 205</td>
</tr>
<tr>
<td>Min.E. 107</td>
<td>High Temperature Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 190</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>Electives</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Total .......................... 51-52

### Management Option

This option is recommended for students interested in futures in mining industry management, to be coupled with a fifth year—Master's degree—emphasizing economic aspects of mining and 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>Economics of Prices and Markets</td>
<td>5</td>
</tr>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133</td>
<td>Industrial Accounting</td>
<td>4</td>
</tr>
<tr>
<td>Lang. 1, 2</td>
<td>Modern European Language</td>
<td>8</td>
</tr>
<tr>
<td>Pol.Sci. 1</td>
<td>Major Issues of American Public Policy</td>
<td>5</td>
</tr>
</tbody>
</table>

and Group A or B below:

**A (Mining)**

- Geol. 51 | Elementary Petrology | 5 |
- Geol. 105 | Structural Geology | 5 |
- Geol. 281 | Ore Deposits | 5 |
- Min.E. 114 | Elementary Problems in Mining Engineering | 2 |
- Min.E. 115 | Mine Exploration | 3 |
- Electives | | 6 |

Total .................................. 51

**B (Chemical and Extractive Metallurgy)**

- Chem. 171, 173 | Physical Chemistry | 6 |
- Engr. 50 | Introductory Science of Materials | 3 |
- Min.E. 107 | High Temperature Laboratory, or Min.E. 190 | Physical Chemistry of Metal Refining, and Min.E. 216 | Mineral Processing Seminar (Engineering), Min.E. 228 | Extractive Metallurgy Seminar | 9-10 |
- Electives | | 7-8 |

Total .................................. 51
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>
<tr>
<td>Geol. 171</td>
<td>Geology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 271</td>
<td>Geochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 116</td>
<td>Theory of Probability</td>
<td>4</td>
</tr>
<tr>
<td>C.S. 136</td>
<td>Use of Automatic Digital Computers</td>
<td>3</td>
</tr>
</tbody>
</table>

Mining Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 171</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Math. 24</td>
<td>Analytical Geometry and Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 107</td>
<td>Geologic Field Techniques</td>
<td>2</td>
</tr>
<tr>
<td>Geophys. 190</td>
<td>General Geophysics</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 240</td>
<td>Construction Planning</td>
<td>2</td>
</tr>
<tr>
<td>Stat. 110</td>
<td>Statistical Methods in Engineering</td>
<td>4</td>
</tr>
</tbody>
</table>

Chemical and Extractive Metallurgy Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 161</td>
<td>Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 283</td>
<td>Microscopic Study of Ore Minerals</td>
<td>3</td>
</tr>
<tr>
<td>Mat. Sci. 105</td>
<td>Imperfections in Crystalline Solids</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133</td>
<td>Industrial Accounting</td>
<td>3</td>
</tr>
<tr>
<td>Phys. 57</td>
<td>Atomic Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

Note 1—Engineering 11, 12, and 15 can be replaced by Mathematics 130 and Physics 110 and 111.

Note 2—Chemical Engineering 130a may be substituted and is preferred in the Chemical and Extractive Metallurgy option.

GRADUATE PROGRAMS OF STUDY

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

Because the majority of mineral engineers seek industrial employment, these programs are designed to carry forward training in basic sciences, engineering, 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 6 of which must be independent work on a research program; be registered in the graduate school for at least three quarters.
2. Overcome important deficiencies in previous training. Not more than 10 units of such work may be counted as part of the minimum total of 45 units.

Courses Required for the Master's Degree

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.E. 215</td>
<td>Mineral Economics</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 300</td>
<td>Advanced Work</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. 133</td>
<td>Industrial or Management Accounting</td>
<td>4–6</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>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>17–19</td>
</tr>
</tbody>
</table>

Mineral Processing Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min.E. 203</td>
<td>Advanced Solid Separations: Principles</td>
<td>4</td>
</tr>
<tr>
<td>Min.E. 216</td>
<td>Mineral Processing Seminar (Engineering)</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 217</td>
<td>Mineral Processing Seminar (Research)</td>
<td>2</td>
</tr>
<tr>
<td>Min.E. 223</td>
<td>Equilibria and Kinetics in High Temperature Reactions, or</td>
<td>3</td>
</tr>
<tr>
<td>Min.E. 226</td>
<td>Corrosion and Electrometallurgy</td>
<td></td>
</tr>
<tr>
<td>Min.E. 225</td>
<td>Surfaces and Interfaces, or Min.E. 227. Equilibria and Kinetics in Aqueous Systems</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>21</td>
</tr>
</tbody>
</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>Equilibria and Kinetics in Aqueous Systems</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>
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<tr>
<td>Electives</td>
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<td>17</td>
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</table>

Management Option

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus. 200–01</td>
<td>Business Economics</td>
<td>6</td>
</tr>
<tr>
<td>Bus. 210–11</td>
<td>Management Accounting</td>
<td>6</td>
</tr>
<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>8</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>6</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 Stanford. The candidate must complete 90 units of course work, no more than 10 of which may be applied to overcoming deficiencies in undergraduate training. At least 30 units must be taken in advanced work, that is, work beyond the undergraduate requirements, in engineering and closely allied fields. The student must prepare a thesis meeting the approval of the supervising instructor and the University Committee on the Graduate Division.
Courses Required for the Engineer Degree*

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></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 Work (Thesis)</td>
<td>10</td>
</tr>
<tr>
<td>C.S. 136</td>
<td>Use of Automatic Digital Computers</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>22</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 Chemical and 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, spring, (Staff), by arrangement

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

3 units, autumn, (Just), by arrangement

103. **Principles of Mineral Processing**—Study of mineral separation techniques and auxiliary operations aimed at recognizing the basic principles involved and the means by which they may be applied in practice. Topics include comminution, sizing, solid-liquid separations and gravity, magnetic, electrostatic, and flotation techniques of solid-solid separation. Prerequisites: Chemistry 3, Physics 55, and Mathematics 43.

4 units, autumn, (Parks), MWF 11 and one lab. by arrangement

105. **Extractive Metallurgy Processes**—Introduction to metallurgical thermodynamics, and fundamentals of the processes used in the production and refining of metals. May be taken as an introduction to metallurgical thermodynamics by enrolling for 2 units. Prerequisite: Chemistry 3. In addition, Chemistry 173 is recommended.

2 to 3 units, winter, (Parlee), MWF 9

107. **High Temperature Laboratory**—Lectures and laboratory projects relating to high temperature processes, atmosphere control, and vacuum technology; thermodynamic and kinetic measurements. (Same as Materials Science 107.) Prerequisite: 105. (Chemistry 173 in special cases.)

2 units, spring, (Parlee), TTh 1:15-4:05
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

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

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

3 units, winter, (Just), by arrangement

122. **Solid State Thermodynamics**—Systematic development of basic laws, mathematical techniques, and definitions. Thermodynamic functions. Maxwell identities and derivation of thermodynamic relations. Solution thermodynamics, partial molar quantities, activity, and the Gibbs-Duhem integration. The reaction isotherm, law of mass action, and applications. Imperfection equilibria. The phase rule and heterogeneous equilibria. (Enroll in Materials Science 122.) Prerequisite: Chemistry 171 or Physics 170.

3 units, autumn, (Stevenson), MWF 9

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

3 units, spring vacation, (Staff), by arrangement, alternate years, to be given in 1965-66

176. **Field Trip**—Similar to 175 except to mining and metallurgical 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, (Staff), by arrangement, alternate years, to be given in 1966-67

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

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

190. **Physical Chemistry of Metal Refining**—Refining processes and the physical chemistry underlying them. A systematic treatment, of unit processes based on types of impurity phases, deals effectively with the fundamentals of such widely different methods as the zone refining of semiconductors, the industrial refining of copper, steelmaking, and the vacuum refining of high temperature alloys. Prerequisite: 105, or Chemistry 173 or equivalent.

3 units, autumn, (Parlee), 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. Emphasis on use of elementary physical inorganic chemistry and solid state physics in critical study of principles. May be taken for 1 unit by students who have previously taken 103. Prerequisite: 103 or equivalent. Chemistry 175, Geology 25, and Engineering 50 recommended.

4 units, autumn, (Parks), MWF 11; one recitation section by arrangement

206. **Advanced Solid Separations: Engineering**—Reading and laboratory study emphasizing scale-up procedures and critical or comparative analysis of operations. May be repeated with credit. Prerequisite: 103 or equivalent.

2 units, winter, (Parks), W 1:15-4:05 and one lab. by arrangement

209. **Separation Flowsheet Development**—Techniques of examination of ores and plant products. Practice in choice of treatment or diagnosis of plant problems.
May be repeated with credit. Prerequisites: 103 or equivalent, and Geology 25. Geology 220 and Materials Science 127 recommended.

2 units, spring, (Parks), W 1:15-4:05 and second lab. 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.

4 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. May be repeated with credit. Prerequisite: 103. In addition Speech 20 recommended.

1 to 2 units, winter, (Parks), by arrangement


1 to 2 units, spring, summer, (Parks), by arrangement

218. Petroelasticity—Covers the general principles of rock elasticity and failure. Supplemented with seminars and laboratory measurements of static and dynamic rock properties. (Same as Geophysics 221 and Geology 221.)

3 units, winter, (Staff), by arrangement

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

3 units, spring, (Stevenson), MWF 11


3 units, summer, (Parlcc), by arrangement, alternate years, to be given in 1965-66

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

1 to 3 units, summer, (Parlcc), by arrangement, alternate years, to be given in 1966-67

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

3 units, spring, (Parks), three lecs. by arrangement, alternate years, to be given in 1966-67

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

3 units, winter, (Shepard), MWF 11

224. Equilibria and Kinetics in Aqueous Systems—Review and development of concepts useful in predicting probability, extent and rate of heterogeneous reactions involving one aqueous phase. Applications in hydrometallurgy or other topics chosen by the student. Prerequisites: either Chemistry 173 and Materials Science 122 or Chemistry 173 and Geology 70.

3 units, spring, (Parks), three lecs. by arrangement, alternate years, to be given in 1965-66
228. Extractive Metallurgy Seminar—Student seminars, discussions, and guest speakers on various aspects of chemical and extractive metallurgy.
2 to 3 units, spring, (Parlee), by arrangement, alternate years, to be given in 1965–66

229. Principles of Steelmaking—Systematic development of the physical chemistry underlying ironmaking and steelmaking processes. Treatment generalized to promote understanding of the physical chemistry of other metals as well. Seminar treatment of important processes. Prerequisite: 105 or Chemistry 173 in special cases.
3 units, winter, (Parlee), by arrangement, alternate years, to be given in 1966–67

4 units, autumn, (Just), by arrangement

231. Mining Seminar—Case histories, economics.
4 units, winter, (Just), by arrangement

232. Mining Seminar—Valuation, law, organization.
4 units, spring, (Just), by arrangement

265. The Freezing Process I—Thermodynamics of surfaces and liquid-solid equilibria, nucleation and the atomic kinetics of solidification. (Enroll in Materials Science 226.) Prerequisite: Materials Science 125.
3 units, autumn, (Tiller), MWF 2:15–3:05

272. Spectrochemical Analysis—Fundamentals of spectrochemical analysis and their application to study of rocks and minerals. Enrollment limited to 6. Prerequisite: Consent of instructor.
5 units, winter, (Reitan), MW 10; lab, MW 1:15–4:05 and one lab. by arrangement

273. Advanced Spectrochemical Analysis—Enrollment limited to 6. Prerequisite: 272.
3 units, spring, (Reitan), three 3-hour labs., by arrangement


300. Advanced Work in Mining or Metallurgical Engineering—Individual work on a research problem in mining, mineral processing, or chemical and extractive metallurgy.
Each quarter, (Staff), by arrangement

PETROLEUM ENGINEERING

Emeritus: Frederick George Tickell (Professor)

Executive Head: Frank G. Miller
Professors: Sullivan S. Marsden, Jr., Frank G. Miller
Assistant Professor: To be announced
Visiting Lecturers: Elmer L. Dougherty, Thomas D. Mueller
Research Associate (By Courtesy): Marshall B. Standing

OFFERINGS

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

The Department occupies the Lloyd Noble Petroleum Engineering Building devoted exclusively to petroleum engineering. It contains five laboratories for instruction and research, a classroom, a seminar and library room, a drafting room, staff offices, and office study space for graduate students.

PROGRAMS OF STUDY

UNDERGRADUATE

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

Courses Taken by All Undergraduates

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 1, 2, 3</td>
<td>General Chemistry</td>
<td>13</td>
</tr>
<tr>
<td>Math. 10, 11, 21, 22, 23, 44. Analytical Geometry and Calculus</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Math. 130. Ordinary Differential Equations</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>English 1, 2, 3</td>
<td>Freshman English</td>
<td>9</td>
</tr>
<tr>
<td>History 1, 2, 3</td>
<td>History of Western Civilization</td>
<td>12</td>
</tr>
<tr>
<td>Physics 51, 53, 55</td>
<td>Mechanics, Sound, Electricity, Light, and Heat</td>
<td>12</td>
</tr>
<tr>
<td>Physics 52, 54, 56</td>
<td>Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 9</td>
<td>Engineering Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Engr. 31. Elementary Engineering Thermodynamics</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Chem. 171</td>
<td>Physical Chemistry</td>
<td>3</td>
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<tr>
<td>Ch.E. 130a.</td>
<td>Transport Phenomena: Momentum Transport</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 20</td>
<td>Elementary Surveying or Geol. 107. Geologic Field Techniques</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 11</td>
<td>Engineering Mechanics (Statics)</td>
<td>2</td>
</tr>
<tr>
<td>Engr. 12</td>
<td>Engineering Mechanics (Dynamics)</td>
<td>4</td>
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<tr>
<td>Engr. 15</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Engr. 41. Circuits, Electronics, and Electromechanics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Engr. 161. Engineering Economy</td>
<td>3</td>
<td></td>
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<tr>
<td>Geol. 1</td>
<td>Physical Geology</td>
<td>5</td>
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<tr>
<td>Geol. 2</td>
<td>Historical Geology</td>
<td>5</td>
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<tr>
<td>Geol. 25</td>
<td>Elementary Mineralogy and Crystallography</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 105</td>
<td>Structural Geology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 51. Petrology or Geol. 157. Sedimentary Petrology</td>
<td>5 or 3</td>
<td></td>
</tr>
<tr>
<td>Pet.E. 103</td>
<td>A Survey of the Petroleum Industry</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 108</td>
<td>Petroleum Reservoir Fluids Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>Pet.E. 150a, 150b, 150c. Formation Evaluation</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Pet.E. 151a. Petroleum Reservoir Fluids</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pet.E. 151b. Fluid Behavior in Reservoir Rocks</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pet.E. 152. Development and Production Technology</td>
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<td>Pet.E. 153. Development and Production Laboratory</td>
<td>4</td>
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<tr>
<td>Pet.E. 160</td>
<td>Report on Oil Field Training</td>
<td>1</td>
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<tr>
<td>Social Sciences.*</td>
<td>(General Studies Requirement)</td>
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<tr>
<td>Group Activity</td>
<td>(General Studies Requirement)</td>
<td>(6)</td>
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<tr>
<td>Humanities</td>
<td>(General Studies Requirement)</td>
<td>8</td>
</tr>
<tr>
<td>Restricted Electives</td>
<td>8</td>
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</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. 272b.</td>
<td>Natural Gas Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Electives*</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

Total 45


* 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 foreign languages: Russian or German plus French or Spanish. His record must indicate outstanding scholarship. He must pass the Departmental oral examination. He must fulfill the requirements of the minor department, if a minor is elected. He must pass the University oral examination, which is essentially a defense of the dissertation problem. He must prepare under faculty supervision a dissertation which is a contribution to knowledge and the result of independent work expressed in satisfactory form.

The Ph.D. dissertation must be submitted in its final form within five calendar years from the date of admission to candidacy by the University Committee on the Graduate Division. Candidates for the degree who fail to meet this deadline will be required to 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: Chemistry 3 (or consent of instructor).

3 units, spring, (Marsden), TWF 11

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

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


3 units, autumn, (———), MWF 10

3 units, winter, (———), MWF 9

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

2 units, spring, (———), WF 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, (Marsden), 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 and Th 9, alternate years, to be given in 1965-66

153. **Development and Production Laboratory**—Core analysis, methods, applications. Testing, treatment of drilling fluids. Formation resistivity factor. Prerequisite: 151b.

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

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

1 unit, any quarter, (Staff), by arrangement

267. **Engineering Valuation and Appraisal of Oil and Gas Properties**—Seminar, problems. Methods in appraising oil lands; estimation of productive capacity, reserves; operating costs, depreciation of materials, salvage, value of future profits, tax returns. Prerequisites: 151b and 152.

3 units, winter, (Miller), S 9-12, alternate years, to be given in 1965-66


3 units, autumn, (Miller), MWF 11


3 units, winter, (Miller), MWF 11

270c. **Applications of Oil Reservoir Engineering**—Lectures, seminar. Advanced group study of reservoir engineering: Applications of electronic computing machinery to reservoir problems. Prerequisite: 270b.

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

271. **Advanced Production and Reservoir Engineering Laboratory**—Cappillary 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, reserve estimation, underground storage. Prerequisite: consent of instructor.

*2 units, spring, (——), by arrangement*

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

*Any quarter, (Marsden, Miller), by arrangement*
SCHOOL OF EDUCATION

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

Dean: I. James Quillen


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

Acting Instructor: J. Mudra

Lecturers: Guy H. Browning, Kenneth J. Cooper, James B. Lyon, William J. Platt, 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, Howard Dallmar, William Paul Fehring, Charles E. Finger, James Gaughran, John C. Gilmore, Joseph R. Higgins, Conrad Jarvis, Payton Jordan, William L. Leland, Raymond E. Lunny, Jr., Rudolph Morgan, Virginia Puich, John Ralston, Clifford F. Weigle, and J. Raymond Young.

The School of Education is responsible for the preparation of teachers, supervisors, guidance workers, administrators, and other educational specialists. 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 completed by the student. The University recommends to the California State Board of Education that credentials be granted.

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

The University offers no correspondence or extension courses.

SUMMER SESSION

The full Summer Session in the School of Education is for eight weeks. In addition, several one-, two-, three-, and four-week workshops and institutes are offered which make it possible for students to earn credit in shorter periods of time. However, those who pursue a full program of study for eight weeks may earn a quarter of residence toward degree and credential programs. The number of units for which a student may register in the Summer Session may not exceed 16, unless part of the registration is for thesis or dissertation.
In the listing of courses below, only those which can be reasonably scheduled at this time are listed for the Summer Session, and there may be changes in these. The Summer Session Bulletin, issued each year in February, will contain more definite information.

PROGRAMS OF STUDY

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

<table>
<thead>
<tr>
<th>Degree</th>
<th>Credential</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M.</td>
<td>Teaching Credential (Secondary)</td>
</tr>
<tr>
<td></td>
<td>Teaching Credential (Junior College)</td>
</tr>
<tr>
<td></td>
<td>Standard Designated Services Credential with a Specialization in Pupil Personnel Services</td>
</tr>
<tr>
<td></td>
<td>Standard Supervision Credential (requires two years of postgraduate education)</td>
</tr>
<tr>
<td>M.A.T.</td>
<td>Not usually associated with a credential because this program is for experienced teachers</td>
</tr>
<tr>
<td>Ed.D.</td>
<td>Administration Credential</td>
</tr>
</tbody>
</table>

GRADUATE DEGREES

Students who wish to be candidates for the Ed.D. or Ph.D. degree are urged to write to the Office of the Dean, School of Education, for full information. The sections below summarize the requirements for the degrees but do not describe the programs in detail. The details are supplied upon request by the Office of the Dean, School of Education.

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

Students working toward graduate degrees should follow the suggestions outlined under each degree. Students applying for the Master’s, 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.

<table>
<thead>
<tr>
<th>General School Administration</th>
<th>Overseas and/or Comparative Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary School Education</td>
<td>Psychological Foundations of Education</td>
</tr>
<tr>
<td>Secondary School Education</td>
<td>Social Foundations of Education</td>
</tr>
<tr>
<td>Higher Education</td>
<td>Health Education</td>
</tr>
<tr>
<td>Junior College</td>
<td>General Curriculum</td>
</tr>
<tr>
<td>Guidance</td>
<td>Child Development</td>
</tr>
<tr>
<td>Philosophy and/or History of Education</td>
<td>Educational Research</td>
</tr>
</tbody>
</table>

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 after 12 units of advanced graduate work have been completed at Stanford. Application forms may be obtained at the office of the School of Education.

### Master of Arts*

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

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

* Candidates seeking initial preparation for teaching, by way of a teaching-internship, may prepare for the degree of Master of Arts in Education as well as for a credential. See "Teaching Credential (Secondary)" for pertinent information.
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, are to be submitted to the Master of Arts secretary in the School of Education two quarters before the conferring of the degree:
   a) Transcripts of all academic work previously taken.
   b) A proposed program of courses for the degree, signed by the adviser.

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

4. Completion of student teaching, internship, 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.


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

List of current advisers, programs of study, and order of procedure should be obtained from the School of Education Credential Secretary during registration day in the first quarter of residence.

Master of Arts in Teaching*

The degree of Master of Arts in Teaching is offered jointly by the following academic departments and the School of Education: Art, Biology, Chemistry, Classics, English, French and Italian, History, Mathematics, Modern European Languages, Physical Sciences, Physics, Political Science, Sociology, and Speech and Drama. In

* The degree of Master of Arts in Teaching is ordinarily reserved for experienced teachers or for individuals who have previously completed a program of teacher preparation. Candidates seeking their initial preparation for teaching by way of a teaching-internship may prepare for the degree of Master of Arts in Education as well as for a credential. See “Teaching Credential (Secondary)” for pertinent details.
addition to these fields, it is possible for candidates to work out special programs in areas such as the social sciences and humanities. General requirements for the degree include these:

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

2. The candidate must have a teaching credential and must submit evidence of having had one or more years of successful teaching experience.

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

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

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

6. At least 12 units of the MAT requirements shall consist of graduate courses in the School of Education at Stanford. Certain courses cross-listed in two departments may be used to satisfy requirements in either the academic department or the School of Education, but the same courses may not be used to meet requirements in both departments. Requirements for the School of Education consist of recent advanced courses in the following areas to supplement the candidate's preparation:
   a) Curriculum and methods in the candidate's teaching field.
   b) General curriculum in Secondary or Elementary education.
   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 at least one full quarter (a minimum of 12 quarter units) must be outside the field of education. Evaluation of Stanford residence is based on tuition payments. Candidates for the degree will be required during the course of work to register at Stanford for a minimum of one academic year (three quarters). A minimum of two of these quarters must be in consecutive full-time residence. All requirements for the degree must be completed within five years after the candidate has passed his qualifying examinations. Graduate course work beyond the Master's degree taken seven or more years ago will not ordinarily be included in the doctoral program. Applicants 45 years of age and over are not admitted to the doctoral program in education.

Organization of Program—The candidate for the Ed.D. degree will organize his program in conference with an adviser in his field of concentration. The adviser will make recommendations to the Committee on Advanced Graduate Degrees in connection with application for candidacy, will aid in planning, approve the program of the individual, and function as adviser on research for dissertation. The adviser will be aided by other members of the faculty in the direction of the research program.

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

Doctor of Philosophy

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

Residence—Nine quarters of graduate study (a minimum of 135 units) beyond the baccalaureate degree are required for the doctorate, which must include a minor field of study if the candidate does not hold a Master's degree outside the field of education. Evaluation of Stanford residence is based on tuition payments. Candidates for the degree will be required during the course of work to register at Stanford for a minimum of one academic year (three quarters). A minimum of two of these quarters must be in consecutive full-time residence. All requirements for the degree must be completed within five years from the date the applicant is admitted to Ph.D. candidacy by the University Committee on the Graduate Division. Graduate course work beyond the Master's degree taken seven or more years ago will not ordinarily be included in the doctoral program. Applicants 45 years of age and over are not admitted to the doctoral program in education.
Organization of Program—Considerable flexibility is allowed in projecting a program for the Ph.D. degree. The candidate will be expected to organize his program of work for the degree in conference with an adviser in his field of concentration. All programs require the approval of the School of Education Committee on Advanced Graduate Degrees and the University Committee on the Graduate Division. Complete information concerning 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 the Chairman of the Committee on Advanced Graduate Degrees in the School of Education.

CREDENTIALS FOR PUBLIC SCHOOL SERVICE

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

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

ADMINISTRATION AND SUPERVISION CREDENTIALS

The Stanford School of Education is authorized to recommend the supervision and administration credentials described below. Information about current advisers, programs of study, and application procedures should be obtained from the Credential Secretary in the School of Education, Room eC5, on or shortly after registration day in the first quarter of residence.

The Standard Supervision Credential authorizes the holder to serve as supervisor, consultant, coordinator or equivalent supervisory or intermediate administrative position. Contingent upon completion of course work, the Supervision Credential is designed to prepare the applicant to serve in an area in which his basic credential authorizes him to teach or serve: elementary principalship, secondary principalship, junior college principalship, elementary school supervision, secondary school supervision, junior college supervision, subject field supervision, supervision of special education, supervision concerning instructional aids, or any additional capacity when approved by the State Board of Education.

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

Requirements for the Standard Supervision Credential

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

Requirements for the Administration Credential

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

Teaching Credentials

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

Standard Teaching Credential (Secondary), 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 in the major teaching area.

Standard Teaching Credential (Junior College), 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.
3. Fulfillment of the Constitution Requirement, either by passing an examination or by taking satisfactory course work. The following courses at Stanford will satisfy this requirement: Political Science 10, History 60, or History 151.
4. Approval by the appropriate committee, based on scholarship and other requisites for successful teaching.

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

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

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

A brief summary of these credentials follows.

Teaching Credential (Secondary)—Secondary Internship Program

Candidates preparing for the Standard Teaching Credential with a specialization in Secondary School Teaching can also complete requirements for a Master of Arts degree in Education. Consult Master of Arts secretary, Room eC5 for information.

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

1. Eligibility. Graduates of colleges and universities of recognized standing are eligible to apply if they have maintained at least a B— academic average in undergraduate and graduate courses. Because the number of internships is limited, persons meeting minimum requirements are not assured of admission to the program.

2. Closing date for filing applications. Completed applications (available from the Secondary Teacher Education Office, School of Education) should be filed no later than the fifteenth of March. However, candidates who wish to receive consideration for scholarship awards must have their applications filed by January 15. Candidates who intend to earn the credential through a teaching major in a modern foreign language are urged to submit their scores in the ETS-MLA test for advanced students and teachers at the time of their application.

3. Personal interviews. Three personal interview dates have been established for intern applicants. At the time a candidate submits his application, he should indicate which of these dates is most convenient. In unusual cases it is possible to petition to have the personal interview waived.
   a) Saturday, December 18, 1965
   b) Saturday, January 22, 1966
   c) Saturday, March 12, 1966

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

5. School internship. Cooperating high schools will consider for employment persons who have been admitted to preliminary candidacy. School placement is a requisite of internship. However, placement may be guaranteed for outstanding candidates at the time of admission. Employment interviews are arranged by the Intern Office. The intern normally spends a half day in school, including teaching two classes. In return, the intern receives about one third of the salary for a beginning teacher (approximately $2000). The intern spends the balance of his half day in school in supplementary activities, such as classroom observation.

6. Requirements. To complete the program in Secondary School Teaching, the candidate must satisfy the following requirements. Requirements marked (*) are normally completed prior to admission. Requirements marked (**) are normally substantially completed prior to admission, but provision has been made within the program for their completion. Other requirements are normally completed as a part of the program itself.
*a) A four-year college course with a Bachelor’s degree with 68 quarter units (45 semester hours) in general studies including work in at least four of the following six fields

1) Humanities, excluding foreign languages but including a year of English. (Competency in composition must be demonstrated, either by completing a college course or passing an examination.) This field is required as one of the four.

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

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

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

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

6) A foreign language.

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

**b) A teaching major consisting of a minimum of 36 quarter units (24 semester units) of upper division or graduate courses. This State minimum requirement is typically exceeded by Stanford’s requirements. Requirements for specific majors may be obtained from the Credential Secretary of the School of Education, Room eC5. Stanford offers the credential in the following major fields only: Art, English, Mathematics, Modern Language, Music, Physical Education (Men), Physical Sciences, Biological Sciences, Social Studies, Speech and Drama.

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

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

**Requirements for the Secondary Teaching Internship Program**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Quarter Given</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ed. 211a, b</td>
<td>Psychological Foundations</td>
<td>Su A</td>
<td>6</td>
</tr>
<tr>
<td>Ed. 211c</td>
<td>Social Foundations</td>
<td>W</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 260 Series</td>
<td>Curriculum and Instruction in Major Teaching Field</td>
<td>Summer</td>
<td>3</td>
</tr>
<tr>
<td>260b, c.</td>
<td>Curriculum and Instruction in Major Teaching Field</td>
<td>AW</td>
<td>2</td>
</tr>
<tr>
<td>260d.</td>
<td>Curriculum and Instruction in Major Teaching Field</td>
<td>S</td>
<td>1</td>
</tr>
<tr>
<td>Ed. 240 Series</td>
<td>Secondary Education</td>
<td>Summer</td>
<td>3</td>
</tr>
<tr>
<td>240a.</td>
<td>Secondary Education</td>
<td>AW</td>
<td>2</td>
</tr>
<tr>
<td>240d.</td>
<td>Secondary Education</td>
<td>S</td>
<td>1</td>
</tr>
<tr>
<td>Ed. 246 Series</td>
<td>Instruction Laboratory</td>
<td>Summer</td>
<td>3</td>
</tr>
<tr>
<td>246a.</td>
<td>Internship</td>
<td>A</td>
<td>3</td>
</tr>
<tr>
<td>246b.</td>
<td>Internship</td>
<td>W</td>
<td>4</td>
</tr>
<tr>
<td>246c.</td>
<td>Internship</td>
<td>S</td>
<td>4</td>
</tr>
</tbody>
</table>

Total ........................................................................................................... 47-54

(Ed. 212 History/Philosophy—required for A.M. only .. S 4)
The Graduate Record Examination (Aptitude test and advanced subject test) is required for admission.

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

Standard Teaching Credential (Junior College)

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

1. Completion of professional course requirements, which include a course or courses in the psychological foundations of education, curriculum and instructional procedures and materials (normally taken during the summer or autumn), and practice teaching.
2. Completion of the Master's degree in the teaching major.
3. Completion of a teaching major and a teaching minor satisfactory to the departments concerned. For details consult the Credential Secretary of the School of Education.
4. Completion of general education courses prescribed by the California Administrative and Education Codes.
5. Acceptance by the academic department and the School of Education.

Standard Designated Services Credential with a Specialization in Pupil Personnel Services

Stanford University is authorized to recommend candidates for the Standard Designated Services Credential with a Specialization in Pupil Personnel Services, which is necessary for certification in counseling and school psychology. Two programs for counseling are available depending upon the candidate's present or anticipated teaching experience.

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

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ed. 230</td>
<td>Foundations of Guidance, or</td>
<td></td>
</tr>
<tr>
<td>Ed. 230a</td>
<td>Guidance in Elementary Schools</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 215</td>
<td>Psychological Foundations of Education</td>
<td>4</td>
</tr>
<tr>
<td>Psych. 160</td>
<td>Abnormal Psychology</td>
<td>4</td>
</tr>
<tr>
<td>Psych. 191</td>
<td>Seminar in Behavior Change</td>
<td>2</td>
</tr>
<tr>
<td>Ed. 333a</td>
<td>Counseling Techniques: The Interview</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 333b</td>
<td>Counseling Techniques: Testing</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 312</td>
<td>Occupational Trends</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 216</td>
<td>Statistical Analysis in Education</td>
<td>3</td>
</tr>
<tr>
<td>Psych. 190</td>
<td>Exceptional Children</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 398</td>
<td>Reading in Secondary Schools</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 323</td>
<td>Public School Law</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 333c</td>
<td>Counseling Techniques Practicum</td>
<td>9</td>
</tr>
</tbody>
</table>

2. Candidates who desire to qualify as school counselors and who have not had (or will not be able to obtain) three years of successful full-time teaching experience may qualify for the credential by meeting the following minimum requirements:
a) All the requirements listed under 1 (above).
b) A total of 90 quarter units in graduate level course work to be planned with the adviser and to include preparation in the field of education and other disciplines. The required additional courses will include as a minimum the following or their equivalent:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ed. 251</td>
<td>Educational Testing and Evaluation</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 204</td>
<td>Philosophy of Education, or</td>
<td>4</td>
</tr>
<tr>
<td>Ed. 200</td>
<td>History of Education</td>
<td>3</td>
</tr>
<tr>
<td>Psych. 119</td>
<td>Adolescent Development, or</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 116</td>
<td>Development in Middle Childhood</td>
<td>3</td>
</tr>
</tbody>
</table>

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

Authorization in School Psychology

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

a) Must be doctoral candidates who have been admitted through the preliminary interview.
b) Must have met all the requirements in either 1 or 2 (above).
c) Must have completed the following courses satisfactorily:

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

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

COURSES IN OTHER DIVISIONS OF THE UNIVERSITY

It is required that workers in education have thorough backgrounds in areas outside of professional work. Students are therefore urged to consider the courses offered in other divisions of the University in planning their programs.

COURSES IN EDUCATION

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

The various courses are distributed as follows:

- Foundations of Education (Digits 00-19), i.e., 218, Health Foundations of Education
- Administration (Digits 20-29), i.e., 320a, b, c. 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 55-59 and 70-79), i.e., 155, Elementary Analysis of Body Movement
Special Curriculum and Instruction in Other Fields (Digits 60-69 and 80-99), i.e., 261a, b, c, d, Curriculum and Instruction in Secondary School Art

**JUNIOR-SENIOR**

These courses are also open to graduate students.

111. Developmental Psychology—(Enroll in Psychology 111.)
113. Adolescent Development—(Enroll in Psychology 113.)
116. Development in Middle Childhood—Development of the child from six to twelve. Research readings, observations, development of case study materials. Pre-requisite: Psychology 111 or equivalent.

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

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

2 to 4 units, autumn, winter, spring, (Staff), by arrangement

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

3 units, spring, (Grommon), Th 4:15-6:05 and by arrangement

**GRADUATE**

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

200. History of Education—Foundational course in educational history meeting advanced degree requirements. Survey; emphasis upon European backgrounds, educators, schools, covering period from “Golden Age” of Greece to twentieth century.

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

4 units, summer, (Gross), MTWTh 1:15 and by arrangement

201. History of Education in the United States—Detailed study of American educational history in its cultural setting. Education 200 will provide a helpful background but is not a pre-requisite.

4 units, summer, (——), MTWThF 10

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

4 units, winter, (Thomas), MTWTh 9
summer, (Thomas), MTWThF 2:15

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

4 units, summer, (——), MTWThF 2:15

3 units, winter, (Hanna), TWTh 2:15

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

4 units, autumn, (——), MTWTh 1:15
summer, (——), MTWThF 11

The following courses in the Foundations of Education are taken by students admitted to the program for the secondary teaching internship. Students enrolled in other programs select foundation courses from 200, 204, 206, 210, 215, 218.
211a. Foundations of Education: Psychological—Application of psychological principles to problems of learning and development. Major topics include learning, personality development, social interaction, and theories of instruction. Prerequisite: Psychology 1 or equivalent.

3 units, summer, (McDonald), MTWTh 1:15

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

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

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

3 units, winter, (———), M 4:15–6:05 and W 4:15


4 units, spring, (Gross, Thomas), MW 4:15–6:05

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

4 units, autumn, (———), MTWTh 11

summer, (———), MTWTh 8 and by arrangement

216. Introduction to Statistical Analysis in Education—Introduction to statistical description and inference in study and conduct of educational research. No previous college mathematics necessary. This or equivalent required of all doctoral candidates.

3 units, autumn, (Coladarci), MWF 2:15

spring, (Atkinson), MWF 1:15

217. Mental Hygiene—Recent developments in theory and practice leading to understanding of bases for emotional, personality disturbances. Prerequisite: 215 or permission of instructor.

3 units, autumn, (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

winter, (Byrd), MWF 11

4 units, summer, (Byrd), MTWThF 9

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

3 units, winter, (Odell), Th 7–10 p.m.

4 units, summer, (Odell, Strand), MTWThF 9

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

3 units, autumn, (Sowards), Th 7–10 p.m.

4 units, summer, (———), MTWThF 9

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

3 units, winter, (Boyan), Th 7–10 p.m.

4 units, summer, (Boyan), MTWThF 11
225. Field Practice in Elementary School Supervision and Administration—Field practice in elementary school administration and supervision that will meet requirements for California Elementary School Administration Credential and California Supervision Credential. Consent of instructor required.
   1 to 6 units, autumn, winter, spring, (Sowards, Shaftel, James), by arrangement

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

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

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

   3 units, autumn, (McDaniel), M 7–10 p.m.
   4 units, summer, (—), MTWThF 3:15

   3 units, spring, (Sears), MW 4:15–5:30

239a, b. Observation of Study Skills and Developmental Reading in College, and Directed Teaching of Study Skills and Developmental Reading—Two-quarter practicum, to be taken in sequence. Two-hour weekly seminar plus individual conferences with instructor supplement required observation (239a) and directed teaching (239b) of regular college class in developmental reading, study skills.
   4 units, autumn, winter, spring, (Browning), by arrangement

240a. Secondary Education: Instructional Problems—An orientation to the American Secondary School with a focus on the problems of teaching. Topics are specifically related to the instruction laboratory (246a) which is taken concurrently. Prerequisite: admission to the Secondary Education Program.
   3 units, summer, (Allen), MTWTh 2:15

240b. Secondary Education: Student Problems—Consideration of typical student personnel problems confronting the beginning teacher. Specifically related to the internship experience (246b) which is taken concurrently. Prerequisite: 240a.
   1 unit, autumn, (Boyans), W 5:15

240c. Secondary Education: Curriculum Problems—Consideration of problems and issues of curriculum design, including the relationship between instruction in various subject areas of the secondary school curriculum. Specifically related to the internship experience (246c) which is taken concurrently. Prerequisite: 240b.
   1 unit, winter, (Bush), W 5:15

240d. Secondary Education: Staff and Organizational Problems—Consideration of the administrative structure of the secondary school, including proposals for change. Problems of internal communication and staff relationships. Specifically related to the internship experience (246d) which is taken concurrently. Prerequisite: 240c.
   1 unit, spring, (Boyans), T 5:15 and by arrangement

241. Audio-Visual Aids—Theory and laboratory course to acquaint teachers with audio-visual principles, materials, equipment.
   3 units, spring, (Mudra), M 7–10 p.m.
   summer, (Mudra), MTWThF 1:15

241a. Audio-Visual Laboratory—To acquaint elementary credential students with the use of audio-visual equipment. Enrollment limited. (Students must enroll in School of Education office.)
   1 unit, autumn, winter, (Mudra), M or W 4:15
242. **Student Teaching in Speech Correction**—Supervised teaching in speech therapy and lip reading in public schools in partial fulfillment of requirements for special credential in these fields.

2 to 5 units, autumn, winter, spring, (Puich), by arrangement

246a. **Instruction Laboratory: Micro-teaching Clinic**—Training and practice in specific skills of teaching. Micro-teaching is a closely controlled teaching encounter. Candidates teach 5- or 10-minute lessons at first to one student and later to increased numbers of students. These lessons are subjected to a critique by supervisors and students. The clinic is closely associated with concurrent courses in the secondary education program: 211a, 240a, and the 260 series course in the teaching major. Open to candidates for the Standard Teaching Credential (Secondary).

3 units, summer, (Allen), MTWThF 8-1 and 4:15

246b, c, d. **Internship in Teaching**—Field experience in local secondary schools. Taken during each quarter of internship. Includes a 1-hour weekly meeting with Stanford tutor supervisors. Prerequisite: 246a.

246b. 2 to 6 units, autumn, (Allen), by arrangement

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

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

248. **Student Teaching in the Junior College.**

3 to 6 units, autumn, winter, spring, (Mayhew), by arrangement (total of 6 units required)

250a. **Statistical Analysis in Educational Research**—Designed for graduate students planning to use statistical methods in their research. Foundations of statistical inference. Review of special hypotheses and test procedures for the normal distribution. Non-parametric analysis. Prerequisite: 216 or equivalent.

3 units, winter, (Olkin), MW 11:00-12:30

250b. **Statistical Analysis in Educational Research**—Continuation of 250a. Regression and correlation analysis, measures of association, analysis of variance and covariance. Prerequisite: 250a.

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

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

4 units, summer, (Krumbolts), MTWTh 1:15 and by arrangement

252. **Introduction to Test Theory**—Concepts of reliability and validity; mathematical models underlying commonly used procedures for test analysis. Test scales and norms. Prerequisite: Psychology 60 or Education 216.

3 to 4 units, autumn, (Cronbach), MW 2:15-4:05, alternate years, to be given in 1965-66

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

3 units, spring, (Cronbach), MWF 9, alternate years, to be given in 1965-66

**Curriculum and Instruction in Secondary School Major Teaching Fields**

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

261a, b, c, d. **Curriculum and Instruction in Secondary School Art**—Lectures on foundations of art education; curriculum development in art education; exploration of methods and materials.

261a. 3 units, summer, (———), MTWTh 3:15

261b. 1 unit, autumn, (———), T 4:15-6:05

261c. 1 unit, winter, (———), T 4:15-6:05

261d. 1 unit, spring, (———), T 4:15-6:05
262a, b, c, d. Curriculum and Instruction in Secondary School English—Evaluation of conflicting views of programs of language arts; study of research and recommendations for teaching of composition, critical thinking, semantics, grammar, usage, punctuation, spelling; study of recommendations for teaching of reading and of the various types of literature.

262a. 3 units, summer, (———), MTWTh 3:15
262b. 1 unit, autumn, (Grommon), T 4:15-6:05
262c. 1 unit, winter, (Grommon), T 4:15-6:05
262d. 1 unit, spring, (Grommon), T 4:15-6:05

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

263a. 3 units, summer, (———), MTWTh 3:15
263b. 1 unit, autumn, (Begle), T 4:15-6:05
263c. 1 unit, winter, (Begle), T 4:15-6:05
263d. 1 unit, spring, (Begle), T 4:15-6:05

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

264a. 3 units, summer, (Politser), MTWTh 3:15
264b. 1 unit, autumn, (Politser), T 4:15-6:05
264c. 1 unit, winter, (Politser), T 4:15-6:05
264d. 1 unit, spring, (Politser), T 4:15-6:05

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

265a. 3 units, summer, (Kuhn), MTWTh 3:15
265b. 1 unit, autumn, (Kuhn), T 4:15-6:05
265c. 1 unit, winter, (Kuhn), T 4:15-6:05
265d. 1 unit, spring, (Kuhn), T 4:15-6:05

266a, b, c, d. Curriculum and Instruction in Secondary School Physical Education (Men)—Major emphasis on knowledge of the activities basic to school physical education and athletic programs. Also involves teaching techniques, curricular materials, and evaluation. Theoretical and practical training.

266a. 3 units, summer, (Ruff), MTWTh 3:15
266b. 1 unit, autumn, (Nixon), T 4:15-6:05
266c. 1 unit, winter, (Nixon), T 4:15-6:05
266d. 1 unit, spring, (Nixon), T 4:15-6:05

267a, b, c, d. Curriculum and Instruction in Secondary School Science—Introduction to objectives of secondary science teaching; selection and organization of teaching units; laboratory and demonstration techniques; tests, evaluation. Emphasis upon instructional materials, community resources for science teaching. Special attention to science fair, junior academy, field trip, junior research, special programs of scientific societies and industry for high school science students.

267a. 3 units, summer, (———), MTWTh 3:15
267b. 1 unit, autumn, (Hurd), T 4:15-6:05
267c. 1 unit, winter, (Hurd), T 4:15-6:05
267d. 1 unit, spring, (Hurd), T 4:15-6:05

268a, b, c, d. Curriculum and Instruction in Secondary School Social Studies—Emphasis on the methodology of social studies instruction; review of curriculum trends; survey of teaching materials; opportunities to develop teaching and resource units.

268a. 3 units, summer, (Gross), MTWTh 3:15
268b. 1 unit, autumn, (Gross), T 4:15-6:05
268c. 1 unit, winter, (Gross), T 4:15-6:05
268d. 1 unit, spring, (Gross), T 4:15-6:05
269a, b, c, d. Curriculum and Instruction in Secondary School Speech and Drama—Theory, practice in curriculum and instruction in speech and drama.

269a. 3 units, summer, (———), MTWTh 3:15
269b. 1 unit, autumn, (———), T 4:15-6:05
269c. 1 unit, winter, (Schrader), T 4:15-6:05
269d. 1 unit, spring, (Schrader), T 4:15-6:05

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

4 units, summer, (Politser), MTWThF 1:15

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

2 units, winter, (Weir), TTh 10


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

287. German Applied Linguistics—(Same as German 190).

2 units, winter, (Politser), T 2:15-4:05

288. Methods of Teaching French—(Same as French TF288).

3 units, winter, (Politser), M 4:15-6:05 and by arrangement

289. Curriculum and Instruction in the Junior College—Curriculum and methods of teaching in junior colleges.

3 units, winter, (Mayhezv), M 7-10 p.m.

291. Methods of Teaching German—(Same as German 200).

3 units, spring, (Lohnes), MWF 11

292. Methods of Teaching Spanish—(Same as Spanish 200).

2 units, winter, (Morgan), TTh 3:15

293. Seminar for Science and Mathematics Teachers—Lectures by guest scientists and mathematicians; field trips to research laboratories. (Enrollment limited to Shell Merit Fellows.)

4 units, summer, (Hurd), MTWTh 11:00-1:30; field trips F 11-5

295. Use of the Language Laboratory—(Same as Modern European Languages T200).

2 units, autumn, (Morgan), T 7-9 p.m.

297. Seminar in the Development of Laboratory Techniques—(Same as Modern European Languages T201).

2 units, summer, (Morgan), TTh 1:15 and by arrangement

298. Practice Teaching in Foreign Languages in the Elementary School.

1 unit, any quarter, (Staff), by arrangement

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

3 units, winter, (Iverson), W 7-10 p.m.

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

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, spring, (Sanford), T 4:15-6:05

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

4 units, autumn, (Cowley), TTh 2:15-4:05

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
summer, (Quillen), MTWTh/F 10

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

3 units, spring, (McDaniel), T 3:15-4:05 and Th 3:15-5:05

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 1:15
4 units, summer, (Coladarci), MTWTh/F 9

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. (Same as Anthropology 256.)

3 units, autumn, (Spindler), M 7-10 p.m.
4 units, summer, (——), MTWTh/F 9

316. Advanced Educational Psychology II—Principles of learning and motivation relevant to the study of classroom behavior. Prerequisite: 314.

3 units, autumn, 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, (——), MWF 3:15
4 units, summer, (——), MTWTh/F 9 and by arrangement

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

320a. 3 units, autumn, (Strand), W 7-10 p.m.
320b. 3 units, winter, (Odell), W 7-10 p.m.
320c. 3 units, spring, (Odell), W 7-10 p.m.

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

3 units, spring, (Sowards), 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.

322a. 4 units, autumn, (Boyan), Th 7-9 p.m. and by arrangement
322b. 2 units, winter, (Boyan), W 7-9 p.m.
322c. 2 units, spring, (Boyan), W 7-9 p.m.
323. Public School Law—Nature of legal responsibilities faced by public school administrator; resources available to him for solution of legal problems. Specifically designed to meet requirements for California administrative credentials.
   3 units, spring, (James), M 7-10 p.m.
   4 units, summer, (James), MTWThF 2:15

324. School Staff Personnel Problems—For experienced teachers, administrators. Recruitment, selection, placement of teachers; orientation of new teachers; administrative responsibilities for in-service education; staff participation in salary scheduling and other aspects of economic welfare of teachers; administrator-teacher relations; codes of ethics; merit rating; certification, tenure. Education 324 serves as an equivalent for 340, which is a requirement for individuals pursuing the programs for the “old” Elementary, Secondary, and General Administration Credentials. Education 324 is also a requirement for the “new” Standard Supervision and Standard Administration Credentials.
   3 units, spring, (Boyan), Th 7-10 p.m.
   4 units, summer, (Boyan), MTWThF 2:15

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

   3 units, autumn, (James), M 7-10 p.m.
   4 units, summer, (James), MTWThF 3:15

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

   1 to 3 units, autumn, winter, spring, (Boyan), by arrangement

329. American Higher Education II—This course is a continuation of 308 and examines the development of the research and auxiliary functions of American colleges and universities. Although 308 is not a prerequisite, students are encouraged to take it first.
   4 units, winter, (Cowley), TTh 1:15-3:05

333a. Counseling Techniques: The Interview—Basic concepts, practices of counseling interview. For graduate students who expect to become school counselors.
   4 units, winter, (McDaniel), MW 1:15-3:05

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 1:15-3:05

333c. Counseling Techniques Practicum—Experience and observation in school counseling under supervised conditions. Placements made in nearby secondary schools. Student must arrange schedule so that he can spend eight hours per week for three terms in the secondary school in addition to a one-hour seminar each week. This sequence must be started in the autumn quarter.
   3 units, autumn, (Krumboltz), T 4:15 and eight hours per week by arrangement
   winter, (McDaniel, Krumboltz), T 4:15 and eight hours per week by arrangement
   spring, (McDaniel, Krumboltz), T 4:15 and eight hours per week by arrangement
333d. Practicum in School Psychology—Supervised experience in the work of the school psychologist. Open only to doctoral candidates in guidance.
   3 units, autumn, winter, spring, (McDaniel), by arrangement

334. Counseling Center Practicum—Experience in college counseling center operations, including testing and counseling. Placements made through Stanford Counseling and Testing Center. By permission. May be repeated for credit.
   2 to 4 units, autumn, winter, 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 1:15-3:05

338. Student Personnel Services in Higher Education—Critical examination of operation of student personnel services in American colleges and universities.
   3 units, autumn, ( ), F 10-12 and by arrangement

   4 units, winter, (Bush), MW 8-10
   2 to 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.

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

345. Sociodrama and Related Techniques—Designed to help classroom teachers explore the rationale and skills for role-playing, dramatic play, and related techniques as teaching tools for inter-personal relations, cross-cultural understanding, and decision-making in the social studies.
   3 units, winter, (Shaftel), Th 7-10 p.m.

347. The Junior College—Suggested for all candidates for junior college credential. Philosophy, problems of the junior college.
   3 units, autumn, (Mayhew), M 7-10 p.m.
   4 units, summer, (Mayhew), MTWThF 1:15

348. American Higher Education III—An examination of the self-continuity functions of colleges and universities: their administration and government. Although 308 and 329 are not prerequisites, students are encouraged to take them first.
   4 units, spring, (Cowley), MW 1:15-3:05

349. Professional Education of Teachers—For doctoral candidates interested in studying programs and procedures for teacher education.
   4 units, spring, (Bush), TTh 1:15-3:05

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, winter, (Coladarci), MW 3:15-5:05
   spring, (Coladarci), MW 3:15-5:05

351a, b. Advanced Statistical Analysis in Educational Research—an advanced course in statistical methodology devoted to the analysis of multi-variables. Multivariate normal distribution, multiple regression, partial and multiple correlation, discriminant analysis, canonical correlation, factor analysis. Emphasis on computation procedures. Prerequisites: 250a, b or equivalent, and consent of instructor.
   3 units, autumn, (Olkin), MW 11-12:30
351b. 3 units, winter, (Olkin), by arrangement

353. Problems in Measurement—For prospective research workers. Survey of alternate mathematical models used in test construction and analysis covering such topics as profile analysis, measurement of gains, factor analysis, theory of personnel decisions. Prerequisites: 250b and 252, or equivalent.

3 to 4 units, autumn, (Cronbach), alternate years, to be given in 1966-67

354. Curriculum Evaluation—Functions of evaluation, outcomes to be measured, design of evaluation programs, qualities desired in evaluation instruments. For persons concerned with curriculum research. Prerequisites: 251 and 314, or permission of instructor.

3 to 4 units, winter, (Cronbach), M 7–10 p.m., alternate years, to be given in 1965–66

380. Recent Developments in Art Education—Current contributions of educational foundations to art education.

4 units, summer, (———), TTh 4:15–6:05 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. Use of audio-visual aids in language class. Programmed instruction in foreign languages.

3 units, autumn, (Politser), W 7–10 p.m.
4 units, summer, (Morgan), TTh 2:15–4:05 and by arrangement

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

4 units, autumn, (Iverson), W 7–10 p.m.
summer, (Iverson), MTWThF 11

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

3 units, spring, (Politser), W 7–10 p.m.

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

2 units, autumn, (Begle), by arrangement
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. Enrollment limited to Shell Merit Fellows.

3 units, summer, (———), TTh 2:15–4:05

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

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

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

4 units, spring, (Hurd), TTh 1:15–3:05
3 units, summer, (Hurd), MW 2:15–4:05


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

   4 units, autumn, (Shaftel), TTh 9-11
   summer, (Shaftel), MTWThF 1:15


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

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

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

Mass Communications in Society—See Communication 220.
Non-Commercial Station Operation—See Communication R201.
Teaching by Television—See Communication R203.
Television Production—See Communication R214.

SEMINARS AND INDIVIDUAL STUDY FOR
ADVANCED GRADUATE STUDENTS

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

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

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

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

406. Seminar in Comparative and Overseas Education—Restricted to candidates in this doctoral concentration.

   1 unit, autumn, (Textor, Staff), Th 12
   2 units, winter, spring, (Hanna, Staff), Th 12 and by arrangement
   summer, (Hanna, Staff), W 12 and by arrangement

406c. Culture and Education in Developing Nations—Concepts of culture and cultural relativism as analytical tools in defining and approaching problems of socioeconomic development in Africa, Asia, and Latin America. Relation of education to culture and national development will be explored. For comparative education majors and others planning careers as educators in the developing areas. (Same as Anthropology 228.)

   3 units, spring, (Textor), by arrangement

406i. Independent Study in Comparative Education.
   (Textor, Staff), by arrangement

407. Seminar on Techniques for Overseas Fieldwork in Education—Techniques for use in non-Western or developing areas, with special reference to research problems dealing with development and education. Attention will focus on problems of adaptation of structured research techniques to African, Asian, or Latin American cultural conditions without undue sacrifice of reliability. Prerequisites: 216 and 350 or equivalent, or consent of instructor.

   3 units, winter, (Textor), W 7-10 p.m.

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

411i. Individual Study in Child Development.
   (Sears), by arrangement
415. Seminar in Educational Psychology—Topical seminar for advanced students. Admission by permission of instructor.
   4 units, autumn, (Cronbach), by arrangement
   2 to 4 units, spring, (McDonald), by arrangement

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

416. Special Topics in Cultural Transmission—Seminar on cross-cultural data on cultural transmission. Prerequisite: 315 or permission of instructor.
   3 units, winter, (Spindler), to be given in 1967-68

   3 units, winter, (Atkinson), MWF 9

418i. Individual Study in Measurement and Research Methodology.
   (Atkinson, Coladarci, Cronbach, Olkin), by arrangement

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, spring, (Staff), by arrangement

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

423a, b, c. Seminar in School Planning—Designed for advanced candidates in school administration. The autumn quarter will be conducted as a seminar; the winter quarter will be devoted to master-planning the school plant; and the spring quarter to the development of educational specifications for the school plant. Prerequisite: 325 or equivalent, or consent of instructor.
   423a. 3 units, autumn, (MacConnell, Strand), Th 3:15-6:15
   423b. 3 units, winter, (MacConnell, Strand), Th 3:15-6:15
   423c. 3 units, spring, (MacConnell, Strand), Th 3:15-6:15

424a, b, c. Seminar in Junior College Administration—Curricular, teaching, administrative, and philosophical developments in Junior College Education.
   424a. 3 units, autumn, (Mayhew), W 7-10 p.m.
   424b. 3 units, winter, (Mayhew), W 7-10 p.m.
   424c. 3 units, 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.
   winter, spring, summer, (McDaniel, Krumbolts), Th 7:30-9:30 p.m.

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 4:15-5:30

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

444. Seminar in Elementary School Education for Doctoral Candidates—
Limited to advanced graduate students preparing for careers in this field of concentration.

2 to 10 units, autumn, (Sowards), TTh 2:15-4:05
winter, (Shaftel), TTh 1:15-3:05
spring, (Hanna), TTh 8-10
summer, (Sowards), MW 3:15-5:05 and by arrangement

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


2 units, autumn, (Boyan), T 3:30-5:30 (Administration emphasis)

spring, (Bush), T 3:15-5:05 (Teacher Personnel emphasis)

4 units, summer, (Bush), MW 3:15-5:05 and by arrangement

(Studen Personnel emphasis)

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

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

3 to 5 units, autumn, winter, spring, (Staff), by arrangement

448. Seminar in Higher Education—Examination of current problems in American colleges and universities and in higher education as a field of study.

4 units, winter, (Cowley), by arrangement

448i. Individual Study in Higher Education.
(Mayhew), by arrangement

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

452. Educational Specialist Research.
1 to 10 units, any quarter, (Staff), by arrangement

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

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

4 units, autumn, spring, (Cowley), by arrangement

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

480i. Individual Study in Curriculum and Instruction in Art.
(Staff), by arrangement

482i. Individual Study in Curriculum and Instruction in Modern Languages.
(Politzer), by arrangement

484i. Individual Study in Curriculum and Instruction in English.
(Grommon), by arrangement

486i. Individual Study in Curriculum and Instruction in Speech and Drama.
(Schroder), by arrangement

487i. Individual Study in Elementary School Language Arts.
(Iverson), by arrangement

490i. Individual Study in Curriculum and Instruction in Mathematics.
(Begle), by arrangement

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

2 to 3 units, autumn, winter, spring, (Begle), by arrangement
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), by arrangement

496. Seminar in Social Studies Education—For advanced students. Discussion of recent research and trends in social studies curriculum and instruction.
   3 units, winter, (Gross), W 7-10 p.m.

496i. Individual Study in Curriculum and Instruction in Social Studies.
   (Gross), by arrangement

499i. Individual Study in Reading in the Elementary School.
   (Iverson), by arrangement

Professional Physical Education Courses and Degrees for Men

Degrees

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

Teaching Credentials

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

2. Teaching Credential in Junior College. Men desiring to teach Physical Education classes and coach athletic teams at the Junior College level must earn an A.M. degree, with concentration in Physical Education, in order to qualify for the Standard Teaching Credential for the Junior College. This A.M. degree and Junior College Teaching Credential program may be completed at Stanford University as an extension of the basic preparation received in the Physical Education professional program described above. Transfer graduate students with A.B. or B.S. degrees in Physical Education from other institutions may enter this program.

Information

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

155. Elementary Analysis of Body Movement—Introduction to anatomical and mechanical aspects of human movement. Enrollment by permission of instructor.
   2 units, spring, (Ruch), TTh 8

156. Foundations of Physical Education—Psychological, biological and sociological bases of physical education, emphasizing basic research from the above disciplines, the body of knowledge of physical education and the development of sound principles from the above sources.
   3 units, autumn, (Nixon), MWF 8
159. Evaluation in Physical Education—Theory and principles of evaluation in physical education. Emphasis on test construction, the role of evaluation in physical education curriculum and instruction, and research.
3 units, winter, (Nixon), MWF 8

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

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

171b. Basketball.
2 units, autumn, (Dallmar), T 9 and by arrangement

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

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

171g. Athletic Conditioning.
2 units, autumn, winter, spring, (Jarvis), by arrangement

171h. Adapted Physical Education.
1 unit, spring, (Ruff), M 1:15

171j. Combatives.
2 units, winter, (Lunny, Leland), MWF 3:15

171k. Volleyball, Soccer, Speedball.
2 units, spring, (Ruff), MWF 2:15

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, (Gilmore), MWF 3:15 and by arrangement

171s. Tennis.
2 units, autumn, (Gilmore), WF 11 and by arrangement

176. Intramural Programs—The study of the theory and principles of intramural sports organization and administration, including program scope, competition media, scheduling, awards, evaluation, equipment, finance and personnel.
2 units, winter, (Higgins), TTh 9

179. Kinesiology—Application of anatomy, physiology, laws of mechanics to human motion. Prerequisite: Anatomy 114.
4 units, spring, (Ruch), MWF 1:15-3:05

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

357. Recent Developments in Public School Physical Education—An analysis of recent philosophic trends, research developments and trends, curriculum innovations, new teaching procedures, evaluation improvements, teacher education progress, and comparative physical education contributions from selected countries.
3 units, spring, (Nixon), M 7-10 p.m.
4 units, summer, (Nixon), MTWThF 9

358. Special Assignments, Physical Education—An opportunity for the graduate student to undertake the study of a significant problem in physical education or to engage in applied or basic research under the direction of the instructor.
1 to 5 units, any quarter, (Nixon, Ruff), by arrangement
458i. Individual Study in Physical Education—Required of doctoral candidates for the purpose of studying a significant problem or topic in physical education or engaging in applied or basic research under the direction of the instructor. 

2 to 6 units, any quarter, (Nixon, Ruff), by arrangement

459. Seminar in Physical Education—For advanced graduate students. Intensive study and discussion of recent research and crucial problems in the field of physical education.

3 units, winter, summer, (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: 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.M. and Ed.D. degrees with specialization in health education. Candidates interested in the field of education may secure the A.M. degree through the Department of Health Education. Candidates for the Master of Arts degree must complete at least 36 units of graduate work in the Department of Health Education. The degree of Doctor of Education may be recommended for those candidates who satisfy the requirements of the School of Education and who devote approximately one-half of their course work on the graduate level to certain offerings from the Department of Health Education. Complete information on this degree may be secured from the office of the Dean of the School of Education.

Undergraduate Courses

H100. 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, spring, (Cobb), MWF 9

H101. Medicine for the Layman—A nontechnical interpretation of current medical research and clinical experience as revealed in the medical literature. Medical abstracts are based upon articles selected, condensed, and reported by the instructor. Student inquiry and group discussions are based upon these samples of opinion, research, and experience of modern medicine.

3 units, autumn, winter, spring, (Byrd), MWF 10
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, MWF 9

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, winter, 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 are most crucial for happy marriage: health aspects, courtship and mate selection, finances, sex, religion, and interpersonal relations with other family members. Spring quarter class open to juniors and seniors only.

3 units, autumn, winter, spring, (Cobb), MWF 10

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**Graduate Courses**

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

3 units, autumn, MWF 11

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), by arrangement

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

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, (Byrd), by arrangement

H291a, 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.

H291a. 3 units, autumn, (Cobb), MWF 12

H291b. 3 units, winter, (Byrd), 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, (Byrd), 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, MWF 2:15-4:05
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 of Engineering Science: Peter Andrew Sturrock

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 in 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 B, Algebra and 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 accrediting 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 total number of required units is a minimum of 180-194, depending upon the curriculum selected.

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

Substitutions or deletions from the "Supplementary Requirements" may be made with the approval of the student's faculty adviser. Every student is urged to discuss with his adviser any change that would improve the curriculum for his personal needs.

**Courses Normally Taken by All Engineering Students**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. General Education subjects</strong></td>
<td></td>
</tr>
<tr>
<td>English (English 1, 2, 3, 129) (See Note 3)</td>
<td>12</td>
</tr>
<tr>
<td>History of Western Civilization (History 1, 2, 3)</td>
<td>12</td>
</tr>
<tr>
<td>General Studies Humanities (See Notes 1 and 3)</td>
<td>5</td>
</tr>
<tr>
<td>General Studies Social Sciences (See Notes 2 and 3)</td>
<td>10</td>
</tr>
<tr>
<td>Public Speaking (Speech 20; see Notes 1 and 3)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>42</strong></td>
</tr>
<tr>
<td><strong>2. Basic Science and Mathematics subjects</strong></td>
<td></td>
</tr>
<tr>
<td>Physics (Physics 51-57, incl.)</td>
<td>18</td>
</tr>
<tr>
<td>Chemistry (Chem. 1, 2)</td>
<td>8</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus (Math. 41-44, incl.; See Note 4)</td>
<td>18</td>
</tr>
<tr>
<td>Statistics (See Note 5)</td>
<td>3 or 4</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>47 or 48</strong></td>
</tr>
<tr>
<td><strong>3. Engineering Science and General Engineering subjects</strong></td>
<td></td>
</tr>
<tr>
<td>Engineering Mechanics (Engr. 11, 12)</td>
<td>6</td>
</tr>
<tr>
<td>Mechanics of Materials (Engr. 15 or 18)</td>
<td>3</td>
</tr>
<tr>
<td>Mechanics of Fluids (See Note 6)</td>
<td>3 or 4</td>
</tr>
<tr>
<td>Thermodynamics (See Note 7)</td>
<td>3 or 5</td>
</tr>
<tr>
<td>Electrical science (Engr. 41, 41L, 42, 42L)</td>
<td>10</td>
</tr>
<tr>
<td>Science of Materials (Engr. 50)</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Drawing (Engr. 9)</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Economy (Engr. 161, 60, or 61)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>35 to 38</strong></td>
</tr>
<tr>
<td><strong>Total all subjects</strong></td>
<td><strong>124 to 128</strong></td>
</tr>
</tbody>
</table>

*Note 1—The General Studies Humanities requirement is at least 8 units selected from the list of approved courses given in the General Studies Bulletin. Speech 20 is a requirement of the School of Engineering and also may be offered as partial fulfillment of the General Studies requirement.*
Note 2—The General Studies Social Sciences requirement is at least two 5-unit courses selected from the list of courses given in the section on the General Studies Program.

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

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


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

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

Scheduling of Courses

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

Engr. 5 is available for freshmen and sophomores only
Engr. 9 should be taken freshman year
Engr. 11 should be taken before end of sophomore year
Engr. 12, 15, 21, 31, 41, 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>Chem. 3</td>
<td>General Chemistry</td>
<td>5</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. 175</td>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 176</td>
<td>Physico-Chemical Measurements</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 10</td>
<td>Introduction to Chemical Engineering</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</td>
<td>Transport Phenomena</td>
<td>3</td>
</tr>
<tr>
<td>Ch.E. 140a, b, c</td>
<td>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>Chemical Kinetics</td>
<td>3</td>
</tr>
<tr>
<td>Approved Electives (See Note 1)</td>
<td>6 to 20</td>
<td></td>
</tr>
<tr>
<td>Omissions (See Note 2)</td>
<td>0 to -14</td>
<td></td>
</tr>
</tbody>
</table>

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SCHOOL OF ENGINEERING

Note 1—Suggested electives for added depth in closely related engineering and scientific subjects: Ch.E. 160, 190, 201, 202; Chem. 112, 113, 116, 125; Math. 45, 46, 107, 130, 131, 132; C.S. 136.

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

2. Supplementary Requirements, Civil Engineering

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

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

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

Construction—C.E. 126, Advanced Surveying (4 units); C.E. 144, Construction Estimates and Costs (3 units); C.E. 145, Construction Equipment and Methods (3 units); I.E. 133, Industrial Accounting (4 units).

Highway—C.E. 126, Advanced Surveying (4 units) and C.E. 151, Highway Engineering (3 units) plus 6 or more units among: C.E. 144, Construction Estimates and Costs (3 units); C.E. 145, Construction Equipment and Methods (3 units); I.E. 133, Industrial Accounting (4 units).

Hydraulics and Fluid Mechanics—C.E. 145, Construction Equipment and Methods (3 units); C.E. 163, Hydraulic Machinery (2 units); C.E. 170, Man and His Environment (3 units); Math. 106, Complex Variable (3 units); Math. 130, 131, 132, Differential Equations (9 units).

Hydrology—Geol. 185, Hydrogeology (5 units); Math. 130, Ordinary Differential Equations (3 units); Stat. 116, Probability (4 units).

Nuclear Design—Engr. 171, Introduction to Nuclear Engineering (3 units) and Engr. 172, Nuclear Chemistry (3 units) plus 7 units from C.E. 171, Environmental Radioactivity (3 units); Math. 130, Differential Equations (3 units); Mat.Sci. 231, Nuclear Reactor Materials (3 units).
Public Works Administration—C.E. 170, Man and His Environment (3 units); C.E. 171, Environmental Radioactivity (3 units); Pol.Sci. 100, Public Administration (5 units); I.E. 133, Industrial Accounting (4 units).

Sanitary Engineering—C.E. 170, Man and His Environment (3 units); C.E. 171, Environmental Radioactivity (3 units); Biology 1 and 2 (6 units); Medical Microbiology 101, General Bacteriology (5 units).

Structures—C.E. 183, Structural Design (2 units); Math. 130 and 131, Differential Equations (6 units); Math. 45, Advanced Calculus (3 units); Engr. 104, Dynamic Response (3 units).

Water Resources—C.E. 170, Man and His Environment (3 units); C.E. 171, Environmental Radioactivity (3 units); I.E. 133, Industrial Accounting (4 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

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 100*, 101, 102. Circuits</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>E.E. 110, 111. Electromagnetic Theory</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>E.E. 128. Control Systems</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 150, 151, 152. Electronics</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>E.E. 156, 157. Laboratory</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>E.E. 138 or 170. Laboratory, or E.E. 180 Design Project (Lists B, C)</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>C.S. 136. Use of Digital Computers</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Optional program, such as &quot;A,&quot; &quot;B,&quot; or &quot;C&quot; below</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>53</td>
</tr>
</tbody>
</table>

Courses to complete the undergraduate program will be selected according to the student's interest. The following three lists of courses are suggested. These are arranged for three general types of interest in electrical engineering, and students who wish variations or intermediate arrangements should see their faculty advisers.

List A is for students with a primary interest in the business and administrative aspects of electrical engineering such as plant management, contracting, selling, and application engineering. Students who like to deal with people, and prefer committee work to laboratory work, may wish to choose this program.

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

**List A**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 108. Illumination</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 124. Electromechanics</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 138.* Control Systems Laboratory</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 159. Microwave and High-Power Tubes</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 161. Information Transmission, Modulation</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 162. Radio Engineering</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 164. Pulse and Timing Circuits</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>E.E. 200. Seminar</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Math. 130. Ordinary Differential Equations</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

* If not elected under Supplementary Requirements.
List B is for students who expect to engage in technical electrical engineering work such as design or operation of 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 15 units of work are to be taken from the following list. The first course, Math. 130, is required; others are optional, depending on the student's interest.

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

### List B

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 130</td>
<td>Ordinary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 108</td>
<td>Illumination</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 124</td>
<td>Electromechanics</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 138*</td>
<td>Control Systems Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 159</td>
<td>Microwave and High-Power Tubes</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 161</td>
<td>Information Transmission, Modulation</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 162</td>
<td>Radio Engineering</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 164</td>
<td>Pulse and Timing Circuits</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 165</td>
<td>Random Signals and Noise</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 167</td>
<td>Electric and Magnetic Properties of Solids</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 234</td>
<td>Nonlinear Network Analysis</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 235</td>
<td>Introduction to Network Synthesis</td>
<td>3</td>
</tr>
<tr>
<td>F.E. 200</td>
<td>Seminar</td>
<td>1</td>
</tr>
</tbody>
</table>

*If not elected under Supplementary Requirements.

### List C

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 9 units are to be elected from reasonably advanced courses in engineering, physics, mathematics, and chemistry (such as E.E. 138, 165, 167, 171, 234, 270n, Math. 45, 46, 106, 114a, b, 131, 132, etc.). If E.E. 170 was not elected under Supplementary Requirements, it should be included here.

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

### List C

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

Total ..................................................................... 15
4. Supplementary Requirements, Engineering Science

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 130, 131 (Diff. Equations), 45, 46 (Adv. Calculus)</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Restricted Electives in Engineering Science (see below)</td>
<td></td>
<td>21 or more</td>
</tr>
<tr>
<td>Restricted Electives in Basic Science (see below)</td>
<td></td>
<td>9 or more</td>
</tr>
<tr>
<td>Unrestricted Electives (see below)</td>
<td></td>
<td>17 or more</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>53 or more</td>
</tr>
</tbody>
</table>

Restricted Electives in Engineering Science—A total of 21 units selected from the following list of technical courses, including a minimum of 3 units in laboratory work chosen from the first six courses listed: 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); Mat.Sci. 123, High Temperature 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. 100, 101, 102, Electric Circuits (10 units); E.E. 110, 111, Electromagnetic Theory (6 units); E.E. 124, Electromechanics (3 units); E.E. 128, Control Systems (3 units); E.E. 150, 151, 152, Electronics (9 units); E.E. 161, Information Transmission and Modulation (3 units); E.E. 165, Random Signals and Noise (3 units); E.E. 234, Nonlinear Network Analysis; E.E. 235, Introduction to Network Synthesis (3 units); E.E. 240, Linear Systems (5 units); E.E. 270, Electromagnetic Theory (3 units); E.M. 221, 222, 223, Advanced Dynamics (6 units); M.E. 132, 133, 134, 135, 136, Engineering Thermodynamics (16 units); M.E. 161, Engineering Dynamics (6 units); Engr. 171, Introduction to Nuclear Engineering (3 units); Engr. 104, Dynamic Response (3 units); E.E. 167, Electric and Magnetic Properties of Solids (3 units); C.S. 136, Use of Automatic Digital Computer (3 units); Mat.Sci. 121, Mass Transport (3 units); Mat.Sci. 122, Solid State Thermodynamics (3 units); Mat.Sci. 124, Phase Equilibria (3 units); Mat.Sci. 125, Structural Transformation in Materials II (4 units); Mat.Sci. 127, Crystallography and X-Ray Analysis (4 units); Mat.Sci. 130, Mechanical Behavior of Solids (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. 114a, b, 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 Note—Students majoring in Engineering Science may substitute Physics 110 and 111 for Engineering 11 and 12 in the list of “Courses Normally Taken by All Engineering Students.”
5. Supplementary Requirements, General Engineering

Additional courses constituting a coherent program and totaling at least 56 units are required. A minimum of 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 Product Design</td>
<td>9</td>
</tr>
<tr>
<td>M.E. 114a.</td>
<td>Mechanical Engineering Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 116a.</td>
<td>Human Factors in Product Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 116b.</td>
<td>Materials and Structures in Product Design</td>
<td>3</td>
</tr>
<tr>
<td>M.E. 116c.</td>
<td>Advanced Product Design</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 114.</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Art 1.</td>
<td>Introduction to Art</td>
<td>3</td>
</tr>
<tr>
<td>Art 40.</td>
<td>Studio I</td>
<td>2</td>
</tr>
<tr>
<td>Art 50.</td>
<td>Studio II</td>
<td>2</td>
</tr>
<tr>
<td>Art 60.</td>
<td>Studio III</td>
<td>3</td>
</tr>
<tr>
<td>Art 140a.</td>
<td>Drawing I</td>
<td>3</td>
</tr>
<tr>
<td>Art 150a.</td>
<td>Sculpture I</td>
<td>3</td>
</tr>
<tr>
<td>Art 155a.</td>
<td>Design I</td>
<td>4</td>
</tr>
<tr>
<td>Art 155b.</td>
<td>Design II</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

A program in Resource Strategy is offered for engineering students interested in the techniques of application of modern science and technology to the problems and resources of newly developing nations. The program is intended to provide a broad educational background which, with experience, will enable the engineering graduate better to analyze the needs of a political or geographical area, to evaluate the available resources, and to devise an optimum plan of development. It is expected that graduates would be suited for service with international development agencies of the Federal Government, in the Peace Corps, in the Department of the Interior, with state and local governments, in international operations of private concerns, or with foreign governments. The program is particularly suited to foreign students seeking to prepare themselves for positions of leadership in their home countries. In satisfying the General Studies requirements, Anthropology 1, Economics 1, and Philosophy 5 are recommended. The required 20 units of Engineering should be selected to provide special competence in an area such as transportation, communication, industrial enterprise, or civil works. Up to 12 units may be devoted to a foreign language. The balance of 24 or more units are selected by the student in consultation with his adviser. Attention is called to the availability of the following courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthr. 131.</td>
<td>Comparative Social Systems</td>
<td>4</td>
</tr>
<tr>
<td>Anthr. 112.</td>
<td>Peoples of Africa</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 150.</td>
<td>Transportation Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>
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>Engr. 5.</td>
<td>Computer Programming for Engineers</td>
<td>2</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. 120a.</td>
<td>Quality Control by Statistical Methods</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 133.</td>
<td>Industrial Accounting</td>
<td>4</td>
</tr>
<tr>
<td>I.E. 141.</td>
<td>Utilization of Computers</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 152.</td>
<td>Introduction to Operations Research, I, II</td>
<td>6</td>
</tr>
<tr>
<td>I.E. 155.</td>
<td>Design of Production Systems</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 156.</td>
<td>Systems Planning and Control</td>
<td>3</td>
</tr>
<tr>
<td>I.E. 199.</td>
<td>Senior Seminar</td>
<td>3</td>
</tr>
<tr>
<td>Psych. 122.</td>
<td>Industrial Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Econ. 145.</td>
<td>Economics of Labor</td>
<td>5</td>
</tr>
<tr>
<td>Stat. 110.</td>
<td>Statistical Methods or Stat. 27. Probability Theory*</td>
<td>3 or 4</td>
</tr>
</tbody>
</table>

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

Restricted Electives ................................................. 11

* Total ............................................................... 59–60

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

Freshmen who entered in September 1962 and subsequent classes will follow the above program.

7. Supplementary Requirements, Materials Science

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.S. 136 or C.S. 5 and 6. Use of Automatic Digital Computers</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chem. 3.</td>
<td>General Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>Chem. 171, 173. Physical Chemistry</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Math. 130.</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Mat.Sci. 105. Imperfections in Crystalline Solids</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 121. Mass Transport</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 122. Solid State Thermodynamics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 124. Phase Equilibria</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 125. Structural Transformations in Materials</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Mat.Sci. 127. Crystallography and X-Ray Analysis</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Materials Science cuts across several traditional fields of science and engineering. Electives are provided to allow students to develop secondary emphasis in one or more of the traditional fields. Materials Science students who desire a particularly strong background in mathematics and physics in preparation for graduate study leading to a career in research and teaching should include the following elective courses.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math. 45</td>
<td>Advanced Calculus II</td>
<td>3</td>
</tr>
<tr>
<td>Math. 131</td>
<td>Partial Differential Equations I</td>
<td>3</td>
</tr>
<tr>
<td>Physics 110, 111</td>
<td>Intermediate Mechanics</td>
<td>6</td>
</tr>
<tr>
<td>Physics, 120, 121, 122</td>
<td>Intermediate Electricity and Magnetism</td>
<td>9</td>
</tr>
</tbody>
</table>

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

8. Supplementary Requirements, Mechanical Engineering

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

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

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

Aeronautics and Astronautics—23 units minimum from the following: Required: A.A. 100, Introduction to Aeronautics and Astronautics (2 units); Math. 46, Advanced Calculus III, or A.A. 292, Vector Analysis and Cartesian Tensors (3 units); Math. 131, Partial Differential Equations I, or Math. 106, Introduction to Theory of Functions of a Complex Variable (3 units). Optional: Physics 61, Optics and Wave
Motion (3 units); M.E. 134, Introduction to Kinetic Theory and Statistical Mechanics (3 units); E.E. 110, Electromagnetic Theory (3 units); E.E. 128, Control Systems (3 units); A.A. 240a, b, Aircraft and Missile Structures (3 units each); A.A. 242a, Classical Dynamics I (3 units); A.A. 279a, Space Mechanics (3 units); A.A. 227, Introduction to Space Physics (2 units); A.A. 226, Astronomy for Physical Scientists (2 units); A.A. 229, Colloquium on Life Science Problems in Space Exploration (2 units); A.A. 280a, Rocket Propulsion Fundamentals (3 units); E.E. 124, Electromechanics (3 units); E.E. 106, Circuits (4 units); E.M. 242, Mathematical Hydro- and Aerodynamics (3 units); A.A. 210b, Aircraft and Missile Structures (3 units); A.A. 211a, Physical Gasdynamics (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, Mass, and Momentum Transfer (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, Mass, and Momentum Transfer (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, 111, Intermediate Mechanics (3 units each) (students taking these courses may omit Engr. 11 and 12 from the School of Engineering required list and should do so if they plan to take the Physics 130 series); Physics 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); E.E. 167, Electronic and Magnetic Properties of Solids; E.E. 110, 111, Electromagnetic Theory; 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 Aerospace Studies, Military Science, 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 Aerospace Studies, Military Science, and Naval Science programs are so varied in the nature of specialized work that the appropriate sections of this Bulletin should be consulted in preparing an engineering program including ROTC. The additional units of specialized work together with
those of 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 under "Master of Science."

**GRADUATE ADMISSION**

Application for admission with graduate standing in the School should be made to the Director of Admissions of the University; applications are reviewed by the appropriate department of the School before admission is authorized. Inquiries may be addressed to the Dean of Engineering or to the Executive Head of the department. While most graduate students have undergraduate preparation in an engineering curriculum, it is feasible to enter from chemistry, physics, or mathematics (see, for example, the Four-Two program described under "Master of Science").

**GRADUATE REGISTRATION**

New graduate students should consult the faculty member who acts as adviser in the student's field (or departmental secretary) on registration day of his first quarter for advice in planning his program and for instruction on departmental procedures.

**GRADUATE PROGRAMS OF STUDY**

Departments and divisions of the School offer graduate curricula, as follows:

**Aeronautics and Astronautics**

- Aerodynamics
- Aircraft, Missile and Spacecraft
- Structures
- Astronautics
- Experimental Methods
- Guidance and Control
- Physical Gasdynamics
- Plasma Dynamics and Magnetoaerodynamics

**Bioengineering**

(See Master of Science and Doctor of Philosophy programs)
Chemical Engineering

Applied Reaction Kinetics
Chemical Catalysis
Interfacial Stability
Heat, Mass, and Momentum Transfer in Laminar or Turbulent Flow Systems

Civil Engineering

Construction Engineering
Engineering-Economic Planning
Transportation
Water Resources

Electrical Engineering

Administration
Electronic Systems Techniques
Electron Tubes
Illumination
Medical Electronics
Microwaves
Network Theory

Engineering Mechanics

Controls
Dynamics
Experimental Mechanics

Engineering Science

Biomedical Engineering

Institute in Engineering-Economic Systems

Hydrology (See separate section in this Bulletin.)

Industrial Engineering

Biotechnology
Engineering Statistics and Quality Control
Engineering Economy
Engineering-Economic Planning

Materials Science

Physical Metallurgy
Physical Ceramics
Photoelectronic Properties of Solids
Defects in Crystalline Solids and Their Effects on Electronics, Magnetic and Mechanical Properties
Magnetic Behavior of Solids
Mechanical Behavior of Solids

Non-Newtonian Fluid Mechanics
Optimization Theory
Process Dynamics and Control
Thermodynamics
Transport Properties of Fluids
Turbulence Theory

Hydraulic Engineering
Fluid Mechanics
Hydrology
Public Works Administration
Sanitary Engineering
Soil Mechanics and Foundations
Structural Engineering

Radio Science: Ionospheric Propagation, Radio and Radar Astronomy, Space Electronics
Solid-State Electronics
Transistor Electronics

Fluid Mechanics
Mechanics of Solids
Vibrations and Wave Propagation

Nuclear Engineering

Data Processing
Operations Research
Production

Nuclear Metallurgy
Thermodynamics of Solids
Reaction Kinetics in Solids
Phase Transformation in Solids
Crystal Growth
X-Ray and Electron Diffraction and Spectroscopy Applied to the Study of Solid Structures
Mechanical Engineering

Thermodynamics  Engineering Design
Heat Transfer  Product Design
Fluid Mechanics  Nuclear Engineering

For further details see the department sections following.

Related aspects of particular areas of graduate study are commonly covered in the offerings of several departments and divisions. Graduate students are encouraged, with the approval of their departmental advisers, to select courses in departments other than their own to achieve a broader appreciation of their field of study. For example, most departments in the School offer courses concerned with properties of materials, and a student interested in an aspect of materials engineering can often gain appreciable benefit from the related courses given by departments other than his own.

Master of Science

The degree of Master of Science (M.S.) is conferred on graduate students in engineering according to the University regulations stated elsewhere. However, the presentation of a thesis is not required for the Master of Science degree in Engineering.

Four-Two program—Superior students who hold baccalaureate degrees in physical science with adequate physics and mathematics may complete the requirements for an M.S. in engineering at Stanford (in most of the curricula above) in two academic years (six quarters). Programs will be worked out in consultation with an adviser from the department in which the student wishes to study. Further information may be obtained from the department in which the student is interested.

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

Engineer

The degree of Engineer is awarded at the completion of a comprehensive two-year program of graduate study. It is intended for those who desire more graduate training than can be obtained in a Master of Science program but who do not wish to undertake a Ph.D. program. The program of study must satisfy the student's department and include 90 units of which at least 60 must be devoted to advanced or graduate study in the major subject or intimately allied subjects. The presentation of a thesis is required. The University regulations for the Engineer degree are stated in the section "Degrees" in this Bulletin, and further information will be found in the department sections following.

Doctor of Philosophy

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

FELLOWSHIPS AND ASSISTANTSHIPS

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

ENGINEERING

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. Smith), TTh 11

5. Introduction to Programming—This course is an introduction to ALGOL, a problem-oriented language for describing computational processes. There will be practice in solving elementary problems on Stanford’s automatic digital computers. The course is limited to freshman and sophomore students. (Enroll in Computer Science 5.) Prerequisites: Mathematics B or equivalent.
   2 units, autumn, (Staff), WF 11
   winter, (Staff), TTh 1:15
   spring, (Staff), WF 11

6. Introduction to Programming—Continuation of 5. Limited to undergraduates. 5 and 6 together include approximately the same material as Computer Science 136. (Enroll in Computer Science 6).
   2 units, winter, (Staff), TTh 1:15

9. Engineering Drawing—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, (Staff), lec. and lab. MF 1:15-5:05 or TTh 1:15-5:05
   winter, (Staff), lec. and lab. MW 1:15-5:05

   2 units, autumn, (Richards, Staff), TTh 9 and 10
   winter, (Richards, Staff), TTh 9
   spring, (Richards, Staff), TTh 9

12. Engineering Mechanics (Dynamics)—Principles of dynamics of particles and rigid bodies, application to typical mechanical problems. Should be taken before the end of the junior year. Prerequisites: 11 and Mathematics 43.
   4 units, autumn, (Richards, Staff), TWThF 11
   winter, (Richards, Staff), TWThF 11
   spring, (Richards, Staff), TWThF 11 and 2:15
   summer, (Richards, Staff)
15. Mechanics of Materials—Analysis of stresses and deformations in linear elastic materials: simple tension, compression, shear, torsion, and flexure; introduction to combined stresses and instability (columns). Prerequisites: 11 and Mathematics 43.

3 units, autumn, (Richards, Staff), MWF 10
winter, (Richards, Staff), MWF 10 and 11
spring, (Richards, Staff), MWF 10
summer, (Richards, Staff), 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: 11 and Mathematics 43.

3 units, any quarter, (Gere), by arrangement


4 units, autumn, (Vennard, Staff), MWF 9; lab. M or T, 1-4 or 3-6
winter, (Vennard, Staff), MWF 9; lab. M or T, 1-4 or 3-6
spring, (Vennard, Staff), MWF 9 or 10; lab. T or W, 1-4 or 3-6
summer, (Vennard, Staff), 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, and Engr. 21 (or concurrent Engr. 21).

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

41, 42. Circuits, Electronics, and Electromechanics—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
winter, (Smith, Staff), MWF 10; 2-hour problem session
spring, (Smith, Staff), MWF 9; 2-hour problem session

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

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

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


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

161. **Engineering Economy**—Economic decision making for engineering alternatives. Use of compound interest and depreciation calculations to compare the relative economy of both technical investments and plant operating procedures before and after Federal income taxes. Simple decision making in the face of uncertainty as to possible damage or economic obsolescence. Open to those who have 90 units of credit and to others by permission.

3 units, autumn, ( ), MWF 8 and 10
winter, ( ), MWF 9 and 11
spring, (Lave), MWF 9 and 11
summer, ( ), TWThF 8


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, or Physics 57.

3 units, autumn, (P. Kruger), TTh 11

175. **Nuclear Measurements Laboratory**—Principles and techniques of radiation detection and measurement: ionization chambers, proportional, Geiger-Muller and scintillation detectors, solid state detectors; statistical analysis of counting; beta and gamma spectrum analysis; radiation safety. Prerequisite: concurrent 171, or 172, or consent of instructor.

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

176. **Radiochemistry Laboratory**—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisites: 172 or 175 or consent of instructor.

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

180a, b, c. **Seminar in Resource Strategy**—The application of modern science and technology to the problems of newly developing nations. Analysis of technological needs, evaluation of resources, design of an optimum plan of development. Prerequisite: junior standing and consent of the instructor.

2 units, each quarter, (Smith), by arrangement
198. **Computer Programming**—Directed work in solving engineering problems with the electronic digital computer facilities of the Computation Center. Priority will be given to problems that are supplementary to regular course work. Prerequisite: 5 or equivalent.

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

199. **Special Studies in Engineering**—Special studies, laboratory work, or reading under the direction of a faculty member. By permission only.

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

207. **Introduction to Astrophysics I: Solar-Terrestrial Relations**—Origin and characteristics of the solar wind. Magnetosphere and bow wave; radiation belts; aurorae. Phenomena caused by solar flares: interplanetary shock waves; geomagnetic storms; Forbusch effect. Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent.

3 units, autumn, (Sturrock), MWF 11

208. **Introduction to Astrophysics II: The Sun**—Normal photosphere, chromosphere and corona. Fraunhofer spectrum. The solar cycle. Active phenomena: sunspots; prominences; flares; radio bursts. Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, winter, (Sturrock), MWF 11

209. **Introduction to Astrophysics III: Stars and Galaxies**—Radiative and convective energy transport; equation of state; opacity; nuclear processes. Hertzsprung-Russell diagram; stellar evolution. Galactic morphology; structure of our galaxy; spiral arms. Radio galaxies; quasi-stellar radio sources; cosmic rays. Prerequisites: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, spring, (Sturrock), MWF 11

235a, b. **Space Systems Engineering**—Students from all fields of engineering form a team to do a preliminary design study of a space system. In previous years a Weather-Data Satellite System and a Mars Exploration System have been designed. About 20 invited speakers from government and industry give the class the necessary background information. At the end of the second quarter the class gives a verbal briefing to government and industry representatives and publishes a final report of the system. Prerequisite: graduate standing.

235a. 3 units, winter, (Lusignan), TTh 1:15-3:05 and two hours by arrangement

235b. 3 units, spring, (Lusignan), TTh 1:15-3:05 and two hours by arrangement

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**Emeriti:** Alfred Salem Niles, Elliott Gray Reid (Professors)

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**Executive Head:** Nicholas John Hoff

**Associate Executive Heads:** Max Anliker (on leave 1965-66), Daniel Bershader.

**Acting:** Jean Mayers


**Associate Professors:** Max Anliker (on leave 1965-66), I-Dee Chang, Chi-Chang Chao, Wilfred Henry Horton, Krishnamurty Karamcheti (on leave 1965-66), Jean Mayers

**Assistant Professors:** Benjamin Otto Lange. **Acting:** Maurice Lee Rasmussen

OFFERINGS AND FACILITIES

This Department prepares the student for a professional career in aeronautics and astronautics by offering a comprehensive program of graduate teaching and research. Particular emphasis is given to structural, 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 and High Temperature Gasdynamics
- Aircraft, Missile and Spacecraft Structures
- Dynamics and Vibrations
- Elastic and Inelastic Solids
- Experimental Methods
- Guidance and Control
- Plasma Dynamics and Magnetoeaerodynamics
- Propulsion

Requirements for all degrees include courses on basic topics in aeronautics and astronautics, as well as in mathematics, physics and applied mechanics.

The current research activities cover a number of advanced fields, with special emphasis on:

- Thermal Effects in Structures—Structural Problems of Reentry
- Creep Effects in Structures
- Stability of Thin Shells
- Dynamic Response—Wave Propagation
- Continuum Mechanics—Viscoelasticity
- Subsonic Aerodynamics—Boundary-Layer Control
- Viscous Flow—Boundary-Layer Theory
- Hypersonics—Mathematical Methods in Fluid Mechanics
- High Temperature Gasdynamics—Nonequilibrium Flow
- Plasma Dynamics and Magnetoeaerodynamics
- Attitude Control, Guidance, and Instrumentation for Space Vehicles
- Contactor Control—Optical Control
- Biomechanics—Hemology

FACILITIES FOR INSTRUCTION AND RESEARCH

The work of the Department is centered in the Daniel Guggenheim Aeronautical Laboratory and the William Frederick Durand Laboratory.

The Guggenheim Laboratory houses classrooms, aerodynamic laboratory and offices. In the laboratory are a 7.5-foot subsonic wind tunnel (with six-component balance, propeller dynamometer, pressure recording and scaling equipment, etc.) which, with special equipment, is being used, at present, for extensive jet flap studies. A 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 Fahren-
heat 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.

During the academic year 1963-64 three small laboratories were built, two of which are being used for experimental work in the field of gasdynamics (experimental determination of the velocity distribution in gases with the aid of lasers) and one for guidance-and-control instrumentation. Moreover, the Department expanded the study space for its graduate students by making structural modifications in an existing building to accommodate 30 additional desks and book shelves.

The Stanford Computation Center makes available to our students modern computation equipment such as the IBM 7090 and Burroughs 5000.

The Department also sponsors a student branch of the American Institute of Aeronautics and Astronautics which 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 Magnetohydrodynamics, 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 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 Science Foundation, National Aeronautics and Space Administration, Douglas Aircraft Company, Stanford University, and Affiliates of Stanford University in Aeronautics and Astronautics carry grants up to $4,000 for the nine-month academic year. Also, there are forgivable loans available for students interested in a college teaching career who have family obligations, are under 40 years of age, have a Master of Science degree (or equivalent), and are permanent residents in the United States or Canada. NSF and NASA training grants have been allocated for students who plan to become doctoral candidates in the aerospace sciences. Students who already have a Master of Science degree or equivalent may qualify for half-time research assistantships. The minimum stipend for half-time research assistants, on the basis of 20 hours of work per week, is $250 per month, plus tuition. Research assistants are normally given the opportunity of full-time summer employment at the rate of $500 per month. They may use their work as the basis for a thesis and for University credit toward an advanced degree.

Further information and application forms may be obtained upon request to the Department.

UNDERGRADUATE PROGRAM IN AERONAUTICS AND ASTRONAUTICS

A study program in aeronautics and astronautics leading to the Bachelor of Science degree is available in the form of the Aeronautics and Astronautics Option in the Mechanical Engineering Department.
COURSES AVAILABLE TO BOTH UNDERGRADUATE AND GRADUATE STUDENTS


2 units, autumn, (Hoff), TTh 9


3 units, autumn, ( ), TTh 11 and F 12:15
winter, ( ), MWF 11

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

2 units, winter, (Bershader), Th 1:15-5:00

240a. Aircraft and Missile Structural Analysis—Elements of one- and two-dimensional linear and nonlinear elasticity theory; strength of thin-walled structures in bending, shear, torsion; introduction to shear lag and diagonal tension behavior; potential energy principle, direct and indirect methods of the calculus of variations, deflection analysis of straight and curved beams, effects of nonuniformity of loading and sectional properties. Prerequisite: C.E. 114.

3 units, autumn, (Pandalai), MWF 2

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

3 units, winter, (Mayers), MWF 2

240c. Aircraft and Missile Structural Analysis—Further applications of the variational principles to nonlinear behavior of beams, plates and shells; thermal effects; orthotropic and sandwich structures; dynamic behavior of structural elements in bending and torsion; finite difference and matrix methods, influence coefficients. Prerequisite: 240b.

3 units, spring, (Mayers), MWF 10

292. Vector Analysis and Cartesian Tensors with Applications—Vector algebra. Differentiation and integration of scalar and vector fields. Gradient, divergence and curl. Theorems of Gauss, Stokes, and Green. Cartesian tensors. Selected applications. (All students taking graduate courses in Aeronautics and Astronautics are expected to be familiar with the basic subject matter covered in this course.) Prerequisite: Mathematics 45.

3 units, autumn, (Rasmussen), TTh 7:30-8:50
summer, (———)

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 pitch-
ing moments, elementary profile theory. Prerequisites: Engineering 12 and 21, and (or concurrent registration in) 100 and C.E. 107.

3 units, autumn, (——), MWF 9, to be given in 1966–67

200b. Aerodynamics of the Airplane—Span load distribution; viscosity; boundary layer and skin friction; boundary layer control and effects on drag and separation; control and lift augmenting devices; (subsonic) compressibility effects; mutual interference; aerodynamic characteristics of complete airplane; static and elementary dynamic stability; controllability. Prerequisites: 200a and 210a.

3 units, winter, (——), MWF 9, to be given in 1966–67

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, (——), MWF 9, to be given in 1966–67

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, (——), TTh 9, to be given in 1966–67


3 units, autumn, (Flügge-Lots), MWF 1:15


3 units, winter, (Flügge-Lots), MWF 1

207. 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. (Enroll in E.M. 244.) Prerequisites: 206a and either 210a or M.E. 238b, or permission of the instructor.

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


3 units, autumn, (Chang), MWF 9

210a. Fundamentals of Compressible Flow—Fundamentals of the flow of a perfect gas from the standpoint of the aircraft and missile engineer; basic thermodynamics; steady and unsteady one-dimensional flow; shock waves; simple expansion waves. (Enroll in E.M. 288a) and 292.

3 units, autumn, (Vincenti), MWF 10

210b. Fundamentals of Compressible Flow—Continuation of 210a: Equations and some general results for steady and unsteady three-dimensional flows; exact solutions; irrotational homentropic motion; equations of the linearized theory; thin airfoil in steady subsonic and supersonic motion. Prerequisites: 210a (or M.E. 136 or M.E. 238a) and 292.

3 units, winter, (——), MWF 1:15

210c. Fundamentals of Compressible Flow—Continuation of 210b: Slender body of revolution in steady subsonic and supersonic motion; introduction to higher ap-
proximations; similarity rules; hodograph method; method of characteristics. Prerequisite: 210b.

3 units, spring, (——), MWF 1:15

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. Prerequisite: 210a (or M.E. 136 or M.E. 138a).

3 units, winter, (Vincenti), MWF 2:15

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 2:15

211c. Physical Gasdynamics—Kinetic theory of gases in translational nonequilibrium: conservation equations; Boltzmann equation; molecular collisions; H-theorem; Maxwellian distribution; Chapman-Enskog expansion; Sonine-polynomial expansion and variational principle; viscosity and thermal conductivity. Rotational nonequilibrium and bulk viscosity. Approximate methods of Krook, Mott-Smith, and Lees. Prerequisites: 211a and acquaintance with basic equations of viscous flow or consent of instructor.

3 units, autumn, (C. Kruger), MWF 1:15

212. Gaskinetics—Gasdynamics based on kinetic theory: review of the theory for monatomic gas mixtures; introduction to the theory of polyatomic and reacting gases; boundary conditions at a solid-gas interface; outline of techniques for solving gasdynamic problems from the point of view of the Boltzmann equation, moment equations and model equations; discussion of selected specific problems such as Couette flow, boundary layer, free molecule drag and heat transfer, shock structure, and sound propagation; experimental methods. Emphasis is given to applications. Prerequisites: 211c and 207 (207 may be taken concurrently).

3 units, spring, (Karamcheti), MWF 9, to be given in 1966-67


2 units, winter, (Lomax), TTh 9

215. Radiative Gasdynamics—Interaction of radiative transfer and fluid motion: fundamentals of radiative transfer of energy in gases; conservation equations of radiative gasdynamics; types of approximations; solution of simple flow problems. Prerequisite: 211a, b, or permission of instructor.

2 units, winter, (Vincenti), TTh 10, alternate years, to be given in 1966-67

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

3 units, summer, (Van Dyke), by arrangement

217. Aerodynamic Heating—Definition of, and factors that influence aerodynamic heating; relation of aerodynamic heating rates to structural temperature distribution; heat balance; boundary-layer theory with largely varying properties; diffusion and mass transfer; turbulent boundary-layer phenomena and analysis; semi-empirical and engineering approaches. Prerequisite: 207 or both M.E. 231a and M.E. 238b.

2 units, winter, (Rubesin), TTh 8, alternate years, to be given in 1966-67

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 consent of instructor.

3 units, autumn, (Van Dyke), MWF 8, to be given in 1966-67

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 consent of instructor. 3 units, winter, (Van Dyke), MWF 8, to be given in 1966-67

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 2:15-3:05; lab. Th 2:15-5:05

221. Introductory Reentry Aerophysics—Description of the environment of hypervelocity vehicles over a range of altitudes. Calculation of dissociation and ionization in the shock layer, and its effect on thermal transport. Use of the shock tube as a laboratory simulation device. Study of gas-kinetic collision phenomena as the basis of dissociation, ionization and radiation. Selected physical properties of partially ionized gases. Thermal radiation in gases: origins and simple examples of radiative transport. Analysis of radiating species in air shock layers and their contribution to the mean absorption coefficient. Comparison with available experimental data. 3 units, autumn, (Bershader), T 2:15-3:05 and Th 2:15-4:05

226. Astronomy for Physical Scientists—Introduction to stellar, galactic, and extragalactic astronomy: stars, galactic structure, the interstellar medium, galaxies. Stellar evolution: star formation, energy generation, the H-R Diagram. Origin and general properties of the planetary system. Techniques and technical problems. 2 units, spring, (Herbig), S10-12

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. Prerequisite: Physics 55. 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. Recent advances in space biology will be included. 2 units, winter, (Ogden, Feller, Young), 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, (——), M 3:15-5:05, alternate years, to be given in 1966-67

230b. Vertical Take-Off Aircraft—Mechanics, structural design and fatigue problems of helicopters and VTOL aircraft including ground resonance, propeller whirl, wing flutter and drive-system dynamics. 2 units, spring, (——), M 3:15-5:05, alternate years, to be given in 1966-67

231. Experimentation in Aeronautics and Astronautics—For course description, see previous page, under “Courses Available to Both Undergraduate and Graduate Students.”

235a, b. Space Systems Engineering—Students from all fields of engineering form a team to do a preliminary design study of a space system. In previous years a Weather-Data Satellite System and a Mars Exploration System have been designed.
About 20 invited speakers from government and industry give the class the necessary background information. At the end of the second quarter the class gives a verbal briefing to government and industry representatives and publishes a final report of the system. (Enroll in Engineering 235a, b.) Prerequisite: graduate standing.

235a. 3 units, winter, (Lusignan), TTh 1:15-3:15 and two hours by arrangement
235b. 3 units, spring, (Lusignan), TTh 1:15-3:15 and two hours by arrangement


3 units, winter, (Flügge-Lotz), MWF 9

239a. Theory of Control—Concepts of stability in linear and nonlinear systems. Lyapunov functions and their applications. Converse theorems. Construction of Lyapunov functions. Stability criteria in the frequency domain. Applications to dynamics and control. (Enroll in E.M. 239a.) Prerequisites: Mathematics 114a, b, and Mathematics 130; or consent of instructor.

3 units, autumn, (Kalman), TTh 11:00-12:15


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


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

240a, b, c. Aircraft and Missile Structural Analysis—For course description, see previous page, under “Courses Available to Both Undergraduate and Graduate Students.”

241a. Introduction to Structural Systems Synthesis and Analysis—The interaction of structures relative to aerodynamics, propulsion, guidance, payload and ground support for a given mission; the factors (system characteristics or operational requirements) involved in systems synthesis; assignment of priorities to system characteristics; effect of nonengineering constraints (e.g., producibility, economy, maintainability, simplicity) on design aimed at system optimization; preliminary design philosophy; parametric studies and configuration evolution; environments (cumulative and noncumulative) and basic loads (static, dynamic, aerodynamic and thermal); structural analysis versus stress analysis; weight control; structural materials; factors and margins of safety; allowable stresses; design of experiments; prototype testing; behavior predictions versus experiment; design flexibility and growth factor; reliability and structures. Prerequisite: fundamental knowledge of elementary structures, aerodynamics and vibrations.

2 units, spring, (Mayers, Staff), M 2:15-4:05

241b. Introduction to Structural Systems Synthesis and Analysis—Application of the elements of structural systems synthesis and analysis to the preliminary design of a hypothetical guided missile system subject to compromise between cost, schedule and performance; utilization of advanced structural analysis theory, methods and techniques to effect design definition of major structural assemblies taking into account the influences on structural idealizations of fabrication processes, tolerances, eccentricities, misalignments, subsystem interactions, and substructure joints and fittings (boundary conditions). Prerequisites: 240c, 241a, 243b, 248b and Computer Science 136 (or equivalent).

3 units, summer, (Mayers, Staff), by arrangement
242a. Classical Dynamics I—Differential geometry of trajectories, formulae of
Frenet. Kinematics of particles and rigid bodies. Kinematics of relative motion,
Coriolis' theorem. Kinetics of particles, Newton's laws, noninertial reference frames,
energy theorem, and angular momentum theorem. Motion of particles in central
force fields, applications to satellite motion. Kinetics of systems of particles, conserva-
tion laws, elementary rocket equation. D'Alembert's principle and the principle of
virtual work. Generalized coordinates, Lagrange equations. Kinetics of rigid bodies,
inertia tensor and its properties, Euler equations of motion and applications. Impact
problems.

3 units, autumn, (Lange), TTh 11:00-12:15

242b. Classical Dynamics II—Brief review of the dynamics of systems of particles
and rigid bodies. Generalized coordinates, holonomic and nonholonomic mechanical
systems. Lagrange's equations of the first and second kind. Quasi-coordinates. Ham-
ilton's principle and elements of calculus of variations. Basic concepts of analytical
mechanics. Ignoration of coordinates. Legendre's dual transformation. Canonical
equations of motion. Extension of Hamilton's principle and the principle of least ac-
tion to nonholonomic systems. Integral invariants. Canonical equations in parametric
form. Canonical transformations. The bilinear differential forms, the bracket expres-
sions of Lagrange and Poisson. The partial differential equation of Hamilton-Jacobi.

3 units, spring, (Chang), MWF 12

Free and forced vibrations of systems with finite and infinite degrees of freedom.
Simultaneous transformation of two quadratic forms to principal axes. Normal co-
dinates. Damped oscillations. Courant's maximum-minimum principle. Rayleigh's
principle. Waves in simple elastic continua.

3 units, autumn, (Anliker, Staff), MWF 12

243b. Theory of Vibrations—Eigenvibrations of beams, membranes, plates and
shells. Effect of rotatory inertia and shear on the lateral vibrations of beams. Approx-
imate methods of evaluating the eigenfrequencies and the dynamic response of
continuous systems in general. Parametric resonance, Floquet theory and Hill's
equation. Introduction to statistical methods and their application to the dynamic
response of linear systems to random excitation. Prerequisite: 243a.

3 units, winter, (Anliker, Staff), MWF 12

244. Basic Problems in Aeroelasticity—Deformation of aircraft structures under
static and dynamic loads, lift distribution on elastic wings, static aeroelastic phe-
nomena, 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, (Anliker, Staff), MWF 8

245a. Theory of Elasticity—Stress, strain in three dimensions. Plane stress, plane
strain. Rectangular, circular, ring-shaped plates, cylinders. Effects of small holes.
Solutions by complex variable. (Enroll in E.M. 202a.) Prerequisites: C.E. 114 and
Mathematics 130.

3 units, autumn, (Goodier), MWF 9

245b. Theory of Elasticity—Continuation of 245a. Local edge loadings. Tapered
regions. Elliptic holes. Groups of holes. Notches. Torsion of non-circular sections,
non-uniform shafts. (Enroll in E.M. 202b.) Prerequisite: 245a.

3 units, winter, (Goodier), MWF 10

246. Theory of Plates—Analysis of stress, deformation in plates bent by trans-
verse loads. Applications to circular, rectangular, other shapes. Vibrations of plates.
(Enroll in E.M. 207.) Prerequisite: C.E. 114.

3 units, winter, (Flügge), MWF 9

247. Theory of Shells—Direct stresses in shells with axial symmetry. Application
to shell roofs, tanks. Cylindrical shells, shell roofs, pipe lines. Stress-function, relax-
ation methods. Bending stresses in shells. (Enroll in E.M. 208.) Prerequisite: C.E.
114.

3 units, spring, (Flügge), MWF 9

3 units, autumn, (——), TTh 1:15-2:30


3 units, winter, (——), TTh 1:15-2:30


3 units, spring, (——), TTh 1:15-2:30, alternate years, to be given in 1966-67


3 units, spring, (Hoff), TTh 1:15-2:30, alternate years, to be given in 1965-1966

249. Modern Developments in Shell Theory—Elements of tensor analysis, differential geometry, three-dimensional stress and strain analysis. Reduction of the three-dimensional problem of the continuum to the two-dimensional shell problem. Examination of foundations of shell theory. Consistent approximate theories of shells. Variational techniques in shell theory. Prerequisites: 245a and either 247 or 248a.

3 units, summer, (——), by arrangement

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, (Hoff), TTh 10


2 units, spring, (Hoff), 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.

3 units, autumn, (Hoff), MWF 3:15

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

3 units, autumn, (Horton), lec. T 9; lab. TTh 2:15-4:05

260b. Aircraft and Missile Structures Laboratory—Continuation of 260a; visual and optical techniques, including thermally sensitive paints; strain transfer techniques, photo grid methods, interferometer 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), lec. T 9; lab. TTh 2:15-4:05

260c. Aircraft and Missile Structures Laboratory—Continuation of 260b; radiant, inductive and convective heat systems; automatic test systems for heat problems of high speed flight and pressure cabin loadings. Under-carriage testing, ground
resonance testing and the specific application of the techniques outlined in courses 260a and b to the varied problems of testing as defined above.

3 units, spring, (Horton), lec. T9; lab. TTh 2:15-4:05


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

271. Automatic Control of Space and Aerospace Vehicles—Basic dynamics of vehicles in three dimensions. The environment of space and aerospace vehicles, and its role in their control. Passive attitude control, such as gravity gradient, magnetic, solar, spinning, etc. Sensors and active control moment devices (jets, reaction wheels, gyros, magnetic devices, etc.). Space vehicle control system synthesis and techniques. Aircraft stability and response. Automatic flight-control-system synthesis. Prerequisites: 242a or E.M. 222, and E.E. 128.

3 units, spring, (DeBra), TTh 9:00-10:30


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


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

274. Numerical Methods in Flight Mechanics—The application of digital computation to the solution of the trajectory problems of powered and coasting aerospace vehicles at speeds up to several times orbit speed; the problems associated with the boost and entry phases of space flight with applications to such areas as trajectory selection to maximize payload or to minimize heating and acceleration loads and the determination of the guidance and navigation requirements during these critical phases. Students will enroll concurrently in the two-week course in Algol 60, and selected homework problems illustrative of the methods essential to current vehicle performance analysis will be run on the B-5500 digital computer. Prerequisite: 279a (may be taken concurrently) or consent of instructor.

3 units, autumn, (Lange), MWF 8

275. Navigation and Guidance in Space—The theory of cis-lunar and interplanetary trajectories, the effects of injection and navigation errors in space flight, trajectory partial derivatives, measurement techniques for navigation and guidance mechanism. Prerequisite: 279a or consent of instructor. (279a may be taken concurrently.)

3 units, winter, (Lange), MWF 8

276. Physics of Inertial Measurements and Instrumentation—Physical principles which may be used for inertial sensing or for measurements for guidance and navigation. Topics will be selected from such items as the Helium 3, nuclear magnetic resonance, cryogenic, electrostatic, piezoelectric and unsupported gyroscopes; the basic principles of optical sensors and the use of lasers for distance, velocity, and rotation sensing. Prerequisite: 272b (may be taken concurrently) or equivalent.

3 units, spring, (Lange), MWF 8

277. Modern Control Theory—An intensive survey of the developments in the field of automatic control since 1955 with application to the guidance and control of aerospace vehicles. Topics will be selected from the state vector approach to linear system theory, the concepts of controllability and observability, stability theory of nonlinear systems via the Second Method of Lyapunov, contactor control systems,
the theory of optimal control (the control variable formulation of the Calculus of Variations, Pontryagin's Maximum Principle, and gradient techniques in both functional and finite dimensional spaces), statistical control theory, and filter theory. Students will enroll concurrently in the two-week course in Algol 60, and homework problems which apply the theory to such examples as inertial guidance systems, gyroscopic inertial instruments, space vehicle boost and entry problems, orbital guidance and navigation problems, etc. will be run on the B-5500 computer. Prerequisite: A general knowledge of linear algebra and matrix theory, differential equations, and classical servomechanism theory.

3 units, (Lange), by arrangement

278. Flight Trajectory Optimization—Trajectory error propagation; guidance; performance improvement; the maximum principle; steepest descent methods; neighboring optimum control. Prerequisites: 279a and E.E. 245 or consent of instructor.

3 units, autumn, (Breakwell), TTh 11:00–12:15

279a. Space Mechanics—Orbits of near-earth satellites and interplanetary probes; transfer and rendezvous; decay of satellite orbits; influence of earth's oblateness. Stabilization by gravity gradient. Prerequisite: 242a or equivalent.

3 units, winter, (Breakwell), MWF 11

279b. Advanced Space Mechanics—Gravitational perturbations of satellite orbits by sun and moon; second-order effects of the earth's gravitational field; motion in earth-moon space; trajectories launched perpendicular to the ecliptic. Application of Hamilton-Jacobi theory to accurate satellite orbits; methods of Brouwer, Garfinkel and Vinti-Izsak; critical inclination. Prerequisite: 279a.

3 units, spring, (Breakwell), MWF 11

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. Prerequisite: M.E. 132.

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, spring, (Seifert), MWF 8, alternate years, to be given in 1966–67


3 units, spring, (Seifert, Staff), MWF 8, alternate years, to be given in 1965–66


3 units, winter, (Chang), MWF 9
   3 units, spring, (Chang), MWF 9
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 Fluid Dynamics—Fundamentals of the motion of charged particles in electric and magnetic fields, hydromagnetics and plasma physics with application to theories of Van Allen belts, solar phenomena, interplanetary plasma streams and shock waves, geomagnetic storms and wave propagation in the upper atmosphere and interplanetary space. Prerequisite: 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), T 9-11 and Th 9
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, autumn, (Chao), MWF 11
294a. Introduction to Nonlinear Continuum Mechanics—Definitions of general states of stress and deformation of continua. Discussion of constitutive equations, and influence of material symmetries. Applications of the theory with particular reference to finite elasticity. (Enroll in E.M. 214a.) Prerequisite: 293 or 245a.
   3 units, winter, (Lee), TTh 11:00-12:15, alternate years, to be given in 1965-66
   3 units, spring, (Lee), MWF 10, alternate years, to be given in 1965-66
295. Seminar in Solid Mechanics—Problems in all branches of solid mechanics. All Ph.D. candidates in solid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for students presenting talks. (Enroll in E.M. 295.)
   1 unit, autumn, winter, spring, (Goodier), Th 3:15
296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for those students presenting talks. (Enroll in E.M. 296.)
   1 unit, autumn, winter, 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, without letter grade, is optional; a letter grade is given for students presenting talks.

1 unit, autumn, winter, spring, (———), by arrangement

298. Seminar in Space Technology—Study of recent advances in the design, operation and application of spacecraft and their components. Guest lecturers. Registration for one unit of credit only.

1 unit, autumn, winter, 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, Michel Boudart, David Malcolm Mason
Associate Professors: William Herman Schwarz, Douglass James Wilde
Assistant Professor: Robert James Madix
Lecturers: Vaughan Clark Hill, 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 with a very broad background in the physical and engineering sciences and mathematics necessary for a variety of careers in the chemical, space, or petroleum industries; the curriculum is also designed to prepare the student oriented toward teaching or research 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 research problems of the aerospace and nuclear industries.

Candidates for graduation with chemical engineering as the major subject are expected to receive above-average grades 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 to superior students who are primarily interested in teaching or research. The general University
regulations for these advanced degrees are described in the section “Degrees” in this Bulletin. The departmental requirements are summarized below.

**Basic Lecture Courses**—A minimum of 30 units of basic graduate lecture courses are required which may include the following: (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 9 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 30 units of the above 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 a grade point average of at least 3.20 in each quarter should 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; optimization theory; process dynamics and control; and thermodynamics. Further detailed descriptions of research programs are available upon request.

**FELLOWSHIPS AND ASSISTANTSHIPS**

Financially attractive graduate fellowships and assistantships are awarded to worthy candidates each year. Application forms may be procured by writing the Department of Chemical Engineering. Applications should be made as early as possible and no later than March 1 preceding the start of the academic year for which the award is to be made. By mutual agreement of the graduate schools of North America, the student need not commit himself to fellowship or scholarship award offers before April 15.

**UNDERGRADUATE COURSES**

Recommended prerequisites for chemical engineering courses are indicated by the sequence in the sample programs below.

**Sample Programs for Students Interested in Chemical Engineering and Applied Chemistry**

1. Suggested program for freshmen who definitely plan on majoring in Chemical Engineering.
### First Year

<table>
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<th>Course No.</th>
<th>Subject</th>
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<th>Spring</th>
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<td>Ch.E. 130a</td>
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Social Science Electives ........................................... —  5  —
Stat. 27. Probability Theory .................................... 3  —  —
Electives ............................................................. 6  4  7
Totals ............................................................. 15  15  15

2. Suggested program for Engineering or Science oriented freshmen who are considering a major in Chemical Engineering but who would prefer following first-year schedule of other engineering majors.

<table>
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# CHEMICAL ENGINEERING

## Fourth Year

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3 units, autumn, (Wilde), MWF 10

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

3 units, winter, (Boudart), TTh, hour by arrangement

120b. Chemical Engineering Thermodynamics—Continuation of 120a. Mixtures of perfect and imperfect gases; dilute solutions; fugacity, activity, and activity coefficient; phase- and chemical-equilibrium.

3 units, spring, (Boudart), TTh, 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, (Madix), MWF 10

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, (Schwars), MWF 11

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 and computer design methods; optimization.

3 units, spring, (Acrivos), MWF 8

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

3 units, autumn, (Schwars), MWF 11

140c. Unit Operations: Mass Transfer—Theory of molecular diffusion; transfer of material between phases; simultaneous heat and mass transfer; principles of design in processes involving absorption, humidification, drying, evaporation, and crystallization; simultaneous absorption and chemical reaction; unsteady-state behavior of chemical processes.

3 units, winter, (Madix), MWF 10
141a. Chemical Engineering Laboratory—Experiments with discussion questions on the transport of momentum and energy. Measurement of viscosities; thermal conductivities; temperature profiles in solids; friction factors; and fluid efflux times.  
3 units, winter (Madix), TTh 1:15–5:00

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, (Madix), TTh 1:15–5:00

150. 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, (Boudart), TTh, hour by arrangement

160. Chemical Engineering Plant Design—Application of unit operation fundamentals to the basic commercial installation. The course will embrace the principles of economic equipment design and practical plant layout. A number of petroleum and chemical processes will be surveyed with attendant considerations of materials, operating variables, and economics of equipment selection.  
2 units, spring, (Hill), by arrangement

190. Chemical Engineering Research—Laboratory or theoretical work for undergraduate students on assigned chemical engineering problems. It is advisable for National Science Foundation Undergraduate Research Participants to enroll in this course.  
(Staff), by arrangement

COURSES PRIMARILY FOR GRADUATE STUDENTS

3 units, autumn, (Wilde), MWF 2:15

3 units, winter, (Wilde), MWF 2:15

203. Optimal Process Control—Optimal linear control by spectral factoring and quadratic root locus. Applications of calculus of variations, dynamic programming, and Pontryagin's principle to nonlinear control. Analysis of nonlinear systems intended for engineers and operations analysts having no background in electrical control theory. Prerequisite: course in linear control systems (201 or equivalent).  
3 units, spring, (Wilde), MWF, alternate years, to be given in 1966–67

204. Advanced 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, (Boudart), TTh, hour by arrangement

210a. Advanced Transport Phenomena—An intensive course dealing with the fundamental principles of momentum, heat and mass transfer, and their application to processes of interest to chemical engineers. Derivation and analysis of the Navier-Stokes equations, the energy equation, and the equation for mass transport; creeping flow phenomena and Stokes law; the method of singular perturbation expansions; motion of drops and influence of surface active agents.  
3 units, autumn, (Acrivos), MWF 8
210b. Advanced Transport Phenomena—A continuation of 210a. Laminar boundary layer theory and its application to problems in heat and mass transfer; the effect of chemical reactions on transport phenomena; hydrodynamic stability and the Orr-Sommerfeld equation; interfacial instability.

3 units, winter, (Acivos), MWF 8

210c. Advanced Transport Phenomena—A continuation of 210b. Elements of turbulent transport of heat and mass. Phenomenological theories; self-preserving flows; the law of the wall; homogeneous turbulence and statistical theories; mixing and chemical reaction in a turbulent field.

3 units, spring, (Schwartz), MWF 8


3 units, (Schwartz), by arrangement, alternate years, to be given in 1966–67

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, (Schwartz), by arrangement, alternate years, to be given in 1965–66

230a. Thermodynamics of Irreversible Processes—A course dealing with the main developments in the thermodynamic treatment of irreversible chemical and electrochemical processes, transport processes, coupling phenomena, etc., with special emphasis on topics and methods of interest to students of chemical engineering, materials science, physical chemistry, biophysics, etc.

3 units, autumn, (Van Rysselberghe), by arrangement, alternate years, to be given in 1965–66

230b. Thermodynamics of Irreversible Processes—Complements 230a; separately open to qualified students.

2 units, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1965–66

231. Electrochemical 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 1965–66

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), TTh 9, alternate years, to be given in 1966–67

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

2 units, spring, (Van Rysselberghe), TTh 9, alternate years, to be given in 1966–67

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, 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
Associate Professors: James Douglas, John W. Fondahl, En Yun Hsu, Paul Kruger, Perry L. McCarty, Henry W. Parker, Byrne Perry, Vincent J. Roggeveen, (on leave 1965-66), Cedric W. Richards, William Weaver, Jr. (on leave 1965-66)
Assistant Professors: Norman H. Crawford, Robert R. Lee (on leave 1965-66), Robert L. Street

OFFERINGS AND FACILITIES

The undergraduate Civil Engineering program provides a well-balanced program stressing the fundamentals common to all special fields of civil engineering. Elective units permit the student to make a further selection of general courses or, if his interests are well defined, to specialize slightly in a definite branch, such as construction, highways, hydraulics, public works administration, or structures. Well-equipped laboratories are available to supplement the lecture courses. A student's professional competence will be greatly enhanced by a year of graduate study following receipt of the B.S. degree. Students interested in advanced work in special fields should consider further graduate study.

The Civil Engineering Department, in collaboration with other departments of the University, offers graduate programs with particular strength in:

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

Research work under these programs is carried out in two major facilities—the newly renovated hydraulics laboratory and the 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: Construction, Engineering-Economic Planning, Hydraulic Engineering, Public Works Administration, Sanitary Engineering, Soil Mechanics, and Structural Engineering. A general M.S. in civil engineering without special designation is also given. Detailed statements of the requirements for all Master's degrees and the specific course requirements for a degree with special designation may be secured by request to the Civil Engineering Department.

Students having undergraduate degrees in civil engineering normally can satisfy requirements for the M.S. degree with three quarters of graduate work of satisfactory quality. Students with undergraduate degrees in other fields may need longer residence for the M.S. degree as they will be required to make up specified basic undergraduate civil engineering subjects. A minimum grade point average of 2.75 is required for candidates to be recommended for the M.S. degree.

**Engineer**

A minimum of six quarters of graduate work including a thesis is required for the degree of Engineer in Civil Engineering. This degree is recommended for students planning a career in professional practice. The student normally should start his thesis 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 3.00 is required for candidates to be recommended for the degree.

**Doctor of Philosophy**

The degree of Doctor of Philosophy is offered under the general regulations of the University as set forth in the section “Degrees” in this Bulletin. This degree is recommended for those engineers who expect to engage in a professional career in research, teaching, or technical work of an advanced nature in the planning, design, and analysis of civil engineering systems. The Ph.D. program is rigorous and should be undertaken only by students with ability for independent work. It requires a minimum of three years (nine quarters) of graduate study, at least two years of which must be at Stanford.

The first year is represented by the M.S. program described above. The second year will be devoted partly to additional courses of graduate study and partly to the preliminary work toward a dissertation. The third and subsequent years will be applied to further course work and to the completion of an acceptable dissertation. Dissertation research in absentia is not permitted.

The program of study will be arranged by the prospective candidate at the beginning of the second year with the advice of a faculty committee whose members are nearest in the field of interest to that of the student. The chairman of the committee will serve as the student's pro tem. adviser until such time as a member of the faculty has agreed to direct the dissertation research. Insofar as possible the program of study is adapted to the interests and needs of the student within the framework of the requirements of the Department and the University. In the second year of graduate study the student is expected to pass the Departmental Qualifying Examination and to complete a substantial amount of the required foreign language work in order to be admitted to candidacy.

**FINANCIAL ASSISTANCE**

The Department maintains a large and continuing program of financial aid for graduate students. Fellowship or scholarship awards range from $500 to $5,000.
Teaching assistantships carry stipends for one-third time work as teaching aides during the academic year. Research assistantships are also available; research results may be used as a basis for a doctoral thesis. Assistantships and other basic support may be supplemented by fellowship and scholarship awards. Continued support is available for further study toward the Engineer or Doctor of Philosophy degree when performance justifies such support. Detailed information may be obtained by writing to the Department of Civil Engineering.

UNDERGRADUATE COURSES

20. Elementary Surveying—Care and use of instruments; leveling; transit-tape and stadia traverses; topographic surveying; triangulation; plotting and adjusting of field data; computing of areas and topographic mapping. (Limited to 36 students per section.)

3 units, spring, (Staff), MW 1:15-5:05


3 units, autumn, (Vennard), TTh 9; lab. Th 1:15-4:05

114. Mechanics of Materials—Continuation of Engineering 15; combined loads and stresses, bending of curved bars, two-dimensional axially symmetric stress problems, strain energy, statically indeterminate systems, beams of two materials, special problems. Prerequisite: Engineering 15.

3 units, autumn, (Richards), MWF 8

spring, (Richards), MWF 11

116. Plain Concrete—Physical properties of concrete and its constituents. (Limited to 20 students per section.)

3 units, autumn, (Douglas), T 1:15-5:05 and Th 1:15-4:05

winter, (Parker), W 1:15-5:05 and F 1:15-4:05

118. Materials Engineering—Mechanical behavior of solids; effects of stress distribution; dynamic and thermal effects; creep and relaxation; fatigue; statistical methods. Prerequisites: Engineering 15, Chemistry 2 and Engineering 50.

3 units, winter, (Richards), TTh 10; lab. M 1:15-4:05

126. Advanced Surveying—Highway reconnaissance and location, horizontal and vertical curves, earthwork computations, photogrammetry, construction surveys, adjustment of instruments, city and land surveying, plane table, engineering astronomy. Prerequisite: 20.

4 units, spring, (Staff), TTh 11; lab. TTh 1:15-4:05

138. Specifications and Contracts—Principles of contract law as applied to civil engineering; varieties of construction contracts; specification writing; composition, arrangement of typical sets of specifications; legal problems in administering construction contracts; engineering ethics. Prerequisite: junior standing.

3 units, autumn, (Fondahl), MWF 11

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

winter, (Parker), MWF 9

145. Construction Equipment and Methods—Construction procedures, equipment; job planning and scheduling, selection and efficient use of excavation and hauling equipment, related problems. (May be taken concurrently with 150 or 151.)

3 units, autumn, (Parker), TTh 8; lab. M 1:15-4:05

spring, (Douglas), TTh 9; lab. M 1:15-4:05

150. Transportation Engineering—Basic principles of planning and design of highways, airports, railroads, mass transit, etc. Trip generation, desires, capacity, geometric design, pavements, tracks, finance, economy, relationships with land use,
interrelationships between modes, etc. Open to engineering students having 90 quarter-units of credit and to other students by permission.

3 units, autumn, (Staff), MWF 10

151. Highway Engineering — Soils, soil conditioners, asphalts, and concrete as highway materials; design and construction procedures for highway embankments, undercourses, and pavements. Prerequisite: junior standing.

3 units, spring, (Staff), TTh 8; lab. M 1:15-4:05

160. Hydrology and Hydraulic Structures—Introduction to hydrologic measurements, runoff computations, groundwater, water law, reservoir design, frequency analysis, dams, spillways, conduits, economy of water-resources development. Prerequisite: 107.

4 units, winter, (Fransini), MTThF 8


2 units, winter, (Vennard), TTh 11

170. Man and His Environment—Man's interaction with the air, water, and land environment in which he lives; the role of engineering in environmental control.

3 units, spring, (Eliassen), MWF 10

171. Environmental Radioactivity—Review of the sources of radioactivity in man's environment from space, nature, fallout, nuclear power, etc.; the transport of radioactivity throughout the biosphere; and the means of controlling the radiation hazard to man. Prerequisites: 170, or Chemistry 3, or Physics 57, or equivalent with consent of instructor.

3 units, spring, (K. Kruger), TTh 11

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. (Enroll in Engineering 172.) Prerequisites: Chemistry 3, Mathematics 23, or Physics 57.

3 units, autumn, (P. K. Kruger), TTh 11

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. (Enroll in Engineering 176.) Prerequisite: Engineering 172 or 175 or consent of instructor.

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

180. Elementary Structural Analysis—Analysis of beams, trusses, frames; influence lines for beams, girders, trusses; 3-dimensional trusses; cable structures; deflections by virtual work, moment-area, elastic loads; indeterminate analysis by superposition equations, slope-deflection, moment distribution; introduction to matrix methods of analysis. Prerequisite: Engineering 15.

4 units, 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, (Benjamin), MWF 9

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

3 units, winter, (Staff), MWF 10

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, (Staff), TTh 10
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; lab. T or W 1:15-4:05

197. **Engineering Synthesis**—Utilization of students' previous course work and creative abilities with objective of producing problem solutions and workable designs for a comprehensive project. Stress placed on job planning, coordination and efficient use of group talent. Prerequisite: senior standing.

4 units, spring, (Douglas, Staff), by arrangement

198. **Senior Report**—Practice in execution of a simple engineering investigation, preparation of a written report on the investigation. Required of all candidates for the Bachelor's degree during either of the last two quarters before graduation.

1 unit, winter, 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**

205. **Hydromechanics Laboratory**—Prerequisite: 107 or equivalent. Enrollment is limited.

2 units, winter, (Hsu), by arrangement

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. (Enroll in E.M. 241.) Prerequisite: 107.

3 units, autumn, (Vennard), MWF 10

207. **Advanced Hydraulic Laboratory**—Prerequisite: 107, or equivalent. Enrollment is limited.

2 units, spring, (Vennard), by arrangement

208. **Hydraulics of Pipe Lines**—Flow of incompressible fluids in pipes and pipe systems, unsteady flow, surge problems, water hammer. Prerequisite: Engineering 21.

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

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

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

233. **Statistical Models in Civil Engineering**—(Formerly 297.) Applications of probability and statistical analysis to civil engineering; model construction from probability theory; descriptive statistics; estimation with small samples; recognition of variation including professional elements; models for reliability studies of civil engi-
neering designs; construction of complex models. Open to graduate students only.

3 units, winter, (Benjamin), MWF 8 and 10

234. Decision Making in Civil Engineering—Applications of statistical decision theory in civil engineering practice; decision theory; value; prior; posterior; expected value; model of engineering office practice; formulation of problems; economic analysis. Prerequisite: 233.

2 units, spring, (Benjamin), MW 8

235. Stochastic Process Models in Civil Engineering—Introductory course in applications of stochastic processes to problems in Civil Engineering; the traffic model; generalized transportation models; structural dynamics models; creep and one-cycle problems; diffusion models; fitting of data to models and the estimation problem. Prerequisite: 233, 234, or equivalent.

2 units, autumn, (Benjamin), TTh 11

240. Operations Analysis for Work Improvement in Construction—Application of crew balance, process charts, time-lapse motion pictures, and operations research techniques to construction operations. Accident prevention. Prerequisite: graduate standing.

2 units, autumn, (Parker), TTh 2-3; lab. T or Th 3:15-5:05

241. Concrete Construction—Economy and procedures in plant and equipment selection, form design, and field operations. Special techniques in forming and handling concrete.

3 units, spring, (Fondahl), WF 9 and one evening by arrangement

242. Construction Equipment Policy—Application of sound management principles in establishing equipment policy; treats depreciation and obsolescence, standardization, preventive maintenance, and fiscal aspects of equipment ownership. Prerequisites: Engineering 161 and C.E. 243 or equivalent.

2 units, spring, (Douglas), TTh 10


4 units, winter, (Fondahl), MWF 10 and one evening by arrangement

244. Construction Planning and Scheduling—Planning, scheduling, and progress control of construction operations. Emphasis on the Critical Path Method including network diagramming, calculations based on time data, and scheduling variations to optimize cost. Manpower and equipment leveling. Course includes both non-computer and computer techniques. Prerequisite: graduate standing.

2 units, autumn, (Fondahl), WF 3:15

winter, (Fondahl), TTh 10

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

4 units, autumn, (Parker), TTh 10; lab. M 1:15-4:15 and one evening by arrangement

246a. Heavy Construction Estimates—Estimating and bidding construction work, with emphasis on procedures adapted to large engineering projects. Prerequisites: 144, 145 and graduate standing in construction option.

3 units, winter, (Peugh), TTh 1:15-3:05

246b. Estimating for Building Construction—Estimates and costs attached to construction of large buildings, such as apartment houses, warehouses, and other commercial and industrial type structures. Limited enrollment. Prerequisites: 138 and 144. Graduate standing in construction option.

3 units, spring, (Staff), by arrangement

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

2 units, 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, (Staff), 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. (Enroll in E.E.S. 311.)

3 units, spring, (Staff), MWF 1:15, alternate years, to be given in 1965–66

251. Transportation Problems—Individual investigation. Prerequisite: permission of instructor.

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

260. Advanced Hydrology—Meteorology, climatic data, precipitation, evapotranspiration, and streamflow, techniques of measurement and interpretation.

4 units, autumn, (Crawford), MWF 9; lab. T 1:15–4:05

261. Advanced Hydrology—Methods of applied hydrology: runoff relationships, unit hydrographs, flood routing, frequency analysis, etc. Prerequisite: 260.

4 units, winter, (Linsley), MWF 10; lab. T 2:15–5:05

262. Advanced Hydraulic Engineering—Integration of procedures in hydraulic projects illustrated by discussion, student reports, and design problems. Prerequisite: 261.

4 units, 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: 107 or equivalent.

2 units, spring, (Fransini), MWF 9

264. Oceanographical and Coastline Engineering—Fundamentals of water waves and their effects. Wave generation, storm swell, tsunamis, coastal processes. Effects of structures on waves and functional design of marine structures including sea water intakes and ocean outfalls. Prerequisites: 107, Engineering 12, 21, and Mathematics through 43; equivalents, or consent of instructor.

3 units, spring, (Street), MWF 11


4 units, autumn, (Perry), MWF 11 and one afternoon by arrangement


3 units, winter, (Perry), MWF 1:15

267. Engineering Hydrodynamics—Continuation of E.M. 246. Selected theoretical topics from naval hydrodynamics, hydraulic engineering, and oceanography. Possible topics include forces on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, density currents, flow over weirs and spillways. (Enroll in E.M. 247.) Prerequisite: E.M. 246.

3 units, spring, (Perry), MWF 2:15

269. Hydraulic Engineering Seminar—Discussions on all phases of hydraulic engineering.

1 unit, autumn, (Fransini), T 4:15–6:05
spring, (Fransini), W 3:15–5:05

270. Water Quality Control I—Natural and man-made characteristics of water quality; effect of quality on the use of water; unit operations of water quality control for municipal and industrial use. Prerequisite: 170 or equivalent.

3 units, autumn, (Eliassen), MWF 8
271. Water Quality Control II—Characteristics of waste waters; chemical and biological unit processes for the treatment of sewage and industrial wastes; water quality requirements in stream pollution control. Prerequisite: 270.

3 units, winter, (Eliassen), MWF 9

272. Design of Water Quality Control Systems—Application of physical, biological, and chemical unit operations and unit processes to the functional design of treatment plants for water, sewage, and industrial wastes. Prerequisites: 270 and 271.

2 units, spring, (Eliassen), W 1:15–5:05

273. Water Resources Chemistry—Application of basic principles of analytical, physical, and organic chemistry to the analysis and treatment of water, sewage, and industrial wastes.

3 units, autumn, (McCarty), TTh 8; lab. M 1:15–4:05

274. Water Resources Microbiology—The ecology of streams, lakes and other water resources; identification and control of microorganisms in water and wastes; fundamental aspects of microbiology and biochemistry as related to stream pollution and water quality control. Prerequisite: 273.

3 units, winter, (McCarty), TTh 10; lab. W 1:15–4:05

275. Water Quality Control Processes—Laboratory and pilot plant studies of physical, chemical, and biological processes for the treatment of water, sewage, and industrial wastes. Prerequisite: 274.

3 units, spring, (McCarty), M 1:15–5:05 and Th 1:15–4:05


2 units, spring, (McCarty), TTh 8

278. Radioactivation Analysis—The use of radioactivation as a research tool: radioactivation, properties of radioisotopes, sources of irradiations, activation analysis, practices and uses in biology, chemistry, and engineering. Individual study optional.

2 units, winter, (P. Kruger), TTh 11


3 units, autumn, (Young), MWF 9

281a. Matrix Analysis of Structures—Introduction to matrix algebra; use of matrix methods in the analysis of statically and kinematically indeterminate structures; flexibility and stiffness methods. Prerequisite: 114.

3 units, autumn, (Gere), MWF 9

281b. Matrix Analysis of Structures—Continuation of 281a. Emphasis on the stiffness method, including implementation of the method on a digital computer. Prerequisite: 281a.

3 units, winter, (Gere), MWF 11

283. Advanced Structural Analysis—Membrane stresses in tank, roof shells; discontinuity stresses in domes, tanks; barrel shell roofs; introduction to plane plate theory. Prerequisite: 281.

4 units, spring, (Flügge), TTh 11 and M 2–5 and F 1–4

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, (Staff), 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, (Benjamin), TTh 8; lab. W 1:15–4:05
   4 units, winter, (Benjamin), TTh 9; lab. W 1:15-4:05

287. Advanced Structural Design—Continuation of 286. Design of buildings in steel, timber; lateral load analysis, design; shear walls; diagonal sheathing; framing problems. Prerequisites: 285 and 286.
   4 units, spring, (Benjamin), TTh 8; lab. W 1:15-4:05

288. Structural Engineering Seminar—Problems in all phases of structural engineering.
   1 unit, autumn, winter, spring, (Staff), alternate W 4:15

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; slope stability; embankment design; earth retaining structures. Prerequisite: 190.
   3 units, winter, (Williams), TTh 11 and M 4:15

   2 units, spring, (Williams), TTh 9

   3 units, autumn, (Williams), MWF 10
   winter, (Williams), MWF 11

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

   4 units, winter, (Young), MWF 9

296b. Structural Dynamics—Continuation of 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

298. Stability Problems—Beam-columns; elastic buckling of columns; non-prismatic columns; inelastic bending and buckling of bars; torsion of bars of open section; lateral buckling of beams; buckling of frames. Prerequisites: 114 and ordinary differential equations.
   3 units, spring, (Gere), MWF 11

299. Directed Reading and Special Studies in Civil Engineering—Graduate students by special permission.
   Autumn, winter, spring, (Staff), by arrangement

300. Thesis—Investigation of some engineering problem; required of candidates for degree of Engineer.
   Autumn, winter, spring, (Staff), by arrangement

301. Thesis—Dissertation; required of candidates for degree of Doctor of Philosophy.
   Autumn, winter, spring, (Staff), by arrangement

tions to spatial deformation of skeletal structures. Extensions of nonlinear aspects. (Enroll in E.M. 265.) Prerequisite: 280.
2 units, autumn, (Hetényi), TTh 10

391. Predoctoral Seminar—Required of all post-masters students to serve as orientation to the selection of a research topic.
1 unit, autumn, (Staff), by arrangement

Civil engineering graduate students with interests in special fields will also take appropriate courses in other schools and departments of the University including the Graduate School of Business, Division of Engineering Mechanics, the Departments 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: John Grimes Linvill
Director Undergraduate Program: Ralph Judson Smith
Graduate Administration: Robert Arthur Helliwell
Honors Cooperative Program: Willis Walter Harman
Associate Professors: Richard H. Bube, Owen Kay Garriott, Thomas Kailath, Robert Wayne Newcomb, Marshall Scott Sparks, Robert Lee White, Bernard Widrow. Acting: Donald Allen Dunn, Donald John Grace
Assistant Professors: Thomas Merrill Cover, Stephen Ernest Harris, David Gilbert Luenberger, Bruce Burr Lusignan, Richard Lewis Mattson, Richard Dale Smallwood. Acting: John Charles Edson

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:

<table>
<thead>
<tr>
<th>Administration</th>
<th>Quantum Electronics</th>
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<tbody>
<tr>
<td>Electron Tubes</td>
<td>Radio Sciences: Ionospheric Propagation,</td>
</tr>
<tr>
<td>Electronic Systems Techniques</td>
<td>Radio and Radar Astronomy, Space Electronics</td>
</tr>
<tr>
<td>Illumination</td>
<td>Solid-State Electronics: Circuits; Materials;</td>
</tr>
<tr>
<td>Microwaves</td>
<td>Electronic, Magnetic, and Optical Properties</td>
</tr>
<tr>
<td>Network Theory</td>
<td>Theory of Systems: Control Systems, Communication</td>
</tr>
<tr>
<td>Plasmas</td>
<td>Theory, Computers, Adaptive Systems</td>
</tr>
<tr>
<td></td>
<td>Transistor Electronics</td>
</tr>
</tbody>
</table>

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.

Graduate study beyond the Master of Science degree requires an academic record in graduate work well above a B average and written permission from the Department of Electrical Engineering. A two-year 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 in corresponding sections under School of Engineering. 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 calculus), mechanics (e.g., Engineering 11, 12 or Physics 110 and 111), electrical circuits (e.g., E.E. 100, 101, 102), electronics (e.g., E.E. 150, 151, 152), electromechanics and fields (e.g., Engr. 42, 42L, E.E. 110), 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), automatic digital computers (Computer Science 136), atomic physics (Physics 57), control systems (E.E. 128), electromagnetic theory (E.E. 111), and additional laboratory work (e.g., E.E. 138 or 170). 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 for 3 quarters, 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) Tentative 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. This application must be completed and filed in the Department office before completion of 25 units of work beyond the Master's degree.

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 one copy of the Application for Doctoral Candidacy form for preliminary Departmental approval. Official Departmental approval will be given after successful completion of the qualifying examination and passing an examination of reading knowledge of one foreign language.

Not later than the first autumn quarter after receiving the Master of Science degree he should submit an application to take the Department qualifying examination (given each winter quarter).

Requirements may be summarized as follows: The student is to complete successfully (1) a minimum of three years of residence with graduate standing, one year of which must be in residence at Stanford; (2) one or more qualifying examinations given by the faculty of the Electrical Engineering Department, beginning in the second year of graduate study; (3) an examination to show reading knowledge of a foreign language (usually French, German, or Russian, although another language may be substituted if it is of greater value in the student's research); (4) an approved program of courses in electrical engineering and allied subjects; (5) an oral examination near the completion of the doctoral program; (6) a dissertation, based on research, which must be a contribution to knowledge.
About one-fourth of the program of graduate study should be in departments other than Electrical Engineering. Courses shall be selected to form an integrated program, to be approved by the Department. A student wishing to fulfill the requirements for a formal minor may elect to do so.

Ph.D. Minor—For a minor in Electrical Engineering the candidate will take 15 quarter units of course work in the Electrical Engineering Department following a program to be approved by the Department committee on doctoral candidates. He will take and pass 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.

Medical Electronics Program—The Master of Science degree carrying the designation "Electrical Engineering: Medical Electronics" on the diploma may be conferred upon students who wish to combine training in biological or medical sciences with an electronics program in the Department of Electrical Engineering.

A student who wishes to be a candidate for a Master's degree with the designation "Electrical Engineering: Medical Electronics" should so indicate when he submits his application for candidacy for the degree. His proposed program of study for the degree should show at least 45 units of work. A candidate with a Bachelor of Science degree in electrical engineering would normally devote approximately half his time to graduate courses in electrical engineering and the balance of his time to courses in biology or medicine. A candidate for the Doctor of Medicine degree who plans to apply his academic year of "University Time" toward this Master's degree would devote about half of his time to undergraduate courses in electrical engineering, mathematics or physics, and the other half, to graduate courses in electrical engineering.

The minimum amount of time required to obtain this degree is one academic year. Candidates with inadequate preparation in mathematics, physics, and electrical engineering will require more time.

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. Four or five academic quarters are required to complete this program, which combines the technical education that is represented by the Master's degree in electrical engineering with a substantial amount of work in industrial engineering or business.

The degree of Engineer is 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 44) 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.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>First Year</th>
<th>Second Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr. 41, 42, 41L, 42L</td>
<td>Circuits, Electronics, and Electromechanics</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>E.E. 100, 101, 102</td>
<td>Circuits</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 110, 111</td>
<td>Electromagnetic Theory</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 128</td>
<td>Control Systems</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 150, 151, 152, 161</td>
<td>Electronics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 156, 157, 170, 171</td>
<td>Laboratory</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>E.E. 164</td>
<td>Pulse and Timing Circuits</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 200</td>
<td>Seminar</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>E.E. 240</td>
<td>Theory of Linear Systems</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics 130</td>
<td>Differential Equations</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
Physics 57, 110, 111. Atomic Physics, Mechanics — — 3 — 3 3
Optional courses (see Note below) — — 3 3 6 12

Totals .................................. 12 17 16 9 17 15 15

Note—Optional courses may be selected from: other E.E. courses, Mathematics courses such as 106, 107, 114a, b, 131, 132, Computer Science 137, 138, and others of value to the student.

List from which optional courses are selected include:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>E.E. 124.</td>
<td>Electromechanics</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>E.E. 159.</td>
<td>Microwave and High Power Tubes</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>E.E. 162.</td>
<td>Radio Engineering</td>
<td>—</td>
<td>—</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 226.</td>
<td>Two-Port Network Theory</td>
<td>3</td>
<td>—</td>
<td>—</td>
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<tr>
<td>E.E. 227, 228. Transistor Electronics</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td></td>
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<tr>
<td>E.E. 231, 232. Amplifier Circuit Theory</td>
<td>—</td>
<td>3</td>
<td>3</td>
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<tr>
<td>E.E. 235, 236, 237. Network Synthesis and Analysis</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<tr>
<td>E.E. 245, 246. Control System Synthesis I, II</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E.E. 250a, 250b. System Analysis</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>E.E. 251a, 251b. Statistical Communication Theory</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td></td>
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<tr>
<td>E.E. 253a.</td>
<td>Detection Theory</td>
<td>—</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>E.E. 259, 260. Basic Quantum Mechanics</td>
<td>3</td>
<td>3</td>
<td>—</td>
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<tr>
<td>E.E. 270n, 271, 272. Electromagnetic Theory and Radiation</td>
<td>3 3 —</td>
<td>3 3 —</td>
<td></td>
<td></td>
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<tr>
<td>Mathematics 106. Complex Variable</td>
<td>3</td>
<td>—</td>
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</tbody>
</table>

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
- Opto-Electronics
- Plasma Physics
- Quantum Electronics
- Radio and Radar Astronomy
- Radio Studies of Ionized Media
- Semiconductor Materials
- Signal Synthesis and Analysis

- Illumination
- Ion Propulsion
- Magnetic, Electronic, and Optical Properties of Solids
- Microsystem Electronics
- Microwave and Optical Propagation
- Microwave Tubes
- Network Theory
- Solar-Terrestrial Geophysics
- Solid State Circuits
- Solid State Physics
- Space-Probe Experiments
- Statistical Communication Theory
- Systems Theory
COURSES PRIMARILY FOR UNDERGRADUATES

41, 42. Circuits, Electronics, and Electromechanics—Enroll in Engineering 41, 42.

41L. Laboratory I—Enroll in Engineering 41L.

42L. Laboratory II—Enroll in Engineering 42L.

100. Circuits I—Analysis of the response (to various excitations) of simple circuit models, with a view to discovering their fundamental characteristics as transmission networks. Forced and natural components of response, natural frequencies, the complex-frequency plane, resonance, transfer functions, the roles of their poles and zeros, elementary flow graphs, impulse response (its calculation and utility), the superposition (convolution) integral. Prerequisite: Engineering 41 and an average of 2.50 in previous mathematics, physics and electrical engineering courses.

3 units, autumn, (——), MWF 10
winter, (——), MWF 8


3 units, winter, (——), MWF 10
spring, (——), MWF 8


4 units, autumn, (——), MTThF 9
spring, (——), MTThF 10

108. Illumination—Production of light; characteristics of light sources; methods of measuring, controlling, and applying light; home, school, commercial, and industrial lighting. Prerequisite: Mathematics 23 or 43.

3 units, autumn, (——), MWF 8

110. Electromagnetic Fundamentals—The field concept, vector analysis, boundary-value problems, magnetostatics, dielectric and magnetic media, time-varying fields, Maxwell’s equations, plane waves. Prerequisite: Engineering 41.

3 units, autumn, (——), MWF 8
winter, (——), MWF 9


3 units, winter, (——), MWF 8
spring, (——), MWF 9

124. Electromechanics—Theory of electromechanical energy conversion and its applications in common use. Rotating machines (d-c and a-c, both steady and dynamic operation), electromagnets, loudspeakers, microphones, and vibration pickups are considered as elements of systems. The dynamic response of such systems is also considered. Prerequisites: E.E. 105 and Engineering 42.

3 units, autumn, (——), 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: E.E. 101 or 105, or Engineering 104. (E.E. 124 suggested.)

3 units, autumn, (——), MWF 10
winter, (——), MWF 8
spring, (——), MWF 11
138. **Control Systems Laboratory**—Experiments with servomechanisms and analog computers. Prerequisite: E.E. 128.

3 units, winter, spring, (Staff), Th 1:15 and one 3-hour lab. weekly by arrangement

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: Engineering 41 or Physics 120, and previous or concurrent registration in E.E. 100.

150. 3 units, autumn, (——), MWF 8
    winter, (——), MWF 11
151. 3 units, winter, (——), MWF 8
    spring, (——), MWF 11
152. 3 units, autumn, (——), MWF 11
    spring, (——), MWF 8


156. 2 units, winter, (——), T 1:15 and 3-hour lab. weekly by arrangement
157. 2 units, spring, (——), T 1:15 and 3-hour lab. weekly by arrangement

159. **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: E.E. 106 and 152 (may be concurrent).

3 units, autumn, (——), MWF 8

161. **Information Transmission and Modulation**—Signals and circuits for information transmission in electronic systems; signal processing, modulation, demodulation, frequency conversion, multiplexing, and noise; spectrum, envelope, and instantaneous frequency relations; information measure, channel capacity, and comparison of systems from an information-theory standpoint. Prerequisites: E.E. 102 or E.E. 106, and E.E. 152.

3 units, winter, (——), MWF 8

162. **Radio Engineering**—Systems applications of electronic circuits; propagation of radio waves, antennas, transmitters, receivers, etc. Engineering decisions involved in design of system components with examples in communication and radar. Prerequisite: E.E. 111.

3 units, spring, (——), MWF 8

164. **Principles of Pulse and Timing Circuits**—Tube, transistor circuit techniques for diversity of waveforms, functions needed in pulse systems, instrumentation, computers. Prerequisite: E.E. 152 or equivalent.

3 units, autumn, (——), MWF 10
    spring, (——), MWF 10
    summer, (——)

165. **Random Signals and Noise**—Introduction to the random process model for undetermined signals and noise waveforms, statistical descriptions of signals, power spectral density and autocorrelation function, analysis of linear networks with random inputs, some elementary results with nonlinear elements, physical sources of noise, noise figure. Prerequisites: E.E. 105 and Statistics 116 or equivalent.

3 units, winter, (——), MWF 2:15

167. **Electric and Magnetic Properties of Solids**—The electrical and magnetic properties of solids are examined from a fundamental point of view. The necessary elementary concepts of quantum mechanics are introduced. Free electron theory, band
theory, effective mass approximation, dielectric and ferroelectric materials, magnetic materials, ferromagnetism, and superconductivity. Prerequisites: Physics 57 and preferably E.E. 150 or Engineering 50.

3 units, spring, (———), MWF 1:15

170, 171, 172. Electronic Measurements—Primarily laboratory, one or two lectures per week; principles and methods of electronic measurement. Prerequisites: E.E. 152, 157; in addition, E.E. 111 and 161 are suggested for 171.

170. 3 units, autumn, (———), TTh 9 and 3-hour lab. weekly by arrangement

171. 3 units, winter, (———), TTh 9 and 3-hour lab. weekly by arrangement

172. 3 units, spring, (———), TTh 9 and 3-hour lab. weekly by arrangement

180. Design Project—Individual or team projects that emphasize the creative use or design of electrical devices or systems to meet specifications. Prerequisite: senior standing.

3 units, autumn, winter, spring, (———), by arrangement

191. Special Studies in Electrical Engineering—Special studies, laboratory work, reading, etc. under direction of a faculty member. Student must find faculty sponsor and have approval of his adviser. A term paper is required.

2 to 3 units, (———), by arrangement

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

COURSES PRIMARILY FOR GRADUATE STUDENTS

Note—In addition to the following courses, certain courses from the previous list are acceptable for M.S. work: E.E. 164, 165, 167.

200. Seminar—Weekly discussion of special topics of current interest in electrical engineering. Normally taken each quarter for 3 quarters by graduate students.

1 unit, autumn, winter, spring, (Garriott), Th 11

201. Introduction to Solid State Quantum Theory—(Enroll in Materials Science 233.)

202. Electrical Transport Processes in Crystals—(Enroll in Materials Science 234.)

203. Photoelectronic Processes in Crystals—(Enroll in Materials Science 235.)

205. Medical Electronics—A discussion of problems unique to biomedical instrumentation. Various medical, electrical and chemical transducer systems and the accompanying electronics are considered. The students are expected to give a half-hour oral presentation during the quarter on some specific aspect of biomedical instrumentation. Prerequisite: familiarity with electrical instrumentation techniques.

2 units, autumn, (Thompson)

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: E.E. 108 or equivalent.

2 or more units, autumn, winter, spring, (Brown)

For description of Courses 211p–218p, see Applied Physics 250–355

211p. Electron and Ion Dynamics—(Enroll in Applied Physics 250.)

212p. Electron and Ion Dynamics—(Enroll in Applied Physics 251.)


214p. Electromagnetic Measurements Laboratory I—(Enroll in Applied Physics 351.)


216p. Electromagnetic Measurements Laboratory II—(Enroll in Applied Physics 353.)


218p. Electromagnetic Measurements Laboratory III—(Enroll in Applied Physics 355.)
220n. Topics and Methods in Solid State Research—Discussion of technical topics in solid state electronics and related mental processes and thinking tools. (Shockley), by arrangement

225. Solid State Circuits Laboratory—Experimental projects, usually of 10-weeks duration, on electrical properties, performance, and circuit design for various state-of-the-art solid-state devices (including transistors, field-effect transistors, varactors, tunnel diodes), with emphasis on relationship of performance to physical mechanisms, instrumentation techniques, and a realistic minimum of report preparation. Prerequisites: previous or concurrent registration in any one of the following: E.E. 226, 227, 228, 229, 231, 232, and permission of the instructors. 
3 units, autumn, winter, spring, (Angell, J. Linvill)

3 units, autumn, winter, (Angell, J. Linvill, Newcomb)

227. Principles and Models of Semiconductor Devices—Quantitative description and modeling of the physical processes of transport, storage, generation and recombination of carriers in semiconductors. Development, based on the models of the physical processes, of a range of circuit models of transistors and diodes, including the commonly encountered models. Emphasis is placed on lumped models applicable to small- and large-signal cases. Prerequisite: E.E. 152 or graduate standing in electrical engineering. 
3 units, autumn, winter, (Angell, J. Linvill, Tuttle)

228. Transistor Electronics—Discussion of linear amplifiers, active circuits, non-linear switching and regenerative circuits based on the network theory of E.E. 226 and the circuit models developed for transistors in E.E. 227. Prerequisites: E.E. 226 or 236 with approval of instructor, and 227. 
3 units, spring, (Angell, J. Linvill)

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. Prerequisite: E.E. 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 physical, device and circuit aspects of solid state electronics. 
1 unit, autumn, winter, spring, (Angell, Spicer)

231. Amplifier Circuit Theory—Representation of tubes and transistors over wide frequency ranges. Amplifier design based on steady state and transient performance. Relationships between steady-state and transient behavior. D-C amplifiers. Background in undergraduate electronics and basic complex variable theory required. E.E. 227 is useful but not necessary in understanding the models used. 
3 units, winter, (McWhorter, Staff)

3 units, spring, (McWhorter, Staff)

233. Network Theory Seminar—Discussion of recent results in network theory. Prerequisite: E.E. 236 or permission of instructor. 
1 unit, spring, (Newcomb)

234. Nonlinear Network Analysis—Introduction to the analysis (steady-state and transient) of networks containing nonlinear elements, both passive and active. Energy considerations. Discussion of methods of analysis with emphasis on approxi-
mate methods (graphical, numerical, analytical), particularly averaging techniques. Resonance. The describing function. Oscillators (wave shapes, amplitude limitation), elementary control systems. Prerequisites: E.E. 106, 128, and 152.

235. Introduction to Network Synthesis—A one-quarter survey of the principal ideas of network theory, for both passive and active networks. Properties of networks, practical limitations on their performance, and procedures for their synthesis. (The study of network synthesis is continued in E.E. 236 and 237 for those interested in advanced work in the subject.) Prerequisite: E.E. 106.

3 units, spring, (Tuttle)

236. Advance Network Analysis—An investigation of analysis methods needed for modern synthesis: n-ports and properties; linear and nonlinear descriptions; scattering concepts; positive and bounded-real matrices; topological methods; Hilbert transforms; Manley-Rowe relations; stability; appropriate topics in synthesis. Prerequisites: E.E. 235 and E.E. 240.

3 units, autumn, (Newcomb), alternate years, to be given in 1966-67

237. Advanced Network Synthesis—A continuation of the work of E.E. 235 with more extensive coverage based upon E.E. 236: Formal n-port synthesis; topological and transformerless synthesis; distributed, variable parameter, active and nonlinear synthesis; approximation; filter design; equivalent network theory. Prerequisite: E.E. 236.

3 units, spring, (Newcomb), alternate years, to be given in 1966-67

238. Contactor Control and Optimal Control—(Enroll in Engineering Mechanics 236.)

239a, b, c. Theory of Control—(Enroll in Engineering Mechanics 239a, b, c.)


4 units, autumn, spring, (W. Linvill, Abramson, Bracewell, Kailath)

241a, b. Dynamic Probabilistic Systems—(Enroll in Engineering-Economic Systems 251a, b.)

3 units, winter, spring, (Smallwood, Howard)


2 or more units, (Luenberger)


3 units, winter, (Franklin, Widrow)


3 units, spring, (Franklin, Widrow)

optimal control by gradient methods. Quasi-optimal designs. Prerequisite: E.E. 246.

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. Prerequisite: E.E. 240 or equivalent.

1 unit, autumn, winter, spring, (Flügge-Lotz, Franklin)


3 units, spring, (Widrow)


3 units, winter, spring, (W. Linvill)


3 units, winter, (Kailath, Cover)

251b. Analog Modulation and Demodulation—Spectra of sinusoids which are amplitude, phase or frequency modulated by random and pseudo-random processes; wideband carriers. Spectra and signal-to-noise ratios at the outputs of nonlinear detectors. Spectra of a variety of pulse signals occurring in communication systems. Prerequisite: E.E. 251a.

3 units, spring, (Kailath, Cover)

252n. Communication Channels—Study of communication channels with more than two inputs. Channel capacity. Calculation of channel capacity and error probability for Gaussian channels and for discrete memoryless channels. Application of error-probability bounds to problems of signal design, input and output quantization, and probabilistic decoding. Prerequisite: second-year graduate standing.

3 units, autumn, (Kailath, Cover)


3 units, winter, (Kailath, Cover)


3 units, spring, (Kailath, Cover)
254. Information Theory—Information sources; the measure of information; language structure. Properties of codes; coding information sources. Information channels and mutual information. Reliable messages through unreliable channels. Prerequisite: senior or graduate standing.
3 units, autumn, (Cover)

3 units, winter, (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: E.E. 255.
3 units, spring, (Moll)

257a, b, c. Solid State Electronics Laboratory—Experimental projects on semiconductor crystal growth, gaseous diffusion of impurities, Hall effect, minority-carrier diffusion and drift mobility, thermoelectricity, electroluminescence, etc. Registration by permission of instructor. Prerequisite: E.E. 255 or Physics 172, or Mat.Sci. 121.
3 units, autumn, winter, spring, (Pearson)

258. Optical Properties of Solids—Basic theory with emphasis on the relationship between band structure and the optical properties of solids; behavior of representative semiconductors, insulators, and metals. Representatives of the materials to be discussed are Ge, Si, GaAs, CdS, NaCl, ruby, Cu and Al. Prerequisites: E.E. 103 plus the following: Physics 130 and 131, or E.E. 259, or Mat.Sci 233.
3 units, winter, (Spicer)

259. Basic Quantum Mechanics—Introduction to the concepts of quantum mechanics; the postulates of quantum mechanics; observables, wave functions, and probability density; the Schrödinger equation; complementary variables and the uncertainty principle; the harmonic oscillator and particles in a box; the hydrogen atom; angular momentum; the matrix formulation of quantum mechanics; the Dirac notation. Prerequisites: Physics 57, 110, 111. Mathematics 130, and 131, or equivalent.
3 units, autumn, (White)

260. Basic Quantum Mechanics—Time independent perturbation theory; time dependent perturbation theory; transition probabilities; spin, identical particles, and exchange; energy levels of atoms; elementary band structure; the symmetry properties of wave functions. Prerequisite: E.E. 259.
3 units, winter, (White)

3 units, winter, (———)

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. Prerequisite: E.E. 261.
3 units, spring, (———)

3 units, spring, (Luenberger)

266. Digital Computer Circuitry—Introduction to logical design of digital circuits. Survey of switching, memory, and input-output devices finding applications in
computing, control and communications systems. Prerequisites: E.E. 152, Math. 44 or permission of instructor.

3 units, autumn, (Peterson)


2 units, winter, (Peterson)


3 units, autumn, (Buneman, Garriott, Kino)

271. Electromagnetic Theory—Time-dependent fields; Faraday's law; inductance; Maxwell's equations; place waves; reflection; refraction; energy; Poynting's vector; wave impedance. Wave guides; resonators; elementary radiation and antenna problems. Prerequisite: E.E. 270n or equivalent.

3 units, winter, (Buneman, Garriott, Kino)

272. Radiation—Spectra; wave packets; mode density; Maxwell stresses; radiation pressure. Green's function; delta-function; retarded potentials; multipole fields; bremsstrahlung. Huygen's principle; Fresnel diffraction; dispersive and anisotropic media. Prerequisite: E.E. 271 or equivalent.

3 units, spring, (Buneman)

273. Guided Waves—Review of uniform wave guide theory. Wave guide modes; microwave network theory and normal mode theory; the Foster reactance theorem; reciprocity; equivalent circuits for a cavity; impedance of a diaphragm; variational techniques; quasi-static techniques. Perturbation theory of cavities and wave guides; applications to measurements. Mixed TE-TM modes, the sheath helix. Periodic systems, the disc loaded wave guide, and the tape helix. Wave guides filled with anisotropic media. Prerequisite: E.E. 271 or equivalent.

3 units, spring, (Buneman)


3 units, autumn, (Siegmund)

274c. Seminar in Quantum Electronics and Optics—Discussion by staff and students of selected topics, such as optical coherence theory; electro-optic, electro-acoustic, and nonlinear optical effects; optical resonators; lasers; light modulation and demodulation.

Units by arrangement, autumn, winter, spring, (Siegmund, Staff)

275. Magneto-Ionic Theory and Its Applications—Introduction to magneto-ionic theory, including the whistler mode; applications to propagation in the ionosphere, from very low to high frequencies; measurement techniques. Prerequisite: E.E. 271, or permission of instructor.

3 units, winter, (Helliwel, Staff)


3 units, (Bracewell), to be given in 1966-67
277. Theory and Application of Radio Wave Scattering—Theory of radio wave scattering from electron ensembles (e.g., meteor trails), and from turbulent and thermal fluctuations in a plasma. Scattering from metallic and dielectric spheres, cylinders, and laminas, of small and large size. Emphasis on physical descriptions and on applications to communications, radar astronomy, and space probes. Prerequisite: E.E. 271 or permission of instructor.

3 units, autumn, (Eshleman)

278. Ionospheric Processes—Brief description of neutral atmosphere; production, loss and diffusion processes in the ionosphere; some aspects of geomagnetism; dynamo theory and ionospheric storms. Prerequisite: E.E. 270n or equivalent.

3 units, spring, (Garriott)

280. Radioscience Seminar—Student-faculty discussion of research problems in general field of radio propagation, ionospheric physics and radio astronomy.

1 unit, autumn, winter, spring, (Bracewell)

281a, b. Satellite System Engineering—(Enroll in Engineering 23Sa, b.)

3 units, winter, spring, (Lusignan)

285. Plasma Physics Seminar—Discussion of research problems and current literature in plasma physics is offered by faculty, students and outside specialists.

1 unit, autumn, winter, spring, (Kino)

286n. Introduction to Plasma Physics—Plasma as a new medium; its significance in space and fusion research, individual and collective phenomena; ionization, charged particle orbits, collisions, mirroring, drifts; oscillations, Debye length, instability, electrostatic and electromagnetic waves, magneto-ionic propagation and dispersion, Maxwell-Boltzmann distribution, magnetogasdynamics, confinement. Prerequisite: 271 or equivalent.

3 units, spring, (B uncman)

287. The Laboratory Plasma—Methods of forming laboratory plasmas in gases and in the solid state and measurement of their properties. Collision processes, velocity distributions, the Boltzmann transfer equation, concepts of temperature and pressure, nonequilibrium velocity distributions. Macroscopic averages of the Boltzmann equation. D.C. and R.F. breakdown and avalanche phenomena, the effect of a magnetic field, the positive column at low pressure and medium pressure, ambipolar diffusion, the plasma sheath, wave propagation in infinite plasmas and in bounded plasma, probe theory, R.F. diagnostic techniques. Prerequisite: E.E. 271 or Physics 103: E.E. 286 recommended but not required.

3 units, autumn, ( Kino)


3 units, winter, (B uncman)

289a. Introduction to Astrophysics I: Solar-Terrestrial Relations—(Enroll in Engineering 207.)

289b. Introduction to Astrophysics II: The Sun—(Enroll in Engineering 208.)

289c. Introduction to Astrophysics III: Stars and Galaxies—(Enroll in Engineering 209.)

290. Special Studies and Reading in Electrical Engineering—Special studies, under direction of a faculty member, for which academic credit may properly be allowed. (This course number is used to give credit for laboratory work, directed reading, etc. A grade of + indicates satisfactory work; no letter grade will be assigned.)

By arrangement

291. Special Studies and Reports in Electrical Engineering—Special studies, under direction of a faculty member, leading to written report or end-quarter examina-
tion. Letter grade indicates quality of written work; if letter grade based on written work is not applicable, student should enroll in E.E. 290.

By arrangement

292. Special Seminars—Each year special seminars are given on topics of current interest. These seminars are usually announced one or two quarters prior to their presentation and are given by specialists in the field. See the Time Schedule for detailed announcements.

295. Electrical Engineering Instruction: Practice Teaching—Open to a very limited number of Electrical Engineering students who plan to make teaching their career.

By arrangement

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. Graduate students from all engineering departments are especially invited.

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

DIVISION of ENGINEERING MECHANICS

Emeriti: Stephen Prokofievich Timoshenko, Lydik Siegumfeld Jacobsen (Professors)

Executive Committee: Miklos Hetenyi (Chairman), Wilhelm Flügge, Irmgard Flügge-Lotz, James Norman Goodier, Rudolf Emil Kalman, Thomas R. Kane, Erastus Henry Lee, Donovan Harold Young (Professors)

Affiliated Faculty


Associate Professors: Max Anliker, Chi-Chang Chao, Krishnamurty Karamcheti, Byrne Perry, William Craig Reynolds, Cedric W. Richards, Alan Stephen Tetelman

Assistant Professor: Robert L. Street

OFFERINGS AND FACILITIES

The Division provides, one, two, or three years of advanced training in solid and fluid mechanics leading to abundant career opportunities in industrial and governmental research establishments, in technical development in industry, and in the uni-
versities and institutes of technology. It also offers programs of study for mechanical, aeronautical, and civil engineers who find that their work involves them in advanced mechanics, and necessitates a year or more of graduate study to acquire a deeper grasp of fundamental concepts and advanced methods.

The Timoshenko Center of Engineering Mechanics provides facilities for special experimentation in conjunction with the laboratories of the Departments of Civil and Mechanical Engineering. Individual accommodation is provided for the work of each research student. Weekly seminar meetings acquaint the students with a great variety of subjects in their field, and give opportunity to practice speaking on a selected topic.

The Division also conducts government-sponsored research projects. Qualified students participate in these as research assistants, engaged in thesis research, in close working association with the faculty director and fellow students. The projects include original experimental and theoretical investigations in the strength and deformability of elastic and anelastic elements of machines and structures, vibrations and nonlinear dynamics, controls and system theory, and the flow dynamics of liquids and gases.

PROGRAMS OF STUDY

Bachelor of Science

The Division operates exclusively on the graduate level and requires the B.S. degree for admission. Suitable preparation for graduate study can be found in the undergraduate curriculum of Engineering Science, in the option Engineering Mechanics of the Department of Civil Engineering, and in the option Mathematics, Physics, and Engineering Mechanics of the Department of Mechanical Engineering.

Master of Science

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin. The following are Divisional requirements.

To secure the recommendation of the Division for the Master's degree, a candidate must include a minimum of 6 graduate units in each of the four subdivisions: (1) Advanced Dynamics, (2) Elasticity and Plasticity, (3) Fluid Mechanics, and (4) Mathematics. (Candidates who have a strong interest in Control Engineering may be allowed to substitute appropriate Electrical Engineering courses for one of the subdivisions (2) and (3) above.) In addition to these 24 units of required courses, the program calls for a minimum of 12 units in approved electives and 9 units in free electives, making in all 45 units of course work. No thesis is required. In all of this work a minimum grade point average of 2.75 is required.

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

Engineer

The University's basic requirements for the degree of Engineer are discussed in the section "Degrees" in this Bulletin. A minimum grade point average of 3.00 is required in courses. The program of courses and thesis are arranged in consultation with the student's adviser, and require the approval of the Executive Committee of this Division. The requirements for the M.S. degree (see above) must be met.

Doctor of Philosophy

The University's basic requirements for the Ph.D. degree are discussed in the section "Degrees" in this Bulletin. The requirements of the Division include one or
more qualifying oral examinations early in the second year of graduate study, and the presentation of a satisfactory program after consultation with the faculty member who will direct the dissertation research. Preparation for research usually requires that this second year be devoted mainly to courses. The requirements for the M.S. degree (see above) must be met. Reading proficiency in German or Russian must be demonstrated before dissertation research is begun.

FELLOWSHIPS AND ASSISTANTSHIPS

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

COURSES


3 units, autumn, (Young), MWF 8


3 units, autumn, (Goodier), MWF 9


3 units, winter, (Goodier), MWF 10


2 units, winter, (Chao), TF 3:15


2 units, spring, (Chao), TF 3:15

204. Advanced Theory of Elasticity—Topics from stress concentration, crack propagation, contact stress, thermal stress, instability and finite deformation, selected in relation to current research. Prerequisites: 202a, b.

2 units, spring, (Goodier), TTh 11


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

206a. Elastic-Plastic Instabilities—Instabilities of structural elements under steady or sudden loading. Types of elastic buckling analysis in small and large deformations. Compressed bars. Dynamic instability within the longitudinal pressure wave. Prerequisites: C.E. 114 and Mathematics 130.

2 units, autumn, (Goodier), TTh 11, alternate years, to be given in 1966-67

2 units, winter, (Goodier), TTh 11, alternate years, to be given in 1966-67


2 units, spring, (Goodier), TTh 11, alternate years, to be given in 1966-67


3 units, winter, (Flugge), MWF 9


3 units, spring, (Flugge), MWF 9


3 units, autumn, (Flugge), MWF 11


3 units, autumn, (Chao), MWF 11


3 units, autumn, (Flugge), MWF 10


3 units, winter, (Flugge), MWF 11


3 units, winter, (Lee), TTh 11:00-12:15, alternate years, to be given in 1965-66


3 units, spring, (Lee), MWF 10, alternate years, to be given in 1965-66


3 units, spring, (Richards), TTh 10 and one lab. by arrangement

216a. Physical Structure and Mechanical Strength—Atomic structure of solids. Imperfections. Dislocation theory and applications to problems of yielding, strain hardening; recovery, recrystallization, creep, fracture and fatigue.

3 units, autumn, (Tetelman), TTh 1:15 and Th 2:15
216b. Fracture of Solids—Continuum and dislocation approaches, fracture testing, nucleation and propagation of cleavage and shear cracks. Effect of notches, fracture of steels, creep and fatigue failure, stress corrosion cracking and hydrogen embrittlement. (Enroll in Mat.Sci. 238.) Prerequisite: 216a or Mat.Sci. 130.

3 units, winter, (Tetelman), TTh 1:15 and Th 2:15


3 units, autumn, (Flügge), MWF 2:15

218a. Advanced Theory of Viscoelasticity—Equivalent mathematical representations of stress-strain relations for linear response and connections between them. Stress analysis problems for simple boundary conditions, mixed conditions, and consideration of moving boundaries. Temperature effects. Prerequisites: 202a, 217, and 250.

3 units, winter, (Lee), MWF 2:15, alternate years, to be given in 1966-67


3 units, spring, (Lee), MWF 2:15, alternate years, to be given in 1966-67


3 units, autumn, (Kane), TTh 9 and T10


3 units, winter, (Kane), TTh 9 and T10

223n. Advanced Dynamics—Hamilton's principle, the principle of Least Action, the Hamilton-Jacobi differential equation. Ignoration of coordinates, the use of the energy integral, integration in series, integral invariants, contact and point transformations. Prerequisite: 222n.

3 units, spring, (Kane), TTh 9 and T10


3 units, spring, (Kane), TTh 9 and T10


3 units, autumn, (Anliker, Staff), MWF 12


3 units, winter, (Anliker, Staff), MWF 12
231. **Nonlinear Oscillations**—Derivation and classification of nonlinear differential equations governing various phenomena of mechanics. Phase plane trajectories and integrals of the equations of motion of autonomous systems.

3 units, autumn, (Kane), TTh 2:15 and Th 10


3 units, winter, (Kane), TTh 2:15 and Th 10


3 units, winter, (Flügge-Lots), MWF 9

239a. **Theory of Control**—Concepts of stability in linear and nonlinear systems. Lyapunov functions and their applications. Converse theorems. Construction of Lyapunov functions. Stability criteria in the frequency domain. Applications to dynamics and control. Prerequisites: Mathematics 114a, b and 130; or consent of instructor.

3 units, autumn, (Kalman), TTh 11:00-12:15

239b. **Theory of Control**—Dynamical systems and their duals. Controllability and observability. Canonical structure of linear systems. Theory of realizations. Introduction to the Hamilton-Jacobi formalism in optimization. Prerequisite: 239a or its equivalent.

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


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

241. **Advanced Mechanics of Fluids**—Similitude and dimensional analysis; fluid friction for incompressible fluids in tubes, boundary layers, through granular media; lubrication theory; cavitation. (Enroll in C.E. 206.) Prerequisite: C.E. 107.

3 units, autumn, (Vennard), MWF 10


3 units, autumn, (Flügge-Lots), MWF 1:15


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

244. **Mechanics of Viscous Flow**—Navier-Stokes equations. Very slow motion. Boundary layer equations for incompressible laminar flow. Energy equation for thermal boundary layers; compressible laminar boundary layer flow. Stability of boundary layer flows; introduction to turbulent flow. Prerequisites: 242 and either A.A. 210a, or M.E. 238b, or permission of the instructor.

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


3 units, winter, (Perry), MWF 1:15
247. Engineering Hydrodynamics—Continuation of E.M. 246. Selected theoretical topics from naval hydrodynamics, hydraulic engineering, and oceanography. Possible topics include forces on supercavitating hydrofoils, unsteady flow in open channels, wave forces on structures, density currents, flow over weirs and spillways. Prerequisite: 246.
3 units, spring, (Perry), MWF 2:15

250. Mathematical Methods in Engineering Mechanics—Development of the basic concepts of analytic functions and conformal mapping, and application to problems in several engineering disciplines. Use of the Laplace transform with particular emphasis on vibration and wave problems. Prerequisite: Mathematics 43 or equivalent.
3 units, autumn, (Lee), MWF 11

3 units, winter, (Street), MWF 8

3 units, spring, (Flügge), M 1:15 and TTh 8

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 one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for students presenting talks.
1 unit, autumn, winter, spring, (Goodier, Hetényi, Lee), Th 3:15

296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for those presenting talks.
1 unit, autumn, winter, spring, (Flügge-Lotz, Van Dyke, Vincenti), T 4:15

297. 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. Plus is given for attendance only; a letter grade is given to students presenting talks. All Ph.D. candidates in Controls and Systems Engineering are expected to attend. (Enroll in E.E. 248.) Prerequisite: E.E. 240 or equivalent.
1 unit, autumn, winter, spring, (Flügge-Lotz, Franklin, Staff), T 4:15

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

Autumn, winter, spring, (Staff), by arrangement
ENGINEERING SCIENCE

Program Advisers: James M. Gere (Chairman), Andreas Acrivos, Richard H. Bube, Robert H. Eustis, Thomas R. Kane, Krishnamurty Karamcheti, David F. Tuttle

The undergraduate curriculum is a program in applied science, leading in most cases to further study at the graduate level, and designed for those individuals whose interests extend outside the areas covered by the other engineering programs. Courses in the physical sciences, mathematics, the social sciences, and the engineering sciences are given precedence over those which deal more specifically with professional engineering practice. Thus the student is given the opportunity to develop the ability to approach problems overlapping departmental boundaries, both those which are purely technical and those which involve considerations of social and economic analysis. Each student should arrange his program in consultation with one of the Program Advisers for Engineering Science.

Graduate programs leading to the Master of Science degree in Engineering Science may be arranged also. Address inquiries to the Dean of Engineering.

INSTITUTE in ENGINEERING-ECONOMIC SYSTEMS

Emeriti: Eugene L. Grant, Marion Rice Kirkwood (Professors)

Executive Committee: William K. Linvill (Chairman), W. Grant Ireson, Gerald J. Lieberman, Ray K. Linsley, Julius Margolis (Professors)

Affiliated Faculty

Professors: Kenneth Arrow, Rolf Eliassen, Joseph B. Franzini, Robert V. Oakford, Clarkson H. Oglesby, Lorie Tarshis, Harvey M. Wagner

Associate Professors: Gerard K. Boon, David V. Heebink, Hubert R. Marshall, Vincent J. Roggeveen, Douglass Wilde


OFFERINGS AND FACILITIES

The Institute in Engineering-Economic Systems is an interdisciplinary, interdepartmental organization dedicated to the development of the professional fields of system analysis and design, and engineering-economic planning. It involves research and teaching at the graduate level. In particular, stress is placed on the study of physical and 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. Where appropriate, model-making and computer simulation are emphasized. The various optimization procedures receive strong attention. 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. The field of Engineering-Economic Systems is still evolving and no degree is offered presently by the Institute. Students earn their degrees in the departments in the School of Engineering, in the Operations Re-
search Program, the Economics Department, or in a Graduate Division Special Pro-
gram.

Graduate programs are offered with varying degrees of specialization in Engineer-
ing-Economic Systems, ranging from supplemental training given as a part of a reg-
ular engineering program at one extreme to a doctorate at the other. System analysis
and economic planning are problems of the real world, and research should be done
in the environment of the real world to be most useful. Accordingly, the graduate pro-
gram involves not only an intensive program of coursework at the University, but
also extensive project-directed casework in the field, including follow-up research to
unify and generalize it.

CASEWORK AND RESEARCH PROGRAMS

The casework and research programs stress three kinds of activities which have
somewhat different emphases and will be described separately. The program in Engi-
neering-Economic Planning deals with problems of planning in public works projects
in which improved criteria and methodology for decision making are being developed.
The program in Industrial Development Planning is concerned with industrial de-
velopment, usually in the private sector. Here, feasibility studies, market surveys,
technological evaluations, and simulation of operations are important considerations.
The program in System Design for Computer-Coordinated Systems emphasizes the
technico-economic problems of automation. In these studies, both the physical prob-
lems of systems analysis and design and the economic problems of evaluation specifi-
cation and planning are considered. In all three kinds of projects, the research is aimed
at establishing specific results in specific areas as well as developing general theoretical
results.

Program in Engineering-Economic Planning and Industrial Development
Planning

The Program in Engineering-Economic Planning develops the applications of
engineering economy and system analysis to decisions in project formulation, design,
and operation for public works facilities. The curriculum adapts existing tools or de-
velops new ones for decision-making in the public sector. In addition, by research it
seeks to develop new techniques of analysis for the planning of complex public invest-
ments for both developed and developing nations. This program should be of par-
ticular interest to graduate students who wish to prepare for positions of responsi-
bility in the planning and administration of water resources, transportation systems
and other public works, for economic development of emerging nations for industrial
development planning, and for national defense. Several one-year internships with
the Federal Government in Washington are available to advanced students who are
near the end of their academic programs.

Program in System Design Computer-Coordinated Systems

The program in System Design for Computer-Coordinated Systems has 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.
Graduate students spend two or three periods of from six to fifteen months with pri-
ivate companies. The positions usually are in the research laboratories where the
interns assume responsibility for specific projects in automation. The industrial in-
ternship program is unconventional and couples alternating periods of University
study and research with periods of internships.
Specific Casework Projects

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 interdepartmental interaction necessary to develop interdisciplinary areas.

Engineering-Economic Planning

1. Development of Water Resources
   a) Hydrology and hydraulic engineering.
   b) Economics of 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.
   e) Highway economics: development of economic measures for appraising decisions in the highway field.

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.
   h) Equipment replacement problems.

Industrial Development Planning

1. Economic Development of the Less Developed Nations
   a) Regional economic surveys.
   b) Entrepreneur training and the design of small businesses.
   c) Specification and development of capital equipment.
   d) Systems research on the problems of developing economies.

2. Planning Development of the Electric Power Industry
   a) Technological survey of the state-of-art in energy conversion, transmission, and distribution.
   b) Long-range planning for expansion. Demand estimation, survey of new uses for power.
   c) Planning for overseas markets. Development and design for overseas equipment.
   d) Planning for thermal-hydro systems.

System Design of Computer-Coordinated Systems

1. Automation of the Electric Power Industry
   a) Models of steam boiler and turbine systems.
   b) Simulation of multivariable systems.
   c) Automatic control of plants and coordination of systems.
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.

Research
A strong systems research program has been initiated in both the planning and
system area in order to develop a strong theoretical base. Mathematical and sta-
tistical principles have been applied to optimum allocation of effort, optimal control,
system theory, analysis and simulation of multivariable systems, and to scheduling and
traffic control problems. Continued research in these areas will be encouraged and
supported independently of immediate applications. The meaningfulness of theoretical
work is enhanced, of course, by correlating it to the practical area.

PROGRAMS OF STUDY IN
ENGINEERING-ECONOMIC PLANNING

Master of Science and Engineer Degrees

The Master of Science and Engineer degrees may be earned in Civil or Indus-
trial Engineering with designation Engineering-Economic Planning. To secure this
designation, students must meet the degree requirements of their respective depart-
ments and include about 20 units of courses selected from the list of core or casework
courses below. The selection must meet the approval of department advisers who
are on the faculty affiliated with Engineering-Economic Systems. For the Engineer's
degree the research project should be in the systems or planning area. About 30 units
of core courses must be taken.

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. Gen-
erally 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
couraged.

A special program for the Ph.D. in Civil or Industrial Engineering with a spe-
cialty in Engineering-Economic Planning is offered jointly by the Institute and the
appropriate departments. This program generally involves many more courses from
the department and fewer courses from the foundation disciplines in mathematics,
statistics, and economics. The aim of this program is to develop planning capacity
focused toward an established engineering discipline. Individual programs will be
worked out with appropriate departmental advisers.

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-economic systems; (3) casework courses for the various particular practical areas.

**General Foundation Courses**

**Mathematics**
- 114a, b. Linear Algebra
- 115, 116. Analysis
- 120, 121. Modern Algebra
- 123. Theory of Probability
- 136, 137, 138. Numerical Analysis
- 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**
- 202. Price and Allocation Theory
- 241. Public Finance and Taxation

**Political Science**
- 100. Public Administration
- 110. Administrative Behavior

**Core Courses in Systems**

**Analysis**
- E.E. 240. Introduction to Linear Systems
- E.E. 244, or 251, 252, 254. Information Theory
- E.E. 245, 246, 247. Control Systems
- E.E.S. 250a, b. System Analysis
- Stat. 256. Inventory Theory
- E.E.S. 220. Computer-Aided System Analysis
- I.E. 255. Advanced Production Systems Design
- E.E.S. 263. Optimization of Linear Systems

**Design and Simulation**
- I.E. 141, 261, 263. Electronic Computation and Data Processing
- 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. 232. Capital Budgeting
- E.E.S. 210. Price Theory
- Econ. 159 or E.E.S. 211. Economics of Public Works
- E.E.S. 214. Public Finance
E.E.S. 215. Institutional Setting for Public Works Planning
E.E.S. 316. Cost Allocation for Multiple-Purpose Projects
E.E.S. 319. Depreciation
Pol.Sci. 107. Seminar in Government and Natural Resources
Pol.Sci. 108. Seminar in Administrative Responsibility

Casework Courses in Engineering-Economic Systems

E.E.S. 304, 315. Development of Electric Power Industry
C.E. 251; E.E.S. 213, 310, 311. Transportation Planning
E.E.S. 310. Introduction to City and Regional Planning
E.E.S. 312. Decision Problems in National Defense
E.E.S. 314. Developing Nations
E.E.S. 246. The Engineering and Organization of Small Businesses
E.E.S. 247, 248. Economic Development Programming
E.E.S. 317. Water Law

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 Price Theory and Resource Allocation**—Theory of economic organization, operations of markets, prices as guides for a decentralized economy, criteria for evaluation of performance, planning rules for efficient organization and operation.

3 units, autumn, (Margolis), MWF 10

211. **Economics of Public Works**—Analysis of government production of services, criteria for investment, price and non-price rationing of services, financing of services, particular attention to resources development, transportation and public planning. Prerequisite: E.E.S. 210 or consent of instructor.

3 units, winter, (Margolis), MWF 11

212. **Water-Resources Planning**—Integration of technical, economic, political and social factors in decisions relating to water resources. Prerequisite: 211 or consent of instructor.

3 units, spring, (Linsley), TThF 2:15

213. **Highway Planning**—A study of the decision process in highway planning as influenced by engineering, economic, political and social problems. Prerequisite: 211 or consent of instructor.

3 units, spring, (———), MWF 9

214. **Public Finance**—Financial design of public works. Interrelationships between physical design, construction scheduling and financial planning. Capital budgeting and related financial management of federal, state and local governments including municipalities, districts and authorities. Taxation. General obligation and revenue bonds, equipment trusts and other forms of borrowing.

3 units, (Bartle), Th 3:15-5:05

215. **The Institutional Setting for Public Works Planning**—The role of administrative organization, interest groups, legislative bodies and technical experts in democratic decision-making.

3 units, winter, (———), TTh 11

220. **Computer-Aided System Analysis**—Formulation and computer-aided solution of system problems. Lectures by faculty and guests on examples of practical system problems and their solution. Team projects on system problems. Typical problems which may be discussed include: solution of partial differential equations by overrelaxation, Monte Carlo or direct methods; simulation of dynamic processes; scheduling of operation; optimization in decision situations. Prerequisite: knowledge of elementary computer programming and applied mathematics.

2 or more units, winter, (Luenberger), by arrangement
221. **Probabilistic Systems Analysis**—A subject serving both as a self-contained development for students wishing to become familiar with the theory and application of probabilistic concepts and as a foundation for graduate subjects in engineering, science, and management. Theory of probability presented on an axiomatic basis. Topics ranging from algebra of events to stochastic processes and simulation. Heavy emphasis on sample space concept for both discrete and continuous transform techniques, common distributions, limit theorems, statistics, renewal processes, and computer analysis. Consideration of implications of probability theory for decision making, data analysis, and system modeling. Applications presented concurrently with development of the theory.

3 units, autumn, (——), by arrangement

246. **The Engineering and Organization of Small Businesses**—A laboratory for the development of a technical idea, embodied in a specific product, into an economic enterprise. Includes product selection, market analysis, pricing, engineering design, production design, economic analysis, establishment of marketing organization, financing and financial planning, design of management organization. Inputs from practicing small businessmen are obtained. Students including qualified undergraduates from all appropriate disciplines are encouraged to enroll. May serve as an orientation for a summer economic development project. Prerequisite: consent of instructor.

3 units, winter, (Lave), MW 3:15; lab. T 2:15-5:05

247. **Economic Development Programming I**—Sketch of the problem of economic development in a broader setting, pointing out relationships with other disciplines. Presentation of basic concepts of economic development and the economic interrelationships. Operational methods for some of the most practical devices of economic development programming. Open to undergraduate and graduate students from all disciplines. Prerequisite: Introductory course in economics.

3 units, winter, (Boon), T 9 and Th 3:15-5:00

248. **Economic Development Programming II** — A follow-up to course 247. More advanced models from a micro- and macro-economic nature. Over-all planning, planning at the sector level, project evaluation, priority determination and choice of technology. Open to graduate students from all disciplines. Prerequisites: Course in economic development programming or equivalent, some basic mathematical knowledge.

3 units, spring, (Boon), T 9 and Th 3:15-5:00

250a, b. **System Analysis**—Analytical concepts of model making and optimization necessary for system engineering. The geometrical aspects of matrices and determinants, eigenvalue analysis, the normal coordinates for dynamic systems, iterative procedures for solving simultaneous equations. Least square procedures, Markov processes. Mixed systems involving both continuous and discrete signals. Errors in numerical solutions to differential equations. Optimization procedures, Lagrange multipliers, introduction to linear programming, dynamic programming. (Enroll in E.E. 250a, b.) Prerequisite: E.E. 240 or consent of instructor.

3 units, winter, spring, (W. Linvill), TTh 8:00-9:15

251a, b. **Dynamic Probabilistic Systems**—Analysis of linear probabilistic systems. Application of linear system theory to the study of finite- and infinite-state, discrete- and continuous-time, stationary and nonstationary, Markov and semi-Markov processes. Optimization of probabilistic systems over short and long time periods by means of dynamic programming. A concurrent presentation of examples in the areas of system reliability, marketing, automatic control, maintenance and replacement policies, search procedures, inventory control, and other operating problems of systems. Prerequisites: Statistics 116, and E.E. 240 or permission of instructor.

3 units, winter, spring, (Smallwood, ———), TTh 9:30-10:50

263. **Optimization of Linear Systems**—Introduction to functional analysis: linear vector spaces, linear operators, Banach and Hilbert spaces. Applications to system analysis and optimization. Contraction mapping, iteration and overrelaxation
techniques. The adjoint method of analysis and optimization. Calculus of variations in linear spaces. Applications from control theory, numerical analysis and operations research. Prerequisites: Mathematics 115 and either Mathematics 114 or E.E.S. 250a.

3 units, spring, (Luenberger), 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.

1 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, spring, (W. Linvill), by arrangement

310. Introduction to Regional Planning—Concepts and criteria of regional and urban land use planning, including preparation of master plans, zoning, urban renewal and area redevelopment.

3 units, spring, (——), MWF 1:15, alternate years, to be given in 1966-67

311. 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. (Same as C.E. 250.)

3 units, spring, (——), MWF 1:15, alternate years, to be given in 1965-66

312. Decision Problems in National Defense—A study of national defense planning and the factors controlling decision.

3 units, spring, (Hemmcs), by arrangement

313. 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. Primarily for Ph.D. candidates. (Enroll in Political Science 107.) Prerequisites: Political Science 100; Economics 1 desirable.

5 units, winter, (Marshall), M 2:15-4:05


3 units, autumn, (——), MWF 1:15, alternate years, to be given in 1966-67


3 units, winter, (Staff), MWF 11, alternate years, to be given in 1966-67


3 units, spring, (Grant), TTh 11, alternate years, to be given in 1965-66

317. Water Law—A survey of water law and its relations to water resources planning and economics. (Enroll in Law 284.)

4 units, spring, (Meyers), MTWTh 3


3 units, spring, (Grant), MWF 2:15, alternate years, to be given in 1965-66

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), Robert H. McKim, William H. Schwarz, John C. Shyne, 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 or Resource Strategy (see "Supplementary Requirements" for General Engineering).

The curriculum requires completion of the "Courses Normally Taken by All Engineering Students," as well as sufficient additional units to bring the total to at least 180. The same standards of academic performance are required as for other curricula; there are no special sections or courses for students in General Engineering.

Entering freshmen or sophomore transfer students who have not decided on some other engineering curriculum will be listed automatically as enrolled in General Engineering. They may transfer at any time into one of the other curricula, and must do so by the end of the sophomore year unless they plan to earn the B.S. degree in the general curriculum. In the latter case they must file a petition with the School of Engineering, outlining their objectives, plans, and a program of courses. Each petition should be arranged in consultation with one of the Program Advisers for General Engineering, and will be approved by the committee of Program Advisers only if it provides for a coherent plan and is adequate in quantity and quality of work. Students transferring to General Engineering from another curriculum must also petition to do so. All petitions of this nature must be filed not later than the middle of the third quarter preceding graduation. Petitions received later will normally be acted upon unfavorably. Students following the program in Product Design (see "Supplementary Requirements" for General Engineering) need not submit a petition.

INDUSTRIAL ENGINEERING

Emeritus: Eugene Lodewick Grant (Professor)

Executive Head: William Grant Ireson
Professors: William Grant Ireson, Gerald J. Lieberman, Robert Vernon Oakford, Harvey M. Wagner
Associate Professors: Gerard K. Boon, David Van Driest Heebink, Frederick Stanton Hillier, David Alfred Thompson, Arthur Fales Veinott, Jr.
Assistant Professors: Roy Ellis Lave, Jr. Acting: James Victor Jucker
PROGRAMS OF STUDY

Bachelor of Science

The program leading to the degree of Bachelor of Science in Industrial Engineering is given earlier under School of Engineering. This curriculum is planned to serve those students whose long-run objective is administrative work in enterprises where a scientific and engineering background is necessary or desirable. The fundamentals of engineering are stressed; 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 University.

Advanced Degrees

The Industrial Engineering Department, in collaboration with other departments of the University, offers programs leading to the degrees of Master of Science, Engineer, and Doctor of Philosophy in Industrial Engineering. The programs emphasize the analytical approach to industrial engineering problems using quantitative measures. Specialized work is available in operations research, engineering statistics (including quality control) and data processing; this includes a number of courses in the Departments of Statistics and Mathematics. Special emphasis may also be given to engineering economy and related fields.

The Master of Science degree programs require a minimum of 45 units beyond the equivalent of a Bachelor of Science degree at Stanford. All programs represent substantial progress in the major field beyond the equivalent of a Bachelor's degree.

Applicants for admission as graduate students in Industrial Engineering must submit the results of the Graduate Record Examination.

Other graduate programs that appropriately may follow undergraduate work in industrial engineering include the Graduate School of Business and Department of Statistics.

Master of Science

Programs are available leading to the degree of M.S. in industrial engineering without specialization or with specialization in one of the following seven fields: Biotechnology, Data Processing, Engineering Economy, Engineering-Economic Planning, Engineering Statistics and Quality Control, Operations Research, Production. Detailed statements of the general requirements for the Master's degree and the specific course requirements for the special fields may be secured by request to the Industrial Engineering Department.

Students having Bachelor's degrees in industrial engineering normally can satisfy requirements for the M.S. degree in a year of graduate work of satisfactory quality. Those students who have the Bachelor's degree in some other field of engineering will be required to make up certain basic undergraduate industrial engineering courses, and should enter in the summer quarter if they wish to complete the requirements in one calendar year.

Doctor of Philosophy

The degree of Doctor of Philosophy is offered under the general regulations of the University. The program requires a minimum of three years (nine quarters) of graduate study, at least one year of which must be at Stanford. The first year is represented by the M.S. program. The completion of an acceptable dissertation may occupy most of the third year of study.
The program of study will be arranged by the candidate with the advice of a Faculty Committee of three appointed by the Department head and having as chairman the faculty member who will direct the thesis work. The final program must be approved by the Department.

ASSISTANTSHIPS AND SCHOLARSHIPS

A limited number of fellowships and assistantships with stipends of $750 to $3,500 a year are awarded each year. Application forms and detailed information may be obtained by writing the Department of Industrial Engineering. Applications should be made by March 1 preceding the start of the academic year for which the award is to be made.

The University Information Bulletin should be consulted for a description of the procedure for making application.

UNDERGRADUATE COURSES

100. Industrial Organization and Behavior—Organization theory; research in organizational behavior; relationships among organizational functions; the industrial engineer in organizations.
   4 units, autumn, (——), MTWF 8
   winter, (——), TWThF 11
   spring, (——), MTWF 10

108. Work Design and Measurement—Concepts and techniques of designing and improving work performance and productivity of men and man-machine systems. Flow sequences, human physiological information processing capabilities and resultant work design principles, and measurement and evaluation of work with respect to time and wages. Prerequisite: 120a (or concurrent registration).
   3 units, autumn, (Thompson), MWF 9
   spring, (Thompson), MWF 11

120. Quality Control by Statistical Methods—Use of statistical techniques in control of quality of manufactured product. Basic statistical concepts. Shewhart control charts. Lot-by-lot sampling inspection. Introduction to probability theory with applications to sampling acceptance procedures. Economic criteria. (Not normally taken by students who have had a Statistics course.)
   4 units, autumn, (——), MTWF 8

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, (——), MWF 11
   spring, (——), MWF 10

133. Industrial Accounting—Principles of financial and cost accounting, fixed asset accounting, cost control, standard costs, taxes. Interpretation and use of accounting information for engineering decisions. (Students who have taken or are taking a university course in elementary accounting are not admitted to this course.)
   4 units, autumn, (——), MTWF 11
   winter, spring, (——), MTWF 8
   summer, (——), MTWThF 10

   3 units, autumn, (——), MWF 9 and 2:15
   winter, (——), MWF 1:15
   spring, (——), MWF 8

152. Introduction to Operations Research I—Introduction to deterministic models in operations research. Linear, nonlinear, and dynamic programming. Network
analysis, inventory theory, simplex method, transportation problem, dual theorem, convex programming, integer programming, structure of deterministic dynamic programming problems, minimax theorem. Matrix notation will be introduced. (Same as Statistics 152.) Not open to graduate students. See 252. Prerequisite: Differential Calculus.

3 units, winter, (———), MW 4:15-5:30


3 units, spring, (———), MWF 9


3 units, autumn, (Lave), MWF 8

156. Systems Planning and Control—(Replaces I.E. 110.) Continuation of I.E. 155. Inventory control systems. Integrated planning systems. Management information and control systems. Not open to graduate students. See 245. Prerequisite: 155.

3 units, winter, (———), MWF 1:15

199. Senior Seminar—Includes a major term project by each student. Class discussion of projects and problems, case studies, guest speakers, industrial visits. Emphasis on broad problems requiring initiative, ingenuity, the judicious selection and integration of analytical techniques from all previous course work. Prerequisites: senior standing and 156.

3 units, spring, (———), TTh 1:15-3:15

COURSES PRIMARILY FOR GRADUATE STUDENTS

208. Biotechnology—Design and analysis of human and man-machine physiological information processing systems. Subjective decision making. Physical fatigue. Prerequisite: 108 or consent of instructor.

3 units, spring, (Thompson), MW 1:15-2:30

210. Systems Design Applications—Problems of administrative system and procedure design. Attention to systems for the application of industrial engineering technology and to the selection and use of modern information processing devices. Prerequisites: 156 and 141.

2 units, spring, (———), TTh 9

220. Quality Control Applications—Current practices in quality control and reliability in both industry and government. Plant visits to local industry. Economic considerations in quality control. Prerequisite: 120 or 120a.

3 units, spring, (Ireson), TTh 10; lab. Th 1:15-4:05


2 units, autumn, (Lieberman), TTh 4:15


2 units, autumn, (Oakford), TTh 12

230. Advanced Engineering Economy—Application of engineering economy to problems of competitive industry. Income tax aspects of economy studies. Relation-
ship between accounting and engineering economy. MAPI formula; other approaches to replacement economy. Discounted cash flow method. Prerequisite: Engr. 161 or I.E. 229.

2 units, winter, (Oakford), TTh 10
spring, (Oakford), TTh 8

231. Problems in Engineering Economy—Independent study of selected problem in engineering economy. Prerequisites: Engr. 161 or I.E. 229 and consent of instructor.

1 or more units, (Staff), by arrangement

232. Capital Budgeting—Choosing among various possible criteria for decision making about proposed investments in fixed assets in business and government. Implementing chosen criteria in engineering design and investment authorization. Post audit of engineering economy studies. Prerequisite: 133a or equivalent, and Engineering 161, or consent of instructor.

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

245. Design of Production Systems—For graduate students who have not had the equivalent of I.E. 155 and 156. See I.E. 155 and 156 for course content. Not open to undergraduates. Prerequisites: 141, 153 or 252, and Statistics 110.

4 units, winter, (——), MWF 9

246. The Engineering and Organization of Small Businesses—A laboratory for the development of a technical idea, embodied in a specific product, into an economic enterprise. Includes product selection, market analysis, pricing, engineering design, production design, economic analysis, establishment of marketing organization, financing and financial planning, design of management organization. Inputs from practicing small businessmen are obtained. Students, including qualified undergraduates, from all appropriate disciplines are encouraged to enroll. May serve as an orientation for a summer economic development project. (Enroll in E.E.S. 246.) Prerequisite: consent of instructor.

3 units, winter, (Lave), MW 3:15; lab. T 2:15-5:05

247. Advanced Production Engineering—Advanced problems in factory planning, materials handling, production-line techniques, automation, plant facilities. Prerequisite: 155 (I.E. 155 may be taken concurrently).

3 units, autumn, (Ireson), TTh 9 and Th 1:15-4:05

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—For graduate students who have not had the equivalent of I.E. 152 and 153. See I.E. 152 and 153 for course content. Prerequisites: Calculus and Statistics 27 or 110 or 116.

4 units, autumn, (——), MTWF 10; (Hillier), MW 4:15-6:05
winter, (——), MW 4:15-6:05

253. Seminar in Operations Research—Case studies and papers appearing in the operations research literature. Student teams work in local industry on problems in operations research. Special topics, including some presentations by guest specialists. Prerequisites: at least two courses in operations research.

3 units, spring, (Lieberman), MW 4:15-5:30


3 units, winter, (Wagner), TTh 10:45-12:00

255. Advanced Production Systems Design—Methods of modeling using Markov chains; illustrated with a wide range of applications with special emphasis on control systems. Use of the statistics obtainable from the Markov formulation, estimation methods, tests of hypotheses for fitting data, state reduction techniques, model
validation and control, optimization with policy iteration and linear programming. Prerequisites: 152 and Statistics 110 and 116 or 27.

3 units, autumn, (Lave), TTh 9; lab. Th 1:15-4:05, to be given in 1966-67

257. Data Processing in Operations Research—Seminar in selected topics in the application of electronic computers to operations research activities. Emphasis on the use of simulation techniques. Prerequisites: 141 and at least two courses in Operations Research.

3 units, spring, (Wagner), MTW 3:15

258. Queueing Theory—A survey of queueing theory and its application. Birth-death process. Other useful models where the inter-arrival or the service-time distributions, or both, are non-exponential. Special service disciplines. Statistical estimation of model parameters. Prerequisites: Statistics 217a, b or 116 and 252, or equivalent.

3 units, spring, (Hillier), TTh 4:15-5:30

261. Electronic Computation and Data Processing—Advanced programming techniques, computer systems design, problem formulation and industrial engineering applications of digital computers. Prerequisites: 141 or equivalent.

3 units, winter, (Jucker), MWF 2:15

spring, (Jucker), MWF 11

263. Computation and Data Processing Laboratory—Application of electronic computation machinery to problems related to Industrial Engineering, business management, management science, and systems design. Student will choose problem, program solution, test program, prepare data input, obtain and analyze output. Prerequisite: 261.

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

280. Seminar in Biotechnology—Special topics concerning the biological technological interface, particularly compatible man-machine systems. May be taken twice for credit. Prerequisite: consent of instructor.

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

281. Individual Study in Biotechnology—Directed reading and research in man-machine systems. Prerequisite: consent of instructor.

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

291. Industrial Engineering Problems—Directed study on subject of mutual interest to student and staff member. Student must find a faculty sponsor.

1 or more units, (Staff), by arrangement

300. Dissertation—Required for degree of Engineer.

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

301. Dissertation—Required for degree of Doctor of Philosophy.

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

MATERIALS SCIENCE

Emeritus: Welton J. Crook (Professor)

Executive Head: O. Cutler Shepard
Professors: Richard H. Bube, Robert A. Huggins, O. Cutler Shepard, Oleg D. Sherby, William A. Tiller
Associate Professors: John C. Shyne, William E. Spicer, David A. Stevenson, Alan S. Tetelman, Robert L. White
Assistant Professors: Craig R. Barrett, William D. Nix
Lecturers: Claus G. Goetz, Donald J. Lyman

Members of the faculties of other divisions of the University giving courses or cooperating in the offerings of the Department of Materials Science are Norman A. Parlee and George A. Parks.
OFFERINGS AND FACILITIES

Materials science is concerned with the relation between the structure and properties of materials, factors which control the internal structure of solids and processes for altering the structure and properties of solids. It brings together in a unified discipline the developments in physical metallurgy, ceramics, and the physics and chemistry of solids. The undergraduate program of the Department, described under School of Engineering, provides 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. In addition the Center provides 35,000 square feet of space for materials research in the new McCullough Building for Engineering.

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 this Bulletin. The following are Departmental requirements:

1. Completion of the equivalent of the requirements for the B.S. degree in Materials Science. Deficiencies in previous training should be made up and not more than 15 units of such work may be counted as part of the minimum total of 45 units.
2. Completion of 45 units of an approved program. A minimum grade point average of 2.75 for course work is expected. The program should contain the following:
   a) 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. 233. Introduction to Solid State Quantum Theory
      - Mat.Sci. 237. Equilibria and Dynamics of Defects in Crystals
   b) A minimum of 9 units of courses outside of the Materials Science Department.
   c) A minimum of 6 units and not more than 12 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.
5. The candidate must present the results of his dissertation at a Departmental seminar. The complete graduate program must have the approval of the major professor and one other faculty member. It should include at least 18 course units outside of the Materials Science Department of which at least 6 must be taken at Stanford. A minimum of 60 course units beyond the B.S. degree requirements must be included in the program.

**COURSES**

50. Introductory Science of Materials—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.) Prerequisite: Mathematics 23 or 43.
   3 units, autumn, (Huggins), MWF 9
   winter, (Nix), MWF 11
3 units, autumn, (Nix), MWF 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 or Chemistry 173.
2 units, spring, (Parlee), TTh 1

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, winter, (Stevenson), MWF 9

3 units, autumn, (Stevenson), MWF 9

3 units, winter, (Sherby), TTh 9; lab. by arrangement

4 units, winter, (Shyne), MWF 10; lab. Th 1:15-4:05

126. Materials Engineering Design—Properties of Engineering materials. Fabrication problems, economic and design factors relating to the selection of materials for particular service conditions. Prerequisite: 50 or equivalent.
2 units, 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, (Sherby), MWF 11; lab. M 1:15-4:05 or by arrangement

128. Materials Design—Application of the principles of Materials Science to the development of solids having optimum properties for practical applications. Case studies of the development of materials for structural, electrical, optical, or magnetic usage. Prerequisites: 125, 130, and 152.
3 units, spring, (Staff), MWF 10

4 units, autumn, (Sherby), MWF 10; lab. by arrangement
140. Independent Study—Independent study in Materials Science under supervision of a faculty member. Prerequisites: junior or senior standing in science or engineering with high scholarship and approval of Materials Science Faculty.

2 units, any quarter, (Shepard), and by arrangement


4 units, spring, (Bubc), MWF 9; lab. by arrangement

190. Physical Chemistry of Metal Refining—Refining processes and the physical chemistry underlying them. A systematic treatment of unit processes based on types of impurity phases, deals effectively with the fundamentals of such widely different methods as the zone refining of semiconductors, the industrial refining of copper, and the vacuum refining of steels and high temperature alloys. (Enroll in Mineral Engineering 190.) Prerequisite: Mineral Engineering 105 or Chemistry 173 or equivalent.

3 units, autumn, (Parlcc), by arrangement

200. Special Problems.

Any quarter, (Staff), by arrangement

201. Principles and Methods of Crystal Growth—Broad look at the important phenomena involved in the growth and perfection of crystalline solids from melt, solution, vapor, electrodeposition, etc. Discussion of the merits of the various preparation methods.

3 units, spring, (Tiller), MWF 9

205. Physical Structure and Mechanical Strength—Atomic structure of solids. Imperfections. Dislocation theory and applications to problems of yielding, strain hardening, recovery, recrystallization, creep, fracture and fatigue. (Same as E.M. 216a.)

3 units, autumn, (Tetelman), T 1:15-3:05 and Th 1:15-2:05


2 units, winter, (Lyman), WF 4:15-5:05


2 units, autumn, (Goetzl), M 2:15-4:05, alternate years, to be given in 1965-66


2 units, autumn, (Goetzl), M 2:15-4:05, alternate years, to be given in 1966-67


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, spring, (Stevenson), MWF 11

225. Surfaces and Interfaces—A general study of solid-gas and solid-electrolyte interfaces. Applications in froth flotation and other topics selected by the individual such as surface conduction and the role of surfaces to mechanical behavior. (Enroll in Mineral Engineering 225.) Prerequisites: Chemistry 175 and Mat.Sci. 122.

3 units, spring, (Parks), alternate years, to be given in 1966-67
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 11

230. Materials Science Colloquium.
   1 unit, autumn, (Shepard); winter, (Tetelman); spring, (Tiller); summer, (Shepard), M 4:15

   3 units, spring, (Tetelman), TTh 3:15-4:45

233. Introduction to Solid State Quantum Theory—Elements of wave mechanics, simple non-interacting systems, elementary interacting systems, free electron theory, energy bands in one and three dimensions, time-dependent wave mechanics. Prerequisite: 152.
   3 units, autumn, (Bubc), MWF 1:15

234. Electrical Transport Processes in Crystals—Lattice vibrations, electrical conductivity, mobility and scattering mechanisms, localized levels in the imperfect crystal, galvanomagnetic effects, thermal effects. Prerequisite: 233.
   3 units, winter, (Bubc), MWF 1:15, alternate years, to be given in 1965–66

   3 units, winter, (Bubc), MWF 1:15, alternate years, to be given in 1966–67

   3 units, winter, (Nix), MWF 9

237. Equilibria and Dynamics of Defects in Crystals—Point defects in metals, formal basis of point defect equilibria in nonmetallic crystals, theory of dislocations, relation of defects to physical properties. Prerequisite: 105 or 205.
   3 units, winter, (Nix), MWF 8

238. Fracture of Solids—Continuum and dislocation approaches, fracture testing, nucleation and propagation of cleavage and shear cracks. Effect of notches, fracture of steels, creep and fatigue failure, stress corrosion cracking and hydrogen embrittlement. (Same as E.M. 216b.) Prerequisite: 130.
   3 units, winter, (Tetelman), T 1:15–3:05 and Th 1:15–2:05

239. Seminar in Advanced Mechanical Metallurgy—Prerequisite: 238.
   1 unit, spring, (Tetelman), by arrangement

   3 units, spring, (Shyne), MWF 8

   3 units, spring, (Nix), lec. T 1:15; lab. TTh 2:15–5:05

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 9

248. Magnetic Phenomena in Solids—Physical basis of magnetic phenomena in solids. Emphasis on ferromagnetic, ferrimagnetic behavior; structural, imperfection, time effects. Prerequisite: 152.
   3 units, winter, (Huggins), MWF 9, to be given in 1966–67
249. **Time-Dependent Plasticity**—Theories and mechanisms of creep. Temperature and strain rate effects on plastic flow of solids. Relation of high temperature strength and ductility of materials to structure. Prerequisite: 130.

3 units, spring, (Sherby), TTh 1:15-2:45

250. **Seminar in Advanced Materials Science.**

3 units, summer, (——), TTh 3:15-5:05

251. **Seminar in Advanced Diffraction and Spectroscopy**—Prerequisite: 236.

2 units, spring, (——), by arrangement

254. **The Equilibrium Structure of Surfaces**—Quantitative treatment of diffuse interfaces, gamma plots, thermal faceting, electrical double layers, adsorption, equilibrium forms, interface attachment kinetics. Prerequisite: 122 or equivalent.

3 units, autumn, (Tiller), TTh 3:15-4:35, alternate years, to be given in 1965-66

255. **Seminar in Advanced Nucleation Theory**—Treatment of homogeneous and heterogeneous nucleation, diffuse interface effects, quantum statistical effects, embryo population effects, electrostatic effects, alloy effects, transient and steady state rates, glass formation. Prerequisites: 222 and 224.

3 units, winter, (Tiller), TTh 3:15-4:35, alternate years, to be given in 1965-66

256. **The Redistribution of Solute During Phase Transformations**—Mathematical analysis of the solute distribution in a solid after a phase transformation. Consideration of diffusion in only one or both phases, applied electric field, shape of solid, time dependence of transformation velocity, dendritic interface, multi-phase interface, and fluid motion in one phase. Prerequisites: 240 and Mathematics 131.

3 units, autumn, (Tiller), TTh 3:15-4:35, alternate years, to be given in 1966-67

267. **Seminar in Interface Morphology Control During Phase Transformation**—Quantitative determination of growth rate, shape and perfection of crystals. Stability of planar, cylindrical and spherical crystals; dendritic growth; spherulite formation; eutectic and eutectoid transformations; volume change effects; interface attachment kinetic dominated growth forms. Prerequisites: 264 and 266.

3 units, winter, (Tiller), TTh 3:15-4:35, alternate years, to be given in 1966-67

300. **Research.**

Any quarter, (Staff), by arrangement

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**MECHANICAL ENGINEERING**

Emeriti: Boynton Morris Green, Lydik Siegumfeldt Jacobsen, Stephen P. Timoshenko (Professors)

Executive Head: William Morrow Kays
Division Directors: Stephen Jay Kline (Thermosciences), Thomas Joseph Connolly (Nuclear), Peter Zane Bulkeley (Design)
Professors: Thomas Joseph Connolly, Robert Henry Eustis, Henry Otten Fuchs, James Norman Goodier, Thomas Reif Kane, William Morrow Kays, Stephen Jay Kline, George Leppert, Alexander Louis London
Associate Professors: Frank Robert Arnold, Peter Zane Bulkeley, Joel Henry Fierziger, James Paul Johnston, Charles Herman Kruger, Robert Horton McKim, Morton Mitchner, William Craig Reynolds, Rudolph Sher
Assistant Professors: Robert Edward Keller, Bernard Roth
Lecturers: Donald Herbert Gage, John M. Leslie, Jr., Robert H. Olds, Carl George Arthur Rosen, Henry Wise
OFFERINGS AND FACILITIES

The courses and degrees offered in Mechanical Engineering provide a background for careers in research, development, design, and manufacture in a wide variety of industries concerned with the handling of mechanical, thermal and nuclear energy (generation, transmission, conversion, metering, control, utilization), the handling of fluids, the construction of mechanical devices (tools, mechanisms, machines, mechanical instruments, control systems), and the conception of systems involving mechanical and thermal components together with electrical, chemical, and human components. Graduates at all degree levels typically go into the product manufacturing industries, aerospace industries (especially in propulsion systems), nuclear power industry, gas turbine and internal combustion systems industries, and to a lesser extent into the chemical and petroleum process, and transportation.

The Department is organized into three divisions—Thermosciences, Design, and Nuclear, each of which maintains its own laboratory, shops, and secretarial services. The Thermosciences Division offers courses and specialized work in the areas of thermodynamics, thermal power systems, energy conversion, fluid mechanics, and heat transfer. The Design Division is concerned with comprehensive systems design, product design, mechanical analysis and mechanisms design, and design components. The Nuclear Division offers work in reactor physics and all aspects of nuclear reactor technology. It should be noted that this Department does not offer specialized work in the areas of engineering mechanics, and students interested in concentrating in engineering mechanics should consult the Division of Engineering Mechanics section of this Bulletin. However, students studying for any of the degrees offered by the Department will ordinarily take courses in engineering mechanics, as well as in several other departments of the University.

Facilities

All three Divisions of the Department maintain modern laboratories which are used for both undergraduate and graduate instruction and graduate research work.

The Thermosciences Division Laboratories are equipped with representative power, fluid handling, refrigeration and heat and mass transfer equipment, a magnetohydrodynamic power conversion system, shock tube, gasdynamics facility, and extensive special facilities for convective heat transfer and boundary layer research. A wide variety of instrumentation, extensive shop facilities, utilities, and research space are all available within the laboratories.

The Design Division maintains shops for both student instruction and construction of research apparatus, drafting rooms, an analog computer, and instrumentation and space for instruction and graduate research work in stress analysis, dynamics, mechanics, and control systems.

The Nuclear Division laboratories include a 10 KW pool-type research reactor, a neutron accelerator, a sub-critical assembly, a radiochemistry laboratory, a reactor heat transfer laboratory, an analog computer, and a machine shop.

In addition each Division maintains its own small library and reading room, and office space for a substantial number of graduate research students.

PROGRAMS OF STUDY

Bachelor of Science

Students desiring to specialize in mechanical engineering during their undergraduate period may do so by following the curriculum outlined earlier under School of Engineering. The University's basic requirements for the Bachelor's degree are discussed in the section "Degrees" in this Bulletin.

A program for Product Design is offered by the Design Division and leads to the degree of Bachelor of Science in General Engineering. It is recommended, however,
that this should not be considered a terminal degree and that all students who elect this program continue on through the Master's degree in this field.

Master of Science

Admission and Registration—The basic University requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin.

To be eligible for registration as a graduate student in the Department a student must have received a B.S. degree in engineering, physics, or some comparable science program. His undergraduate record and personal recommendations must demonstrate that he is capable of handling graduate level work and will be able to complete the requirements for the M.S. degree. Students whose undergraduate backgrounds are entirely devoid of some of the major subject disciplines of engineering (for example, fluid mechanics, applied thermodynamics, applied mechanics, circuit theory) may find it desirable to take some undergraduate courses to fill in obvious gaps and prepare themselves to take graduate courses in these areas. Such students may require more than three quarters to fulfill the Master's degree requirements, as the make-up courses may not be used for other than the free electives (see item 4 below) in the M.S. degree program. However, it is not the policy to require fulfillment of mechanical engineering B.S. degree requirements in order to obtain an M.S. degree, and furthermore students who have already fulfilled certain categories of the M.S. degree requirements as a result of their undergraduate work may find they have sufficient time under item 3 below to obtain the M.S. degree in the normal three quarters.

Graduate Program—The Master's degree program requires 45 units of course work. No thesis is required, although many students include some research work in their course program. The program is designed to provide considerable breadth in applied mathematics and the engineering sciences which are used in the professional practice of engineering. Although considerable depth may be attained in a few areas, a high degree of specialization can only be attained by continuing toward the degrees of Engineer or Doctor of Philosophy, or by including more than 45 units in the M.S. degree program.

The Departmental requirements which must be met for the degree of Master of Science are:

1. 6 units of mathematics from E.M. 250, 251, 252 (or Computer Science 134), Math. 106, 114a, 131, 132. (Ordinary differential equations, e.g., Math. 130, may not be used to fulfill this requirement; it may be taken as a free elective, item 4 below.)

2. Two courses in each of two of the following three categories, or two courses in one category and one course in each of the other two categories (12 or 13 units total).
   a) Design and Solid Body Mechanics
      M.E. 214a, 217a, 218a, 222; E.M. 202a, 205, 208, 221n
   b) Nuclear Engineering and Physics
      M.E. 271a, 175, 282, 285; Physics 130, 140
   c) Thermosciences
      M.E. 211a, 231a (or 231b), 233a, 237a, 238b, 251; E.M. 242

3. 21 units of approved electives (approved by adviser); these should ordinarily be in mathematics, physics, chemistry, or engineering, and may include any courses in the above lists not used to satisfy area minimum requirements. Courses in this category should be graduate level courses or, if in another department, they should be at least junior level courses with a minimum of introductory courses; specific exceptions to the graduate level rule are Engineering 104, 113, 152, 171, 172, 175; M.E. 114c, 116b, 116c, 123, 133, 134, 138a, 161. Advisers will normally also approve a limited number of units in the Graduate School of Business or other areas in the University.
A maximum of 9 units in M.E. 291, 292, and 3 units in credit seminars may be included in this category.

Students who have already fulfilled in full, or in part, any of the area requirements as a result of their undergraduate work, or work elsewhere, may place the released units in the approved elective category.

4. 5 or 6 units of free electives, to make a total of 45 units.

Although it is possible to fulfill most of the above requirements with courses taken outside of the Department, or transferred from elsewhere, it is the policy of the Department that a student must present for the degree at least 15 units of course work in courses presented in the Department.

Candidates for the degree of Master of Science will be expected to have a minimum scholastic average of 2.75 in the 45 units presented to fulfill degree requirements, regardless of grades in other courses that might be taken as a graduate student. (Courses with + grades can be included in the 45 units, but will not be counted in grade point computation.)

Students falling below an overall average of 2.25 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 complete degree requirements at the end of 60 units of graduate registration will be disqualified from further registration. An exception to the 60 unit rule will be units used to fill deficiencies arising from inadequate undergraduate preparation for mechanical engineering graduate work.

Product Design—A special Master’s program is available to those interested in the field of Product Design and is intended primarily for those students who have completed the undergraduate program in this field and who are admissible to the graduate school. For these students, the 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.

Course No.  Subject  Units
M.E. 114b. Mechanical Engineering Design 4
M.E. 214a. Philosophy of Design 3
M.E. 214b. Design in the Corporate Environment 3
M.E. 215. Design Seminar 3
M.E. 299a, b, c. Design Project 15
Art 259b. Product Design 4
Approved electives 9
Free electives 5-6

Total 46-47

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 stu-
ents who desire to do professional engineering work upon graduation, and who desire an opportunity to engage in more specialized study than is afforded by the Master's degree alone.

The admission standards for this program are substantially the same as indicated under the Master's degree. However, since thesis supervision is required, and the availability of thesis supervisors is strictly limited, the Department cannot admit a student to candidacy until he has personally arranged with some member of the faculty to supervise a research project. This will frequently involve a paid research assistantship, and research assistantships are awarded by individual faculty members (usually from the funds of sponsored research projects under the direction of individual faculty members) and not by the Department, so again a personal arrangement is necessary. Students studying for their Master's degree at Stanford and desiring to continue to the Engineer degree ordinarily make such arrangements during their M.S. degree year. Students holding Master's degrees at other universities will be admitted and allowed to register if they are sufficiently well qualified. However, the Department cannot guarantee thesis supervision or financial assistance, and the student must make such arrangements himself during his first quarter or two of residence.

The Departmental requirements for the degree include an acceptable thesis; up to 15 units credit will be allowed for thesis work. In addition to the thesis, 30 units of approved advanced course work in mathematics, science, and engineering are expected beyond the requirements for the Master of Science degree; the choice of courses is subject to the approval of the adviser. Students who have not fulfilled the Stanford M.S. degree requirements will be required to do so (with due allowance for approximate equivalence of courses taken elsewhere).

All candidates for the degree of Engineer will be expected to have a minimum scholastic grade point average of 3.00 for 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.

Product Design—A special two-year program is offered in the field of Product Design which leads to the degree of Engineer in Mechanical Engineering. It is intended for students who wish to augment their engineering background with training in the aesthetic and human qualities essential in new product development. University requirements for the degree of Engineer are satisfied. Admission to the program follows the same standards as for the Master's degree. Course work requirements are divided into two components. Approximately 54 units are devoted to engineering and product design and about 21 units are devoted to course work in the Department of Art and Architecture. The program requires a design thesis of 15 units. The total of 90 units can normally be completed in two academic years. Students deficient in prerequisite areas will normally take more time. Students who fulfill requirements for this program are awarded the degrees M.S. in Mechanical Engineering (Product Design) and Engineer in Mechanical Engineering (Product Design) simultaneously at its completion.

Doctor of Philosophy

The basic University requirements are discussed in the section "Degrees" in this Bulletin. The Doctor's degree is intended primarily for students who desire to pursue a career in research, advanced development, or teaching; for this type of work a broad background in mathematics and the engineering sciences, together with intensive study and research experience in a specialized area, are the necessary requisites. The degree requires a minimum of two years beyond the Master's degree, with three years being the most common time.
The Department will allow a minor field of study, but does not require one. However, if a minor is waived, the candidate must show breadth of training by taking a group of courses in one or more related fields or departments.

A student studying for the Ph.D. degree ordinarily will not take an Engineer degree, although this is not precluded. However, he must have a Master's degree, and must fulfill in essence the requirements for the Stanford M.S. degree in Mechanical Engineering.

Admission to the program involves much the same consideration as described under the Engineer degree. A sufficiently well-qualified student from Stanford or elsewhere will be admitted and assigned to an adviser. If the student has not arranged with a faculty member for supervision of his research prior to admission, his adviser will assist him in making such an arrangement. However, the Department cannot guarantee research supervision, as this involves a personal arrangement between the student and the individual faculty member, and such an arrangement is entirely the responsibility of the student. Once a student has obtained a research supervisor, this supervisor becomes thereafter his academic adviser. Research supervisors may require that the student pass the Departmental Oral examination before starting on research work and before awarding a paid research assistantship. Note that research assistantships are awarded by the individual faculty research supervisors and not by the Department.

It is very strongly urged that students anticipating working for a Ph.D. degree arrange to do some research work under M.E. 291 or 292 prior to attempting to make a Ph.D. supervision arrangement. Faculty members supervising Ph.D. research will generally require some such proof that a student has research potential before committing themselves to Ph.D. supervision and a research assistantship. It is most efficient to carry out this preliminary research effort during the M.S. degree year.

Prior to being formally admitted to candidacy for the Ph.D. degree the student must demonstrate his knowledge of engineering fundamentals by passing the Departmental qualifying oral examination. The academic level and subject matter of this examination correspond approximately to the Master of Science degree program described above. The examination consists of five oral interviews, one of which must be in mathematics, and the other four are chosen from the areas of controls, mechanical engineering design, fluid mechanics, heat transfer, elastic body mechanics, solid body mechanics, physics, nuclear reactor theory, or thermodynamics. Additionally the student must complete certain minimum course requirements in a fifth optional area, but need not take an examination. A student must have the approval of his adviser, and at least a tentative arrangement for research supervision, in order to take the examination. The examination is offered during the winter quarter and may in addition be offered at other times as the need arises. Normally the examination will be taken during the first post-Master's year. Details may be obtained from the Department secretary.

The Ph.D. thesis normally represents one full year of research work and must be a substantial contribution to knowledge. Students may register for up to 45 units of course credit for thesis work (M.E. 301) to fulfill University residence requirements, but they are not required to do so if they would prefer to fulfill residence by formal course work, and there is no minimum limit on registered thesis units.

It is the policy of the Department that students engaged in faculty supervised research and special study are obligated to provide the faculty member with a minimum of 20 hours per quarter of reading and grading assistance in the faculty member's other courses, if the faculty member asks for this assistance. The student will be paid for this assistance unless he holds a fellowship that precludes such payment.

FINANCIAL ASSISTANCE

The Department annually awards a number of fellowships, teaching assistantships, and research assistantships to graduate students. The fellowships are usually
awarded to first-year graduate students, with the assistantship used primarily for post-Master's degree students. Preference for the teaching assistantships is generally given to students who obtain their Master's degree at Stanford. Research assistantships are awarded by the individual faculty research supervisors and not by the Department as a whole.

Applicants for all three forms of assistance may obtain the necessary application forms from the University Admissions Office. However, post-Master's degree applicants for research assistantships are advised to contact directly the faculty member under whom they would like to work, because of the individual nature of these awards, and if they are successful they need not apply to the Department for assistance. Formal applications to the Department for research assistantships will be referred to the individual faculty research supervisors.

Research assistants can, and normally do, carry out their thesis research work and write their thesis as an integral part of the commitments of their assistantship.

UNDERGRADUATE COURSES

Note—Laboratory sections in experimental engineering will be assigned in groups. Insofar as the laboratory schedule permits, students will be allowed, with due regard to priority of application, to arrange their own sections and laboratory periods. Enrollment with the instructor concerned, on registration day or the first day of University instruction, is essential in order that the laboratory schedule may be prepared. Enrollment later than the first week will not be permitted under any circumstances.

4. Manufacturing Processes—Fundamental considerations in the selection of materials according to process and part function. Description of fundamental manufacturing processes—casting, forging, extrusion, stamping, drawing, machining, etc. Selection of process according to part geometry and function. Design considerations. Prerequisite: Engineering 9.

3 units, winter, spring, (Staff), TTh 9; lab. TWTh, or F 1:15-4:05

50. Engineering Kinematics—Application of graphical and analytical techniques to the kinematic and dynamic analysis of linkages, cams, and gears. While analysis will be stressed, some attention will be paid to the synthesis of mechanical elements. Prerequisites: Engineering 9 and Physics 51.

3 units, spring, (Staff), WF 1:15; lab. F 2:15-5:05


3 units, autumn, (Cannon), TTh 11 and F 12:15
winter, (Staff), MWF 11

112a. Rapid Visualization—Systematic development, through lecture and laboratory exercise, of visual presentation skills essential to the designer. Emphasis upon quickly executed, freehand orthographic and perspective sketches of concepts which exist only in imagination. Rapid visualization utilized as catalyst for fluent idea production.

3 units, autumn, (McKim), MW 1:15-4:05

112b. Introduction to Product Design—Active encounter with human values in design. Lectures survey central philosophy of product design program, with emphasis upon the relation between technical and human values, the creative process, and design methodology. Laboratory exercises include the development of simple product concepts visualized in rapidly executed three-dimensional mockups. Prerequisite: 112a.

3 units, winter, (McKim), MW 1:15-4:05
112c. Aesthetics in Product Design—The aesthetic qualities of manufactured objects explored through example, analysis, and inventive laboratory exercises. Design problems stress development of ability to make aesthetic judgments and skill in using perspective, color, and rendering techniques to communicate design concepts to others. Prerequisite: 112b.

3 units, spring, (Staff), MW 1:15-4:05

114a. Mechanical Engineering Design—Analysis and design of machine elements and assemblies. Synthesis, practical workability, and ease of manufacture will be emphasized through several short projects. Prerequisites: 4, 50, Engineering 9, 15, and C.E. 114 concurrently.

3 units, autumn, (Staff), TTh 10; lab. T or Th 2:15-5:05

114b. Mechanical Engineering Design—During this course the emphasis will be placed on the actual process of design and the lecture and laboratories will be devoted to the design of a complete and complex machine. The project is so chosen that it will demand the application of knowledge learned in other courses and act as a synthesizing agent. Prerequisite: 114a.

4 units, winter, (Staff), TTh 10; lab. T or Th 1:15-4:05


3 units, spring, (Keller), TTh 10 and third lec. by arrangement

116a. Human Factors in Product Design—Design of products and/or systems with emphasis upon human factors. Study of dimensional and strength characteristics of human anatomy, capabilities and limitations of senses, responses to sensory stimuli and effects of environmental conditions, motivation, and fatigue. Primary emphasis will be upon design that satisfies human needs of ultimate user of product or system. Human factors knowledge actively incorporated into the design of working models. Prerequisite: 112a (may be taken concurrently).

3 units, autumn, (Leslie), TTh 12:00-2:05

116b. Materials and Structures in Product Design—Direct laboratory experience with materials and structures with emphasis upon concrete, sensuous regard for wood, metal and plastics and aesthetic-intuitive approaches to new structural configurations. Concepts developed into three-dimensional mockups and finished models. Prerequisites: 112a, 112b (may be taken concurrently), 116a.

3 units, winter, (Staff), TTh 12:00-2:05

116c. Advanced Product Design—Integration of knowledge, methodology, and skills obtained in 114a, 112a, b, c, and 116a, b. Extension of knowledge related to energized products which incorporate moving parts. Quarter-long design project carried through phases of research, analysis, programming, alternative concepts, concept selection, iteration, prototype and working model construction, and formal presentation to professional jury. Prerequisites: 112a, b, 112c (may be taken concurrently), 114a, 116a, b.

3 units, spring, (McKim), TTh 12:00-2:05

122. Mechanical Engineering Laboratory—Laboratory experiments on hydraulic and thermal power apparatus: (1) to introduce student to experimental methods in field of mechanical engineering, (2) to demonstrate validity of principles, techniques described in Engr. 31, M.E. 132, (3) to give student experience of analyzing own experimental work, presenting results in acceptable engineering report, and (4) to provide experience in joint group effort. Prerequisites: Engineering 21, 31, and preferably M.E. 132.

4 units, winter, (Staff), one afternoon by arrangement

123. Mechanical Engineering Laboratory—More advanced laboratory experiments in thermal and nuclear engineering, and in mechanics, in which students par-
participate to an increasing degree in the design of experiments. Prerequisites: 122 and 132.

4 units, spring, (Staff), one afternoon by arrangement


3 units, autumn, (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

135. Heat, Mass, and Momentum Transfer—Introductory treatment of conduction, convection, and radiation heat transfer, mass diffusion, boundary layer theory including the velocity, temperature, and concentration boundary layers. Prerequisites: Engineering 31 and concurrent registration in Mathematics 130.

3 units, autumn, (Kays), MWF 11


4 units, spring, (———), MWF 8; one lab. by arrangement

138a. 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 registration in Mathematics 130. (This course is intended primarily for graduate students who have not had the equivalent of 136 as undergraduates.)

3 units, autumn, (———), MWF 9


3 units, spring, (Bulkeley), MWF 11

191. Engineering Problems and Experimental Investigation—Directed study and research for the undergraduate student on a subject of mutual interest to student and staff member. Student must find faculty sponsor and have approval of his adviser.

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

COURSES PRIMARILY FOR GRADUATES

Engineering Design

214a. Philosophy of Design—An introduction to the philosophy of comprehensive design. A discussion of the attitudes and viewpoints of the designer and an investigation of the techniques of analysis, synthesis, and evaluation that he uses. Emphasis will be placed on understanding the creative process and the factors that influence it. Limited registration. Prerequisite: graduate standing.

3 units, winter, (Leslie), M or T 2:15-5:05

214b. Design in the Corporate Environment—A discussion of the respective contributions of engineering, research, marketing, manufacturing, finance, and other
corporate functions to comprehensive design. Studies will center upon the relationship of the design engineer to the corporate design team and the organization and control of this team for great effectiveness. Limited registration. Prerequisite: 214a.

3 units, spring, (Leslie), M or T 2:15-5:05

design engineers. Each quarter seminar develops a theme which bears upon design (e.g., Innovation, Design Frontiers). In typical format, prominent guest speaker discusses theme for 15 minutes, remaining time is devoted to a structured question-answer discussion between speaker and students. Registration for one unit of credit, with + or − grade, is optional; letter grade is given to students who write paper related to seminar theme.

215a. Design Seminar—Open to all graduate students. Each quarter seminar develops a theme which bears upon design (e.g., Innovation, Design Frontiers). In typical format, prominent guest speaker discusses theme for 15 minutes, remaining time is devoted to a structured question-answer discussion between speaker and students. Registration for one unit of credit, with + or − grade, is optional; letter grade is given to students who write paper related to seminar theme.

215a. 1 unit, autumn, (Staff), W 4:15
215b. 1 unit, winter, (Staff), W 4:15
215c. 1 unit, spring, (Staff), W 4:15


3 units, autumn, (Bulkeley), MWF 10


3 units, spring, (Bulkeley), MWF 8

218a. Control System Components—Electronic components. General considerations in the characterization of system components. Steady-state analysis of systems containing strongly nonlinear components. Application of the above material to the study of electronic systems. Laboratory consisting of construction, on the analog computer, of vibrators, modulators, other basic electronic devices; no reports required. Prerequisite: E.E. 128 or equivalent (may be taken concurrently).

3 units, autumn, (Keller), TTh 8; one lab. by arrangement

218b. Control System Components—Hydraulic and pneumatic components and systems. Reading of descriptive material concerning fluid power control. Techniques for the simulation of dynamic systems by digital computer. Project consisting of the development and use of a digital computer simulation of a complex hydraulic power control system. Prerequisite: E.E. 128 or equivalent, 218a recommended. No prior digital computer work necessary.

3 units, 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 organized as in M.E. 218a. Prerequisite: 218b.

3 units, spring, (Keller), TTh 8; one lab. by arrangement

219. Development Engineering—Study of methods used in developing new products beyond initial design and in improving existing types. Similitude and physical modeling of mechanical systems. Simulation of service environment. Methods of development testing compared to methods of experimental research and acceptance testing. Case studies and analysis will be used. Actual development of student designs is optional subject to instructor's approval. Prerequisites: 114a and 122 or equivalent.

3 units, spring, (Fuchs), TTh 3:15-4:30

220. Space Mechanisms — Constraints and pairing in three-dimensional mechanisms; spatial velocity and acceleration analysis. The spherical 4-bar. The spatial
4-bar. Synthesis of spatial mechanisms for path and function generation. Prerequisite: 50.

3 units, autumn, (Roth), MWF 12

221. Kinematic Analysis—The relative motion between links in a mechanism is studied in terms of rolling centrodes. The kinematical forms of the Euler-Savary equation are derived and the path curvature of points on a moving link are rigorously determined. The properties of the coupler curves are analyzed in terms of the theory of higher plane curves. Prerequisite: 50.

3 units, winter, (Roth), MWF 12

222. Kinematic Synthesis—The problem of determining linkage proportions from prescribed input-output conditions is considered for both path and function generating mechanisms. Critical comparison of graphical, analytical, and computer oriented methods. The techniques are applied to the synthesis of various machines and computers. Prerequisite: 50.

3 units, spring, (Roth), MWF 12

299a. Design Project—Three-quarter graduate design project guided by a diverse faculty team. In the first quarter, the student uses rational and intuitive problem-finding procedures to identify a design project within an unexplored area of need, presents a project proposal, and performs research. In the second quarter, he prepares a design program, develops concepts, performs necessary experiments, and carries project to the stage of a working prototype. In the third quarter, he refines design from the standpoint of cost and production, builds demonstration model, and presents project to professional jury.

5 units, autumn, (Staff), by arrangement

299b. Design Project—Continuation of 299a.

5 units, winter, (Staff), by arrangement

299c. Design Project—Continuation of 299b.

5 units, spring, (Staff), by arrangement

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.A. 211a.) Prerequisite: 138a (or A.A. 210a or M.E. 136).

3 units, winter, (Vincenti), MWF 2:15

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.A. 211b.) Prerequisites: 238b (or A.A. 210b) and 211a (or M.E. 134).

3 units, spring, (Vincenti), MWF 2:15

211c. Physical Gasdynamics—Kinetic theory of gases in translational non-equilibrium: conservation equations; Boltzmann equation; molecular collisions; H-theorem; Maxwellian distribution; Chapman-Enskog expansion; Sonine polynomial expansion and variational principle; viscosity and thermal conductivity. Rotational non-equilibrium and bulk viscosity. Approximate methods of Krook, Mott-Smith, and Lees. Prerequisites: 211a and acquaintance with basic equations of viscous flow or consent of instructor.

3 units, autumn, (Kruger), MWF 1:15

212. Kinetic Theory of Transport Processes—The Chapman-Enskog development of the Boltzmann equation, its relation to the macroscopic fluid mechanics equations, the transport coefficient. Emphasis will be on the calculation of transport properties (viscosity, thermal conductivity, diffusivity of pure gases, and gas mixtures) from molecular interactions and on the molecular interaction potentials. Ionized gases
will also be treated. If time permits other topics such as the Grad and Wang Chang-Uhlenbeck Solutions of the Boltzmann equation will be discussed. Prerequisites: 211a or consent of instructor.

3 units, winter, (Ferziger), MWF 2:15

231a. Heat Transmission—Application of principles of heat transfer and thermodynamics to solution of steady-state, transient heat transfer problems with combined mechanisms. Classical heat conduction theory. Radiation heat transfer analysis. Prerequisites: graduate standing and at least concurrent registration in Mathematics 130.

3 units, autumn, (Leppert, London), MWF 8

231b. Heat Transmission—Boundary layer theory, including heat, mass, and momentum transfer, laminar and turbulent flows inside tubes and external boundary layers; the high velocity compressible boundary layer; design of heat and mass transfer systems. Prerequisites: 231a or consent of instructor.

3 units, winter, (Kays), MWF 9

231c. Heat Transmission—Continuation of 231b. 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.

3 units, spring, ( ), 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, winter, ( ), TTh 2:15

233b. Advanced Thermodynamics—Continuation of 233a. Further study on relationships among properties of systems. Introduction to chemical thermodynamics; theorems of Onsager, Prigogine. Prerequisite: 233a.

2 units, spring, ( ), TTh 2:15, alternate years, to be given in 1966-67

236. Chemical Energy Conversion—Analysis of thermodynamics and kinetics of energy release in systems undergoing chemical change. Application of principles of mass transport, heat transfer, and electrochemistry to flame propagation, liquid and solid propellant combustion, ignition, and fuel cells. Prerequisites: 134 and 135, or equivalent.

3 units, spring, (Wise), MWF 11

237a. Thermodynamics of Propulsion Systems—Analysis of the performance of propulsion prime movers from a thermodynamic and dynamic point of view, including rocket, ramjet, and turbojet systems as well as piston, gas turbine, and compound piston-turbine type engines. Thermodynamics and kinetics of combustion reaction as applied to internal combustion engine systems. Prerequisites: 132 and graduate standing.

4 units, 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


3 units, winter, (Kline), MWF 11

3 units, spring, (Kline), MWF 9, alternate years, to be given in 1965-66

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: 238b, or equivalent.

3 units, spring, (Johnston), MWF 9, alternate years, to be given in 1966-67

248. Thermonic 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

251. Physics of Partially Ionized Gases—Fundamental equations and physical principles underlying properties and dynamics of partially ionized gases. Elements of electromagnetic theory, motion of a single charged particle, Hall effect, Debye length, plasma frequency, properties and solutions of the MHD equation, collision cross-sections for atomic processes, classical theory of collisions, Rutherford scattering, non-equilibrium relaxation times, electrical conductivity. Prerequisites: Familiarity with elementary vector analysis and electricity and magnetism.

3 units, winter, (——), MWF 1:15

252. Magnetohydrodynamic Energy Conversion—Application of basic principles to MHD generators and accelerators. Thermodynamics of partially ionized gases, Saha equation, calculation of electrical conductivity for equilibrium and non-equilibrium plasmas. MHD one-dimensional channel flow, d.c. and a.c. power generation, engineering problems in power generation and propulsion. Prerequisite: 251.

3 units, spring, (Eustis), MWF 10

253. Kinetic Theory of Partially Ionized Gases—Collisions between charged particles. The Fokker-Planck equation and its relation to the Boltzmann equation. The BBGKY hierarchy equations and the Lenard-Balescu Kinetic equation. Application of Chapman-Enskog theory to the calculation of transport properties of partially ionized gases in a magnetic field with a weak electric field. The electrical and thermal conductivities for very weakly ionized and fully-ionized gases. The effect of strong electric fields on the electron velocity distribution and on the values of the transport coefficients. Prerequisites: 251 and 211c or permission of instructor.

3 units, spring, (Kruger), MWF 1:15

254. Microscopic Processes at High Temperatures—This course will be primarily concerned with providing an introduction to fundamental concepts in electromagnetic theory of radiation and in quantum mechanics. Topics to be covered will include radiation from an accelerated charge, bremsstrahlung, black-body radiation, deficiencies of classical theory, de Broglie waves, the uncertainty principle, Schrödinger’s equation and its solutions, scattering theory, Ramsauer effect. Emphasis will be placed on atomic collision processes of interest in high temperature gasdynamics. Prerequisites: 251 or A.A. 285a, or equivalent, and Mathematics 132 concurrently or equivalent.

3 units, spring, (——), MWF 3:15


3 units, winter, (Leppert), TTh 8

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, (——), MWF 10
3 units, spring, (Leppert), MWF 11

260a. Mathematical Methods in the Thermosciences—Advanced topics in the solution of ordinary and partial differential equations with application in a variety of physical problems, including viscous flows, hydrodynamic stability, liquid sloshing, conduction, convection, and radiation heat transfer. Prerequisites: Mathematics 106 and 132, or equivalent.  
3 units, autumn, (Reynolds), MWF 11

3 units, winter, (Reynolds), MWF 8

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: 231b or E.M. 244.  
2 units, autumn, (———), TTh 11

296. Seminar in Fluid Mechanics—Problems in all branches of fluid mechanics. All Ph.D. candidates in fluid mechanics are normally expected to attend. Registration for one unit of credit, without letter grade, is open to students having the Master's degree; a letter grade is given for those presenting talks. (Enroll in E.M. 296.)  
1 unit, autumn, winter, spring, (Flügge-Lotz, Van Dyke, Vincenti), T 4:15

Nuclear Engineering

For a listing of the courses in Nuclear Engineering, see “Division of Nuclear Engineering” below.

Directed Study

291. Engineering Problems—Directed study for graduate engineering students on subject of mutual interest to student and staff member. May be used to prepare for experimental research during a later quarter under 292. Student must find faculty sponsor.  
1 to 15 units, any quarter, (Staff), by arrangement

292. Experimental Investigation of Engineering Problems—Graduate engineering student may undertake experimental investigation under guidance of staff member. Previous work under 291 may be required to provide background for experimental program. Student must find a faculty sponsor.  
1 to 15 units, any quarter, (Staff), by arrangement

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

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

Division of Nuclear Engineering

Professor: Thomas Joseph Connolly (Director)  
Associate Professors: Joel Henry Ferziger, Rudolph Sher  
Lecturer: George Safanov  
Affiliated Faculty: Paul Kruger, George Leppert
Offerings and Facilities

The Division provides graduate instruction in nuclear reactor theory and experimentation, in nuclear reactor design and control, and in particle and radiation transport theory and experimentation. In addition, a wide range of courses in mathematics, physics, and various engineering sciences is available to the student. The program is intended for those students who plan a career of research, teaching, design, or management in the field of nuclear energy processes or systems. Each student works out a program of study with his adviser.

The Nuclear Engineering Laboratory has among its facilities a pool-type research reactor, an accelerator-type neutron generator with pulsing capability, a subcritical assembly, extensive nuclear counting and spectrometry equipment, and a radiochemistry laboratory. These facilities are used for instruction and graduate student research.

An active program of research is carried on in the Division of Nuclear Engineering under the sponsorship of various agencies. These projects include experimental and theoretical investigations relating to nuclear reactor theory, neutron transport and thermalization, and neutron cross sections. Research programs are also conducted in heat transfer, fluid mechanics, and radiochemistry. Qualified students participate in these projects as research assistants, engaged in thesis research, in close working association with a faculty research supervisor and fellow students.

Programs of Study

Bachelor of Science

The Division operates exclusively at the graduate level and requires the B.S. degree for admission.

Master of Science

Admission and Registration—The basic University requirements for the Master's degree are discussed in the section “Degrees” in this Bulletin. The Division of Nuclear Engineering is administered within the Department of Mechanical Engineering. A prospective student may apply for admission either in this Department (Nuclear Engineering—Mechanical Engineering) or in the Engineering Science program (Nuclear Engineering—Engineering Science). In either case, to be eligible for registration as a graduate student an applicant must have received a B.S. degree in engineering, physics, or some comparable science program. His undergraduate record and personal recommendations must demonstrate that he is capable of handling graduate level work and will complete the requirements for the M.S. degree. The graduate program leading to the M.S. degree under the rules of the Department of Mechanical Engineering is described in the preceding section. A student who wishes to follow a more specialized program of study in nuclear engineering than would conform with the requirements of the Department of Mechanical Engineering may do so under the Engineering Science program. This program is described under School of Engineering graduate programs in this Bulletin.

Graduate Program—To secure the recommendation of the Division for the Master's degree, a candidate must complete 45 units of course work distributed as follows: 6 units of mathematics, 33 units of restricted electives which will include several of the courses described below as well as other engineering or science courses, and 6 units of free electives.

Degree of Engineer

The basic University requirements for the degree of Engineer are discussed in the section “Degrees” in this Bulletin.

This degree represents nominally an additional year of study beyond the Master of Science degree, and includes a research thesis. This program is designed for stu-
dents who desire to do professional engineering work upon graduation, and who de-
sire an opportunity to engage in more specialized study than is afforded by the Mas-
ter's degree alone.

Doctor of Philosophy

The basic University requirements are discussed in the section "Degrees" in this
Bulletin. The Doctor's degree is intended primarily for students who desire to pursue
a career in research, advanced development, or teaching, where a broad background
in mathematics and the engineering sciences, together with intensive study and re-
search experience in a specialized area, are the necessary requisites. The degree re-
quires a minimum of two years beyond the Master's degree, with three years being
the time usually required.

The Division of Nuclear Engineering is administered within the Department of
Mechanical Engineering; a Ph.D. candidate is enrolled in this Department. A stu-
dent may elect a minor field of study if he wishes, but it is not required that he do so.
A Ph.D. program should, however, show some breadth of training outside of a stu-
dent's research field.

A student studying for the Ph.D. degree ordinarily will not take an Engineer de-
gree, although this is not precluded. Although a Master's degree is not technically
required, a student will usually have fulfilled M.S. degree requirements before be-
coming a candidate for the Ph.D.

Prior to being formally admitted to candidacy for the Ph.D. degree, the student
must demonstrate his knowledge of the fundamentals of nuclear engineering by pass-
ing a qualifying oral examination. The examination covers the subjects of mathe-
matics, physics, nuclear reactor theory, and two other engineering science subjects
(e.g., control theory, heat transfer) selected from a list of seven. The academic level
of this examination corresponds to the M.S. degree program. A student must have
the approval of his adviser, and at least a tentative arrangement for research supervi-
sion, in order to take the examination. The examination is offered during the winter
quarter and may in addition be offered at other times as the need arises. Normally
the examination will be taken during the first post-Master's year.

FINANCIAL ASSISTANCE

A number of fellowships and research assistantships are awarded annually to
graduate students. The fellowships are usually awarded to first-year graduate stu-
dents, with the assistantship used primarily for post-Master's degree students. Re-
search assistantships are awarded by the individual faculty research supervisors
and not by the Division as a whole.

Applicants for all forms of assistance may obtain the necessary application forms
from the University Admissions Office. However, post-Master's degree applicants
for research assistantships, because of the individual nature of these awards, are
advised to contact directly the faculty member under whom they would like to work.
Formal applications to the Division for research assistantships will be referred to
the individual faculty research supervisors.

Research assistants can, and normally do, carry out their thesis work and write
their thesis as an integral part of the commitments of their assistantship.

COURSES

171. Nuclear Energy—Nuclear reactions. Thermal energy release. Rates of radio-
active decay, neutron capture, fission, fusion. Design of nuclear reaction systems:
isotope heat sources, fission chain reactors, etc. Measurement techniques in nuclear
systems. Radiation effects and shielding. (Enroll in Engineering 171.) Prerequisites:
Physics 57 and concurrent registration in Mathematics 130.

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, radiotracers, activation analysis, and their applications. (Enroll in Engineering 172.) Prerequisites: Chemistry 3, Mathematics 23, and Physics 57.

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

175. Nuclear Measurements Laboratory—Principles and techniques of radiation detection and measurement: ionization chambers, proportional, Geiger-Müller, and scintillation detectors, solid state detectors; statistical analysis of counting; beta and gamma spectrum analysis; radiation safety. (Enroll in Engineering 175.) Prerequisite: Concurrent registration in 171 or 172, or consent of instructor.

3 units, autumn, winter, (Staff), one afternoon by arrangement

176. Radiochemistry Laboratory—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. (Enroll in Engineering 176.) Prerequisite: Engineering 172 or 175, or consent of instructor.

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


3 units, spring, (———), MWF 9


3 units, spring, (Leppert), MWF 11


3 units, autumn, (Sher), MWF 10


3 units, winter, (Sher), MWF 10


3 units, spring, (Staff), MWF 10


3 units, winter, (Staff), one afternoon by arrangement


3 units, spring, (Staff), one afternoon by arrangement

276. Neutron Transport Theory—Exact solutions of the one-speed neutron transport equation: escape probabilities, reciprocity theorems, infinite medium Green's function, Albedo problem, Milne problem, half-space Green's function; approximate solutions of other problems; applications to kinetic theory of gases and radiative transfer. Extensions to the energy-dependent case will be treated briefly. Prerequisites: 271b and Mathematics 106.

3 units, spring, (Ferziger), MWF 9, alternate years, to be given in 1965–66
277. **Neutron Thermalization**—Calculation of thermal neutron spectra; space-dependent spectra in reactors, time-dependent spectra in pulse systems. Calculation of scattering kernels from the dynamics of the scattering system: the Zemach-Glauber and Van Hove formalisms, application to scattering from an ideal gas, Einstein and Debye crystals, and molecules; approximate treatments of liquids, real gases and crystals. Prerequisites: 271c and Physics 132.

3 units, spring, (Ferziger), MWF 9, alternate years, to be given in 1966–67

282. **Nuclear Reactor Design**—The development of a reactor design from a set of specifications. The synthesis of reactor theory, heat transfer, properties of materials, and economics, in reactor design. The use of digital computer codes in reactor design. Prerequisite: 271a or consent of instructor.

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


3 units, spring, (Sher), TTh 10


3 units, winter, (Ferziger), MWF 3:15
SCHOOL of HUMANITIES and SCIENCES

Dean: Robert R. Sears
Associate Deans: Richard W. Lyman, ———
Assistant Dean: To be announced


ORGANIZATION

The School of Humanities and Sciences includes all members with the rank of instructor or above of the Departments of Aerospace Studies, Anthropology, Art and Architecture, Asian Languages, Biological Sciences, Chemistry, Classics, Communication, Computer Science, Economics, English, French and Italian, History, Humanities, Mathematics, Military Science, Modern European Languages, Music, Naval Science, Philosophy, Physics, Political Science, Psychology, Sociology, Speech and Drama, and Statistics, together with appointees to the Faculty at Large.

Members of the School of Humanities and Sciences are listed under their respective departments, or under the staff for Special Interdepartmental Programs.

UNDERGRADUATE PROGRAMS

A student 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 Aerospace Studies, Military Science, and Naval Science in this Bulletin). Students enrolled in Chemistry or Physics who are also enrolled in an ROTC program will usually require more than the usual four years (twelve quarters) in the University to obtain a baccalaureate degree. Because of the 36 units of credit required for the Aerospace Studies, Military Science, and Naval Science, the Chemistry or Physics courses require additional time for graduation which will vary from one to three quarters depending upon the circumstances in each case.
GRADUATE PROGRAMS

Candidates for the degree of Master of Arts, Master of Science, or Doctor of Philosophy should consult appropriate sections of the announcements following and should also consult the department in which they intend to specialize.

For regional, area studies, or other special graduate programs leading to the degree of Doctor of Philosophy, see listing under Graduate Division Special Programs.

AEROSPACE STUDIES

Executive Head: Joseph E. Terry (Lt. Colonel, USAF)
Professor: Joseph E. Terry (Lt. Colonel, USAF)
Assistant Professor: John W. Dodds, Jr. (Captain, USAF)

GENERAL

The Department of Aerospace Studies offers a program 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. This program can be completed in either a two- or a four-year program.

CURRICULUM

Four-Year Program

The Senior Air Force ROTC Program consists of the General Military Course offered during the freshman and sophomore years and the Professional Officer Course during the junior and senior years.

The General Military Course consists of an introductory course exploring the causes of the present world conflict as they effect the security of the United States and a comparative study of the Free and Communist world military forces.

The Professional Officer Course consists of a study of the growth and development of aerospace power starting with man's early efforts to fly and proceeding through current space programs. It also includes detailed study of the military as a profession with emphasis upon leadership and management.

Students will attend a four-week Field Training Course during the summer preceding their senior year. A transportation allowance is provided by the Air Force and students are paid approximately $110 for this training period.

Throughout the Air Force ROTC courses of study, cadets follow an educational program complementary to fields of study in the University. Aerospace Studies courses satisfy the Group Activity requirement of the General Studies Program and acceptably replace the University's physical education requirement. While the ROTC 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.
Two-Year Program

Attendance at a six-week Field Training Course offered at an active Air Force Base during the summer preceding the junior year meets the requirements of the General Military Course and permits the student to complete his Aerospace Studies in two academic years. Students attending the Field Training Course are paid a transportation allowance of 6 cents per mile and approximately $117 for the six-week training period.

Students enrolled in the Two-Year Program will complete the requirements listed under Third- and Fourth-Year Courses.

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 student. All cadets enrolled in the Professional Officer Education Program offered during the junior and senior years receive a retainer fee of $40 a month. Travel to and from all Field Training is paid at the rate of 6 cents per mile. Students enrolled in the Two-Year Program receive approximately $117 while attending the six-week Field Training Course prior to entering the Two-Year Professional Officer Course. Students enrolled in the Four-Year Program receive approximately $110 while attending the four-week Field Training Course. Financial assistance to include tuition, texts, fees and $50 a month will be available to a limited number of cadets enrolled in the Four-Year Program. Selection, on a nation-wide basis, will probably be offered only to Professional Officer Course students in 1965–66.

DISTINGUISHED GRADUATES

Under the provisions of federal law, advanced students who are outstanding, both academically and in leadership, in military courses and in campus activities may be designated Distinguished AFROTC Graduates upon the concurrent recommendation of the Professor of Aerospace Studies 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. 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 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.

If selected for this program the officer is called to active duty at an 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

During the freshman and sophomore years University General Studies courses are substituted for Aerospace Studies when appropriate. An explanation of the substitution is included in the course descriptions.
FLIGHT INSTRUCTION PROGRAM

A light plane pilot training program is offered during the senior year to cadets who plan to enter the USAF pilot training program following commissioning. Cadets may obtain a private license through this program.

FIRST-YEAR COURSES

13. University General Studies requirements or options will be substituted for and will satisfy the Aerospace Studies academic requirement during autumn quarter.
14. University General Studies requirements or options will be substituted for and will satisfy the Aerospace Studies academic requirement during winter quarter.
15. National Security—An introductory course exploring the causes of present world conflict as they affect the security of the United States. United States power position in world affairs, the armed forces as an instrument of national policy, democracy and communism.
   2 units, spring, (Dodds), TTh 10 or 1:15

SECOND-YEAR COURSES

   2 units, autumn, (Dodds), TTh 10
   2 units, winter, (Dodds), TTh 10
39. University General Studies requirements or options will be substituted for and will satisfy the Aerospace Studies academic requirement during spring quarter.

THIRD-YEAR COURSES

   4 units, autumn, (Staff), MWF 9
126. Astronautics and Space Operations—United States Space programs, administrative control, vehicles, systems and problems in space exploration. Term paper required.
   4 units, winter, (Staff), MWF 9
   4 units, spring, (Staff), MWF 9

FOURTH-YEAR COURSES

142. The Professional Officer—The foundations of the military profession. The military justice system and leadership theory. Term paper required.
   4 units, autumn, (Staff), MWF 10
143. The Professional Officer—Human relations, personnel policies, communication and problem solving. Term paper required.
   4 units, winter, (Staff), MWF 10
144. The Professional Officer—The command staff team, the junior officer as an administrator, performance standards and data processing.
   4 units, spring, (Staff), MWF 10
199. **Leadership Laboratory**—Open to Professional Officer Education Program cadets on the Staff, and Squadron Commanders and specifically selected cadets with the concurrence of the Professor of Aerospace Studies, directed by the Commandant of Cadets. One hour each week for all four-year AFROTC cadets.

1 unit, autumn, winter, spring, (Staff), Th 3:15

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**ANTHROPOLOGY**

*Executive Head:* George Dearborn Spindler  
*Professors:* Joseph Harold Greenberg, Benjamin David Paul, Bernard Joseph Siegel, George Dearborn Spindler  
*Associate Professors:* Clifford Robert Barnett, Alan Robin Beals, Charles Oliver Frake, Bert Alfred Gerow, Antone Kimball Romney, Robert Bayard Textor  
*Assistant Professors:* Harumi Befu, Francis Alexander Cancian, Roy Goodwin D'Andrade, John Calvin Hotchkiss  
*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.

**PROGRAMS OF STUDY**

**Bachelor of Arts**

For the Bachelor's degree in anthropology, 45 units of work in the Department are a requirement. The program of courses can be arranged in consultation with the adviser to meet the special needs and interests of the student. The following basic course requirements will be included in the 45 units, unless specifically excepted: Anthropology 1; Anthropology 5; Sociology 1 or other approved sociology course; Psychology 1 or other approved psychology course; Anthropology 191 (Senior Seminar). To be recommended for the Bachelor's degree, the student must have an average grade of C or higher for work in the major field.

A Department Honors Program gives Department majors with superior scholastic records and outstanding ability in anthropology an opportunity to undertake more independent and creative work along the lines of their special interests. The privilege of entering the Honors Program applies to the junior and senior years, and culminates in the presentation of an honors thesis in the final quarter of the senior year. A student completing the program will graduate "With Departmental Honors."  
Candidates for admission to the Honors Program should apply to the Executive Head of the Department by the third quarter of the junior year. In exceptional cases, a student may be admitted at the beginning of the first quarter of the senior year. To qualify for admission the student must have a grade average of B or better (normally based on at least 20 units of work) in courses within the anthropology major sequence, and an overall grade average of B or better in general University work.
Each student will submit a proposed program of study, including his thesis topic, and this must be formally approved by the anthropology faculty. One faculty member will be assigned to act as an adviser to the student and others will be available for consultation as the study program is developed. The honors student will complete the regular major requirements of 45 units, either in course work or in approved individual study, plus a special study program of 12 units of honors work. These 12 units will be distributed as appropriate between (a) courses in or outside the Department which bear directly on the preparation of the honors thesis and (b) a special independent study course for honors. The honors thesis will be presented at least two weeks before the end of the final quarter of the senior year.

Students majoring in other social science fields or in education, and interested in taking an undergraduate minor or coordinated program in anthropology, may wish to consider a choice from the following courses as being particularly relevant: 1 (General Anthropology); 121 (Cultural Evolution); 126 (Cultural Dynamics); 131 (Comparative Social Systems); 158 (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); 135 (History of Anthropological Theory); 141 (Belief Systems); 143 (Transcultural Perspectives on the Supernatural); 145 (Political Anthropology); 151 (Economic Anthropology); 167 (Language and Culture).

For students in the biological sciences the most relevant courses are: 5 (Development of Man); 275 (Physical Anthropology: by permission of instructor).

It will also be noted that regional courses are given, especially in fields where Stanford has strong teaching and research interests: Western Europe; South, Southeast, and East Asia; the Pacific Islands; North, Central, and South America; Africa; India.

Interested students may take part in 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.

ADVANCED DEGREES

Prospective graduate students should apply formally through the Graduate Admissions Office, which will submit their names to the Department for approval when application requirements are completed.

An applicant for admission to graduate work must file a report of his scores on the Aptitude Test of the Graduate Record Examination. This examination may be taken at most American universities (see your Registrar for further information). Applicants who do not have access to testing centers should write to the Educational Testing Service, Box 955, Princeton, New Jersey 08540, for possible arrangements, or notify the Department.

The Department of Anthropology grants the Master of Arts and the Doctor of Philosophy degrees. Students who are interested in a professional career in anthropology are expected to apply for the Doctor of Philosophy degree. For these students the Master of Arts degree will be awarded at the satisfactory completion of initial preparation for the doctoral degree, as detailed below. Special programs are established for graduate students in Education, Medicine, and other fields who wish to take a Master of Arts degree in Anthropology.

Master of Arts

The requirements for the Master of Arts degree consist of residence at Stanford University as a graduate student for one year, with a minimum of 36 quarter units, plus a thesis, unless the thesis is waived by action of the Department. Course requirements are to be determined by the Department, depending on the student’s program.
Doctor of Philosophy

Admission to candidacy constitutes the first step in fulfilling the requirements for the Doctor of Philosophy degree. For admission to candidacy the student must:

1. Have a reading knowledge of one foreign language in which there exists a substantial body of literature relevant to the student’s program of study.
2. Pass the following courses with a grade of B or better:
   a) The proseminar sequence.
   b) An acceptable course in linguistics.
   c) An acceptable course in statistics.
   d) One course in either physical anthropology or prehistoric archaeology. (Both are required for completion of the doctoral degree.) Students who submit satisfactory evidence of having had previous training in any of these fields are urged to take more advanced courses in the same topic areas, or to submit to the faculty a proposal for substitution of courses in other fields.
3. Pass a written examination covering a basic knowledge of general anthropology.
4. Submit a written paper of high quality.

The graduate program is designed so that these requirements will be completed within the student’s first year of residence. Students entering the Department with a Master’s degree in Anthropology from other universities are expected to fulfill these requirements. Upon satisfactory completion of these requirements and with the recommendation of the Departmental faculty, the student will be encouraged to proceed to candidacy for the Doctor of Philosophy degree. Application for candidacy must be made to the Graduate Division of the University. Candidacy, when approved by the University, is valid for five years and may be renewed upon submission and approval of a new application.

The further requirements for the Ph.D. degree consist of:

1. Submission and approval, normally at the beginning of the student’s second year of residence, of a proposal for a plan of study. This proposal should develop an outline of courses which fulfills the requirements presented below.
   a) Completion of at least five graduate courses given by the Department, not including proseminar courses, reading courses or conceptual skills courses, taken with at least four different faculty members.
   b) Completion of the physical anthropology and prehistoric archaeology requirements.
   c) Completion of training outside the Department in areas related to the student’s major topic of specialization. Fulfillment of this requirement will usually consist of a series of graduate courses taken in other departments. The number of courses is to be determined by the student’s previous level of training and interests.
   d) Completion of training in a special conceptual skill, such as mathematics, linguistics, computer science, a second language, statistics, and special methods. Fulfillment of this requirement will usually consist of a series of graduate or intermediate courses, with the number of courses to be determined by the student’s previous level of training and interests.

2. A written examination, normally taken at the end of the student’s second year. The written examination will cover the candidate’s major topic of specialization and one geographic area. The candidate’s topic of specialization and geographic area are to be defined by a prospectus and by a bibliography presented for approval to the faculty in the second week of the quarter preceding the examination.
3. The University oral examination that is taken after the written examination.
4. A dissertation based upon independent research. Preceding this research the student will present a dissertation proposal to the faculty for approval.
TEACHING ASSISTANTSHIPS AND FELLOWSHIPS

The Department annually nominates graduate students for appointment as teaching assistants. The service expected consists for the most part of conducting sections of 1 (General Anthropology). A teaching assistant devotes approximately a third of his time to the work, and receives $466 per quarter, plus a scholarship equivalent to one-third of the quarter’s tuition cost. Research assistantships may also be available in connection with research programs in the Department, with stipends depending on the amount of work involved. Applicants for these appointments should address their requests to the Executive Head of the Department.

The University also assigns certain fellowship and scholarship funds to the Department. These are allotted initially on the basis of applications for financial aid received up to January 15 of each year, with payment starting at the opening of the following autumn quarter. Applications may be received either from graduate students already in residence or from prospective new students; the latter must also have their admission forms submitted by that date. A student submitting an application for financial aid automatically becomes eligible for consideration for various funds available for Department distribution. Students with first-class records should also ask their advisers about how to apply for outside awards, such as National Science Foundation, National Defense Education Act, and National Institutes of Health fellowships.

COURSES PRIMARILY FOR UNDERGRADUATES

#1. General Anthropology—Anthropological approaches and perspectives relating to man, his culture, and his society. Emphasis on fields of cultural anthropology.

5 units, autumn, (———), MTWTTh 1:15
4 units, summer, (———), MTWTTh 1:15

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, winter, (Gerow), MTWTThF 9

COURSES OPEN TO UNDERGRADUATES AND GRADUATES

(Except where prerequisites are specified, courses are open to all students. With consent of the instructor, an extra unit may be added to 4-unit courses by undertaking special project work.)

102. Indians of North America—(Formerly 155.) History, cultural background, and contemporary situation of major tribes in North America. Prerequisite: 1 or consent of instructor.

4 units, winter, (Barnett), MWF 10

103. Peoples of Middle America—(Formerly 161.) Survey of cultural development of the peoples of Middle America during the last 3,000 years. Special emphasis is placed upon modern village studies. Prerequisite: 1 or consent of instructor.

4 units, autumn, (Hotchkiss), MTWTTh 9

104. Peoples of the Caribbean—Anthropological contributions to cultural and social adaptations in the area. Will be concerned with such problems as: ecology, community types and their relationships, family and kinship, stratification. Prerequisite: 1 or consent of instructor.

4 units, spring, (Siegel), MTWTTh 10

108. Peoples of Europe—(Formerly 149.) A review of anthropological materials on rural (peasant) societies in Europe, with emphasis on Ireland, France, Spain, Italy, and Greece. Prerequisite: 1 or consent of instructor.

4 units, (Cancian), to be given in 1966–67
112. Peoples of Africa—(Formerly 154.) Racial, linguistic, cultural backgrounds and characteristics; opportunities for special work on chosen areas. Prerequisite: 1 or consent of instructor.

4 units, winter, (Greenberg), MTWTh 9

113. Peoples of South Asia—The social structure of the traditional community and its modification in response to changing conditions. Prerequisite: 1 or consent of instructor.

4 units, (Beals), to be given in 1966–67

116. Peoples of East Asia—(Formerly 152.) Emphasis on Japan and relationship with other peoples of East Asia. Racial, linguistic, cultural backgrounds and characteristics; opportunities to read on special areas. Prerequisite: 1 or consent of instructor.

4 units, autumn, (Befu), MTWTh 10

121. Cultural Evolution—Examination of the nineteenth and twentieth century evolutionary theories. General and specific evolution. Cultural adaptation as an evolutionary process. Prerequisite: 1 or consent of instructor.

4 units, spring, (Befu), MTWTh 10

126. Cultural Dynamics—(Formerly 163.) Processes of cultural growth and change, including independent development, diffusion and culture contact. Prerequisite: 1 or consent of instructor.

4 units, winter, (Paul), MWF 11

131. Comparative Social Systems—(Formerly 140.) Analysis of social structure, including kinship, community, other principles of organizing social life; comparison of non-Western with Western societies. Prerequisite: 1 or Sociology 1 or consent of instructor.

4 units, winter, (Siegel), MTWTh 10

135. Introduction to the History of Anthropological Theory—A historical treatment of the chief theoretical trends in anthropology. Prerequisite: 1 or consent of instructor.

4 units, (Greenberg), to be given in 1966–67

141. Belief Systems—Methods for the utilization of personal documents and questionnaires in the study of belief systems will be discussed. Students will be expected to carry out independent research and analysis of particular aspects of belief systems. Prerequisite: 1 or consent of instructor.

4 units, (Beals), to be given in 1966–67

143. Transcultural Perspectives on the Supernatural—This course will emphasize a behavioral, non-evaluative approach to religious belief and behavior. Selected theoretical approaches will be employed. Illustrative materials will be drawn primarily from mainland Southeast Asia. Prerequisite: 1 or consent of instructor.

4 units, spring, (Textor), MTWTh 11

145. Political Anthropology—This course will deal with the generation, allocation, and use of power in a variety of nonliterate and literate societies. Special emphasis will be placed on the politicization of populations in the new nations of the developing areas. Prerequisite: 1 or consent of instructor.

4 units, (Textor), to be given in 1966–67

151. Economic Anthropology—Data on economic systems of primitive and peasant societies and problems in its conceptualization will be reviewed. Prerequisite: 1 or consent of instructor.

4 units, spring, (Cancian), MTWTh 11

158. Culture and Personality—(Formerly 164.) Anthropological contributions to understanding the role of culture in personality development; comparative studies; present status of problem. Prerequisites: 1 and Psychology 1 or consent of instructor.

4 units, autumn, (Romney), MTWTh 9

167. Language and Culture—(Formerly 176.) Contributions of anthropology to study of linguistics; symbolic nature of language; structural and comparative studies;
anthropology. Designed for students in language and other departments as well as in anthropology. Prerequisite: 1 or consent of instructor.
4 units, autumn, (Hotchkiss), MTWTh 11
180. Archaeological Field Methods—Studies, excavations of local archaeological sites, and related work in the Department archaeological laboratory. Prerequisite: 5 or consent of instructor.
4 units, spring, (Gerow), by arrangement
182. Museum Methods—Directed work on anthropological collections in Stanford Museum. Prerequisite: 5 or consent of instructor.
4 units, winter, (Gerow), by arrangement
190. Directed Individual Study—For undergraduate students with special needs, and showing capacity to do independent work. Prerequisite: 1 or consent of instructor.
Any quarter, (Staff), by arrangement
191. Senior Seminar—For undergraduate majors, to give experience in seminar techniques and afford opportunity to undertake special project work. Prerequisite: 1.
2 units, spring, (———), M 2:15-4:05
195. Honors Program—Directed independent study and honors thesis work for students admitted to this program.
Any quarter, (Staff), by arrangement
200. Proseminar—Presentations, discussion and reading in core topical areas in social and cultural anthropology. Required of all first-year graduate students.
4 units, autumn, (Cancian), TTh 1:15-3:05
201. Proseminar—Continuation of 200.
4 units, winter, (Romney), TTh 1:15-3:05
202. Proseminar—Continuation of 201.
4 units, spring, (———), TTh 1:15-3:05
210. Proseminar—This seminar will be devoted in considerable part to the presentation and discussion of current research interests of the faculty. Required of all first-year graduate students.
4 units, autumn, (Siegel), M 3:15-6:05
211. Proseminar—Continuation of 210.
4 units, winter, (Paul), M 3:15-6:05
212. Proseminar—Continuation of 211.
4 units, spring, (———), M 3:15-6:05
216. Comparative Studies on East Asia—This seminar will focus on selected topics in East Asian studies. Prerequisite: graduate standing or consent of instructor.
4 units, winter, (Beals), to be given in 1966-67
223. Cultural Systems: Selected Problems—Stress will be on a procedural approach to cross-cultural comparisons with a special emphasis upon the maintenance of membership, conflict and change. Opportunities for individual research. Prerequisite: graduate standing or consent of instructor.
4 units, (Beals), to be given in 1966-67
226. Advanced Cultural Dynamics—(Formerly 236.) Seminar covering selected topics and problems, especially at the community level. Prerequisite: graduate standing or consent of instructor.
4 units, (Paul), to be given in 1966-67
227. Selected Problems in Cultural and Social Change—Consideration of sources and characteristics of new alternatives, the reorganization of choice behavior in relation to prevailing social structure, technology and cultural orientations. Special consideration of plantation systems, urbanization and industrialization. Prerequisite: graduate standing or consent of instructor.
4 units, autumn, (Siegel), T 3:15-6:05
228. Culture and Education in Developing Nations—Concepts of culture and cultural relativism as analytical tools in defining and approaching problems of socioeconomic development in Africa, Asia and Latin America. Relation of education to
cultural and national development will be explored. (Same as Education 406a.) Pre-requisite: graduate standing or consent of instructor.

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

233. Advanced Social Organization—Seminar or directed individual work, following up that given in Anthropology 131. Prerequisite: graduate standing or consent of instructor.

4 units, (Romney), to be given in 1966-67

244. Advanced Mythology and Folklore—Anthropological contributions to understanding of these fields of human activity; comparisons with Western literature. Prerequisite: graduate standing or consent of instructor.

4 units, spring, (Gerow), W 3:15-6:05

256. Cultural Transmission—(Formerly 265.) 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.) Prerequisite: graduate standing or consent of instructor.

3 units, autumn, (Spindler), M 7-10 p.m.

4 units, summer, (———), MTWThF 9

258. Advanced Culture and Personality—(Formerly 237.) Seminar following up Anthropology 158. Prerequisite: graduate standing or consent of instructor.

4 units, winter, (Spindler), T 3:15-6:05

260. Anthropological Linguistics—(Formerly 177.) Descriptive linguistics, including phonemic and morphological analysis and comparative techniques. Prerequisite: graduate standing or consent of instructor.

4 units, autumn, (Greenberg), MW 1:15-3:05

261. Linguistic Field Methods—(Formerly 253.) Seminar or directed individual work, following up Anthropology 160. 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 consent of instructor.

4 units, (Gerow), to be given in 1966-67

262. Phonetics and Phonemics—(Formerly 204.) Field-oriented training in linguistic analysis as applied to the sound systems of languages. Lecture-discussion and laboratory.

4 units, winter, (Greenberg), MTWTh 11

263. Morphology and Syntax—(Formerly 205.) Field-oriented training in linguistic analysis as applied to grammatical systems. Lecture-discussion and laboratory. Prerequisite: 262 or consent of instructor.

4 units, (Greenberg), to be given in 1966-67

270. Prehistoric Archaeology—Methods, findings in this field; correlations of prehistory of Europe and Near East with that of other zones over the world. Prerequisite: graduate standing or consent of instructor.

4 units, autumn, (Gerow), MTWTh 11

275. Physical Anthropology—Methods, findings relating to human evolution, fossil man, racial differences, bodily growth; includes laboratory exercises. Prerequisite: graduate standing or consent of instructor.

4 units, spring, (Gerow), MTWTh 9

276. Family Structure and Health—Arrangements are made through the Department of Pediatrics for students to observe children and their families in the Clinic and at home. The course is designed to help students understand interrelationships of patients, families and communities as they affect health and disease. (Same as Pediatrics 276 and Preventive Medicine 12.) Prerequisite: graduate students, other than medical students, must have consent of Dr. Barnett.

2 units, winter, spring, (Barnett, Staffs of Departments of Preventive Medicine, Pediatrics and Division of Clinical Social Work), by arrangement

277. Medical Anthropology—(Formerly 259.) Seminar, analyzing theories of disease and therapy in selected societies, the relation of medical beliefs to other areas of
278. Advanced Medical Anthropology — Seminar devoted to examination in depth of research problems requiring medical and behavioral science collaboration. Continued in Anthropology 279. (Anthropology graduate students may count 278 and 279 for only one course in meeting seminar distribution requirements.) Prerequisites: 277 and consent of instructor.

279. Advanced Medical Anthropology — Continuation of 278.

285. Advanced Quantitative Methods — 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 and graduate standing, or seniors by consent of instructor.

292. Metatheory — Using historical and contemporary materials, the seminar will explore a problem in the conceptual systems used by anthropologists. The topic for 1965–66 will be functional analysis. Prerequisite: graduate standing or consent of instructor.

300. Directed Project Work — Special research projects undertaken for course credit.

302. Directed Individual Study — Provides opportunities for advanced students to explore special areas of interest.


Graduate courses offered in other departments and institutes within the University, such as in Anatomy, Geology, Sociology, Psychology, and the Hoover Institution, may also be elected for graduate credit provided the course concerned is approved by the adviser as fitting into the student's program. For the graduate statistics requirement in Anthropology, Statistics 7, Psychology 60, or Education 216 may be taken.

See also Senior Colloquia.

DIVISION OF APPLIED PHYSICS

Executive Head: Marvin Chodorow

Professors: Marvin Chodorow, Edward Leonard Ginzton (on leave), Walter Ashley Harrison, Hubert Heffner, Calvin Forrest Quate, Peter Andrew Sturrock

Associate 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. Student research is super-
vised by the faculty members listed above and also by various members of other departments such as Materials Science and Electrical Engineering, who are engaged in related research fields. Research activities are carried out in the W. W. Hansen Laboratories of Physics and the Stanford Electronics Laboratories.

The number of graduate students admitted to Applied Physics is limited. Applications should be received by January 15, 1966. Graduate students may normally enter the Division only at the beginning of autumn quarter.

PROGRAMS OF STUDY

Requirements for admission to candidacy for the M.S. and Ph.D. degrees in Applied Physics include a Bachelor's Degree in Physics or an equivalent Engineering degree. Students entering from an engineering curriculum should expect to spend at least an additional quarter of study acquiring the background to meet the requirements for advanced degrees in Applied Physics.

The University's basic requirements for the Master's degree are discussed in the section "Degrees" in this Bulletin. Each candidate for this degree will be required to pass an examination. Forty-five units of applied physics, physics, engineering, and mathematics are the minimum requirements for the degree. Up to 6 units of transfer credit for post-B.S. work taken elsewhere may be granted by validation in individual cases. Minimum subject matter requirements for the Master's degree include Physics 170, 171, 172, 220 (or Electrical Engineering 272), Physics 130, 131, 132 (or Electrical Engineering 259, 260, Applied Physics 237), Applied Physics 213, 214, 215 (or Physics 210, 211, 212), one quarter of advanced laboratory (chosen from Physics 200, 201, 202, Applied Physics 351, 353, 355, or Electrical Engineering 257a, b, or c), plus sufficient additional approved courses in applied physics, physics, engineering, or mathematics, to total 45 units. A reading knowledge of French, German, Italian, or Russian can be substituted for 9 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 Divisional 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 170, 171, 172, 210, 211, 212, Applied Physics 213, 214, 215, Physics 220 (or Electrical Engineering 272), Physics 221, 230, 231, 232 (or Electrical Engineering 259, 260, Applied Physics 237), and two quarters of advanced laboratory (chosen from Physics 200, 201, 202, Applied Physics 351, 353, 355, or Electrical Engineering 257a, 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 January 15, 1966.
COURSES


213. 3 units, autumn, (Sparks), MWF 9
214. 3 units, winter, (Sparks), MWF 9
215. 3 units, spring, (Sparks), MWF 9

237. Quantum Mechanics of Atomic Systems—Directed toward application to solid state, magnetics, quantum electronics, etc. Includes the density matrix; quantization of the EM field; second quantization; interaction of EM radiation and matter; multiple-quantum effects. Prerequisite: E.E. 260 or Physics 231.

3 units, spring, (Heffner), MWF 11

250, 251. Electron and Ion Dynamics—Detailed treatment of motion of electrons and ions in stationary and time-varying electromagnetic fields, including beam focusing and space-charge effects. Emphasis on general properties of electron dynamics common to microwave tubes, ion propulsion, plasmas. Illustrations taken from all these applications. Treatment of space-charge waves and cyclotron waves, stability considerations, and parametric effects in electron beams. Prerequisites: Physics 110 and 122 or equivalent courses in mechanics and electricity and magnetism at the junior or senior level.

250. 3 units, autumn, (Chodorow), TTh 9:00-10:15
251. 3 units, winter, (Chodorow), TTh 9:00-10:15

290. Directed Studies in Applied Physics—Special studies under the direction of a faculty member for which academic credit may properly be allowed. Such studies may include laboratory work or directed reading.

Any quarter, (Staff), by arrangement

300. Thesis Research—A grade of + indicates satisfactory work; no letter grade is assigned.

Any quarter, (Staff), by arrangement


3 units, spring, (Buneman)

324. The Laboratory Plasma—Methods of forming laboratory plasmas in gases and in the solid state and measurement of their properties. Collision processes, velocity distributions, the Boltzmann transfer equation, concepts of temperature and pressure, nonequilibrium velocity distributions. Macroscopic averages of the Boltzmann equation. D.C. and R.F. breakdown and avalanche phenomena, the effect of a magnetic field, the positive column at low pressure and medium pressure, ambipolar diffusion, the plasma sheath, wave propagation in infinite plasmas and in bounded plasma, probe theory, R.F. diagnostic techniques. (Enroll in E.E. 287.) Prerequisite: E.E. 271 or Physics 103; E.E. 286n would be helpful but is not required.

3 units, autumn, (Kino)


3 units, winter, (Buneman)

3 units, autumn, (Siegman), MWF

335. **Seminar in Quantum Electronics and Optics**—Discussion by staff and students of selected topics, such as optical coherence theory; electrooptic, electroacoustic, and nonlinear optical effects; optical resonators; lasers; light modulation and demodulation. (Enroll in E.E. 274c.)

Units by arrangement, autumn, winter, spring, (Siegman, Staff)

350. **Electromagnetic 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, (Quote), TTh 8

351. **Electromagnetic Measurements Laboratory I**—Experimental work to accompany 350. Concurrent registration in 350 is required.

2 units, autumn, (Quote), by arrangement

352. **Electromagnetic 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, (Quote), TTh 8

353. **Electromagnetic Measurements Laboratory II**—Laboratory course to accompany 352. Prerequisites: 350 and 351. Concurrent registration in 352 is required.

2 units, winter, (Quote), by arrangement

354. **Electromagnetic 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, TW1, parametric amplifiers, masers). Also selected topics of current interest. Prerequisites: 352 and 353.

2 units, spring, (Quote), TTh 8

355. **Electromagnetic Measurements Laboratory III**—Laboratory course to accompany 354. Prerequisites: 352 and 353.

2 units, spring, (Quote), by arrangement

360. **Introduction to Astrophysics I: Solar-Terrestrial Relations**—Origin and characteristics of the solar wind. Magnetosphere and bow wave; radiation belts; aurorae. Phenomena caused by solar flares: interplanetary shock waves; geomagnetic storms; Forbusch effect. (Enroll in Engineering 207.) Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent.

3 units, autumn, (Sturrock), MWF 11

361. **Introduction to Astrophysics II: The Sun**—Normal photosphere, chromosphere and corona. Fraunhofer spectrum. The solar cycle. Active phenomena: sunspots; prominences; flares; radio bursts. (Enroll in Engineering 208.) Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, winter, (Sturrock), MWF 11

362. **Introduction to Astrophysics III: Stars and Galaxies**—Radiative and convective energy transport; equation of state; opacity; nuclear processes. Hertzsprung-Russell diagram; stellar evolution. Galactic morphology; structure of our galaxy; spiral arms. Radio galaxies, quasi-stellar radio sources; cosmic rays. (En-
roll in Engineering 209.) Prerequisite: Physics 220, or E.E. 271, or A.A. 285a, or equivalent. Physics 132 desirable.

3 units, spring, (Sturrock), MWF 11


377. 3 units, autumn, (Harrison), MWF 10
378. 3 units, winter, (Harrison), MWF 10

379, 380. Special Topics in Solid State Theory—Detailed treatment of specialized topics in solid state theory will vary from year to year. Including optical properties; magnetic properties; transport theory; relaxation phenomena; phonon-electron interaction. Prerequisites: Either Physics 232 or Applied Physics 237 or Physics 130 series and Physics 172 or E.E. 255.

379. 3 units, winter, ( ), by arrangement
380. 3 units, spring, (Harrison), by arrangement

ART and ARCHITECTURE

Emeriti: Edward McNeil Farmer (Professor), Victor M. Arnautoff (Assistant Professor)

Executive Head: Lorenz Eitner

Professors: Lorenz Eitner, Ray Nelson Faulkner, Matthew Seymour Kahn, Daniel Marcus Mendelowitz, Michael Sullivan, Victor King Thompson

Associate Professors: Dwight Cameron Miller, Nathan Oliveira

Assistant Professors: Gerald Martin Ackerman, Keith Boyle, Robert James Mullen.

Acting: John-David Paul LaPlante

Instructor: Patricia Rose

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, George J. Young (Architecture); Daniel Rolfs, Kathryn Imlay Stedman (Landscape Architecture); Myron D. Alexander (Law); Dwight A. Coddington (Mechanical Engineering); Harry L. Sanders (Planning); David J. Hammond, Isadore Thompson (Structural Engineering)

OFFERINGS AND FACILITIES

The Department offers courses of study in four areas: (1) in the history of art, (2) in the practice of drawing, painting, sculpture, design and printmaking, (3) in architecture, and (4) in art education. The undergraduate program of the Department is designed to introduce students to the humanistic study of the visual arts. The courses are intended to increase the students' understanding of the meaning and purpose of the arts, of their historical development, their role in society, and their relationship to such other humanistic disciplines as literature, music, and philosophy. The work in classroom and studio is designed to intensify the students' visual perception of the formal and expressive means of art and to encourage insight into a variety of technical processes. The collections of the Stanford Museum and the exhibitions program of the Stanford Gallery supplement the regular academic program of the Department.

PROGRAMS OF STUDY

Undergraduates may major in Art History, the Practice of Art (Studio), or in Pre-Architecture studies. A freshman or sophomore intending to major in one of these areas should consult with an adviser appointed by the Department in order to
plan his course of study. It is advisable to complete about twenty units of work in art during the freshman and sophomore years.

Graduate programs are offered in Art History, Studio (including Industrial Design), Architecture, and Art Education.

**History of Art**

**Bachelor of Arts**

The major program in the history of art must include the following:
- 3 units—Art 1
- 24 units in courses in art history numbered from 100 to 130
- 15 units in courses in art history numbered from 200 to 237
- 3 units each—Art 40 and Art 50

Total units—48

Each undergraduate major in the history of art shall, in consultation with his adviser, select a coherent and substantial minor program in anthropology, classics, history, literature, philosophy, or some other area approved by the adviser. He shall, furthermore, take at least eight units of beginning German, French, or Italian, or present proof of reading ability in one of these languages.

**Master of Arts**

The University's basic requirements for the Master's degree are set forth in the section "Degrees" in this Bulletin. The following are Departmental requirements:

1. **Admission to Candidacy**—Completion of the University's requirements for a Bachelor of Arts degree in the history of art, or an approximately equivalent training, is required of students entering a program of study for the Master of Arts. Provisional enrollment may be permitted, however, in cases in which previous training has been deficient, with the understanding that the deficiency will be remedied in advance of Departmental approval of candidacy.

2. **Recommendation for the Degree**—To be recommended to the University Committee on the Graduate Division for the degree of Master of Arts in the history of art, the student must have satisfied the following requirements:
   - 1. Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.
   - 2. Completion of a total of at least 45 units of graduate work, at least 36 of which must be in art history, with grades no lower than a C and an average grade of B or better. At least 18 units in art history must be courses at the 200 level or above.
   - 3. Reading knowledge of two foreign languages, preferably German and French.
   - 4. Completion of two term papers of acceptable quality in courses in the history of art numbered 200 or above.
   - 5. Completion of a comprehensive written examination covering the main periods in the history of art.

**Doctor of Philosophy**

Plans for a program leading to the degree of Doctor of Philosophy in the area of art history are being formulated. Please address inquiries to the Executive Head of the Department for information concerning this program.

**Practice of Art (Studio)**

**Bachelor of Arts**

The major program in the studio area must total 65 units and include the following:
- 3 units—Art 1
- 47 units in studio courses, including: Art 40, 50, 60, 140a, 140b, 140c, 145a, 145b,
145c, 150a, 150b, 155a, 160a, and at least nine units in art courses numbered 200 or above.
15 units of art history and architecture, including the two survey courses in art history, two art history courses numbered 100 or above, and Architecture 70. Total units—65

**Master of Arts**

Graduate work leading to the Master's degree may be undertaken by students who wish to engage in advanced studio work. Admission to candidacy for the degree of Master of Arts is based on:

1. The equivalent of a Bachelor of Arts degree in art at this University.
2. A grade point average of B- in at least 65 units of undergraduate work in art.
3. Formal admission to candidacy granted by the University Committee on the Graduate Division.

The requirements for the degree of Master of Arts are:

1. Completion of a minimum of three full quarters of graduate work in residence or its equivalent at this University.
2. Completion of the equivalent of 45 units of selected third- and fourth-year undergraduate and graduate courses. At least 30 units of this work must be in art with a grade of B or above and distributed as follows:
   a) 12 units in one of the four areas of concentration: (a) Drawing and Painting, (b) Sculpture, (c) Design, or (d) Printmaking.
   b) A total of 12 units in the remaining areas of concentration.
   c) 6 units of thesis or creative project.

Master of Arts candidates in the studio program are strongly advised to elect additional art history courses.

**INDUSTRIAL DESIGN**

A Master of Arts in Art with emphasis in Industrial Design is offered jointly by the Department of Art and Architecture and the School of Engineering (Department of Mechanical Engineering). For information concerning the requirements for this program, please direct inquiries to the Executive Head of this Department.

**ART EDUCATION**

**Master of Arts in Teaching**

The degree of Master of Arts in Teaching is offered by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential, who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements 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.

**Teaching Credential (Secondary)**

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 is concerned with the study of design disciplines which determine man's physical environment. The program is developed on three levels within the University: the undergraduate curriculum; the graduate curriculum; and the advanced study center.

Bachelor of Arts (Pre-Architecture)

The undergraduate curriculum provides the opportunity for a broad liberal education combined with introduction to the architectural arts. Surveys of architecture, landscape architecture, and urban design develop an awareness of the nature of these arts and their relationship. The program emphasizes understanding of these arts, the basic design factors, and history and theory. At the end of the third year of this program, students may enter the specialized architecture curriculum if all required courses are completed.

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Units</th>
</tr>
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<tbody>
<tr>
<td>Architecture 70, 71a, 71b, 170, 171, 172</td>
<td>19</td>
</tr>
<tr>
<td>Landscape Architecture 80, 82, 182</td>
<td>8</td>
</tr>
<tr>
<td>Urban Design 90, 192</td>
<td>6</td>
</tr>
<tr>
<td>Art 1, 40, 50, 150a</td>
<td>12</td>
</tr>
<tr>
<td>Physics 21, Mathematics 10, 11</td>
<td>10</td>
</tr>
</tbody>
</table>

Bachelor of Architecture

A three-year graduate program in architecture providing basic professional education. The curriculum reflects the varied nature of practice permitting the student to elect substantial units in specific areas of interest related to the field of architecture such as: administration, engineering, construction and planning. Applicants shall have 135 units including Bachelor of Arts requirements above. A 3.00 grade point average must be attained in required courses. Candidates must complete the following courses:

<table>
<thead>
<tr>
<th>Required Courses</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture 271a, b, c; 272a, b, c; 273; 274a, b, c, d, e; 275a, b, c; 276; 277; 278; 279; 301a, b, c; 382</td>
<td>82</td>
</tr>
<tr>
<td>Civil Engineering 20, 116, 170; Computer Science 136; Engineering 161; Education 325</td>
<td>18</td>
</tr>
<tr>
<td>25 units selected with approval of adviser from: Art 100a, b; 105a, b; 110a, b, c; 259b; Mathematics 21, 22, 23; Engineering 5, 11, 15; Civil Engineering 138, 144, 145, 150, 151, 180, 181, 182, 183, 190; Industrial Engineering 100, 133; Mechanical Engineering 4, 112a, b, c; 116a, b, c; 214a, b; Political Science 100, 104; Geography 191; Biology 128</td>
<td>90</td>
</tr>
</tbody>
</table>

Advanced Study Center

The opportunity is provided for advanced study in architecture on an individual work basis. Advanced students may enroll in the center to pursue an independent course of study. Students are encouraged to bring special problems which may be solved under the direction of selected faculty members. No formal curriculum or academic degree is offered. Admission to the Study Center is granted by the Department on the basis of a written application, a statement of purpose and objectives, and evidence of the student's ability to undertake mature, independent study.
COURSES IN HISTORY OF ART

BASIC COURSES

#1. Introduction to Art—A topical survey of problems in the interpretation of architecture, sculpture, and painting.
   3 units, autumn, winter, spring, (Ackerman, Rose, Staff)

#5. Survey I—Main currents in the history of art from prehistoric time to the end of the Middle Ages.
   3 units, autumn, spring, (Miller, Staff)

#10. Survey II—Main currents in the history of art from the Renaissance to the present.
   3 units, winter, spring, (Ackerman, Staff)


71b. Architecture Since 1500—See Architecture 71b.

INTERMEDIATE COURSES

100a. Ancient Art I—The Pre-Hellenic Cultures: Egypt, Mesopotamia, Crete.
   3 units, any quarter, (Staff), to be given in 1966-67

100b. Ancient Art II—Greece and Rome.
   3 units, any quarter, (Staff), to be given in 1966-67

   3 units, autumn, (Ackerman)

105b. Medieval Art II—Romanesque to late Gothic periods.
   3 units, winter, (Eitner)

110a. Renaissance Art I—The early Renaissance in Italy.
   3 units, autumn, (Rose)

110b. Renaissance Art II—The High Renaissance and Mannerism in Italy.
   3 units, winter, (Rose)

   3 units, winter, (Rose)

115a. Baroque Art I—Seventeenth and eighteenth century art in Italy and Spain.
   3 units, winter, (Miller)

115b. Baroque Art II—Seventeenth and eighteenth century art in the North.
   3 units, spring, (Miller)

120a. Modern Art I—Neoclassicism, Romanticism, and Early Naturalism (1770-1850).
   3 units, autumn, (Eitner)

120b. Modern Art II—Realism, Impressionism and Postimpressionism (1850-1900).
   3 units, winter, (Ackerman)

120c. Modern Art III—Main currents of twentieth century art.
   3 units, spring, (Ackerman)

#125a. Oriental Art I—The arts of India, China and Japan from the Neolithic through the sixth century A.D.
   3 units, autumn, (LaPlante)

#125b. Oriental Art II—The arts of India, China and Japan from the seventh century A.D. to the present.
   3 units, winter, (LaPlante)

126. Chinese Painting.
   3 units, any quarter, (Sullivan)

#130a. American Art I—Architecture, sculpture, painting and the household arts from pre-Columbian times to the Civil War (1860).
   3 units, winter, (Miller)

#130b. American Art II—Architecture, sculpture, painting and the household arts from 1860 to today.
   3 units, spring, (Miller)
Advanced Undergraduate and Graduate Courses

3 units, any quarter, (Staff)

201. Seminar in Ancient Art.
3 units, any quarter, (Staff)

205. Studies in Medieval Art.
3 units, any quarter, (Staff)

206. Seminar in Medieval Art.
3 units, any quarter, (Staff)

3 units, any quarter, (Rose)

211. Seminar in Renaissance Art.
3 units, any quarter, (Rose)

3 units, any quarter, (Miller)

216. Seminar in Baroque Art.
3 units, any quarter, (Miller)

3 units, any quarter, (Staff)

221. Seminar in Nineteenth Century Art.
3 units, any quarter, (Staff)

3 units, any quarter, (Staff)

223. Seminar in Twentieth Century Art.
3 units, any quarter, (Staff)

225c. Seminar in Oriental Art.
3 units, spring, (LaPlante)

227a, b. Studies in Chinese Arts.
3 units, any quarter, (Sullivan)

227c. Seminar in Chinese Arts.
3 units, any quarter, (Sullivan)

228a, b. Studies in Japanese Arts.
3 units, any quarter, (Sullivan)

228c. Seminar in Japanese Arts.
3 units, any quarter, (Sullivan)

235. Methods of Art Historical Research.
3 units, any quarter, (Staff)

236. Readings in the Literature of Art.
3 units, any quarter, (Staff)

237. Methods of Museology.
3 units, any quarter, (LaPlante)

238a. Art of the Theater I—Classical and medieval.
3 units, autumn, (LaPlante)

238b. Art of the Theater II—Renaissance and baroque.
3 units, winter, (Russell)

238c. Art of the Theater III—Romantic through modern.
3 units, spring, (Russell)

Any quarter, (Staff), by arrangement

Any quarter, (Staff), by arrangement

301. Master’s Thesis: Art History.
Any quarter, (Staff), by arrangement

Related Courses

Prehistoric Archaeology—See Anthropology 170.
Museum Methods—See Anthropology 182.
Philosophy of Art—See Philosophy 8.
Aesthetics—See Philosophy 174.
For archaeological courses see “Classics” elsewhere in this Bulletin.

INTERDEPARTMENTAL SEMINAR

Senior Seminar in Humanities—The Relationship Between the Arts—See Humanities 192.

COURSES IN PRACTICE OF ART (STUDIO)

BASIC COURSES

#40. Studio I—Basic drawing and painting concepts introduced through charcoal, pencil, pen and ink, colored chalk, and opaque watercolor.
3 units, autumn, winter, spring, (Staff)

#50. Studio II—Introduction to three-dimensional concepts through the use of clay, wire, wood construction, and plastic materials.
3 units, autumn, winter, spring, (Kahn, Mullen)

#60. Studio III—Basic laboratory problems in two-dimensional design with emphasis on color.
3 units, autumn, winter, spring, (Faulkner, Kahn, Mullen)

INTERMEDIATE COURSES

140a. Drawing I—Continuation of Art 40 with increased emphasis on life drawing and perspective. Prerequisite: 40.
3 units, autumn, winter, spring, (Staff)

140b. Drawing II—Life drawing and composition. Prerequisite: 140a.
3 units, autumn, winter, spring, (Boyle, Staff)

140c. Drawing III—Integration of thought, feeling, and performance through a personalized use of drawing media. Prerequisite: 140a.
3 units, winter, (Kahn, Staff)

145a. Painting I—Introduction to painting procedure. Still life, landscape, and figure studies in oil, watercolor, and varied media. Prerequisite: 40.
3 units, autumn, winter, spring, (Staff)

145b. Painting II—Extended problems in pictorial organization and content, with stress on oil painting. Prerequisite: 145a.
3 units, autumn, winter, spring, (Boyle, Oliveira)

145c. Painting III—Continuation of Art 145b. Extended problems in pictorial organization and content, with stress on oil painting. Prerequisites: 145a and 145b.
3 units, spring, (Boyle, Oliveira)

150a. Sculpture I—Introduction to figure modeling and human anatomy. Prerequisite: 50.
3 units, autumn, winter, spring, (Mullen)

150b. Sculpture II—Introduction to carving, welding, and construction. Prerequisite: 50.
3 units, autumn, winter, spring, (Mullen)

150c. Intermediate Sculpture III—Emphasis on carving, modeling, and construction. Prerequisite: 150a or 150b.
3 units, autumn, winter, spring, (Mullen)

155a. Design I—Two- and three-dimensional laboratory problems basic to key areas of design practice (work in wood, paper, paint, metal, etc.) Prerequisite: 60.
4 units, autumn, winter, spring, (Kahn)

155b. Design II—Laboratory problems in practical phases of design with emphasis on mass media, page layout, industrial products, and craftsmanship. Prerequisite: 155a.
3 units, winter, (Kahn)

155c. Design III—Advanced studio problems in practical and theoretical design, with fewer projects of a more complex nature. Prerequisite: 155a; recommended: 155b.
3 units, spring, (Kahn)
160a. Printmaking I—Introduction to print media: serigraphy, intaglio, and lithography. Prerequisites: 60 and 140a.
3 units, autumn, (Oliveira)

160b. Printmaking II—Continuation of Printmaking I, stressing work in chosen media. Prerequisite: 160a.
3 units, winter, (Oliveira)

160c. Photography—Photography as a fine arts media in color and black and white. Prerequisite: 60 recommended.
3 units, spring, (Staff)

Advanced Undergraduate and Graduate Courses

240a. Individual Work: Drawing—Prerequisite: 140c.
   Autumn, winter, spring, (Staff), by arrangement

240b. Individual Work: Painting—Prerequisite: 145c.
   Autumn, winter, spring, (Staff), by arrangement

241. Advanced Life Drawing and Painting—Prerequisites: 140c and 145c.
   4 units, autumn, (Boyle, Oliveira)

245. Watercolor Landscape Painting—Prerequisite: 145a.
   4 units, spring, (Staff)

246. Portrait Painting—Prerequisite: 145c.
   4 units, (Mendelowitz), to be given in 1966–67

247. Advanced Research in Painting Techniques—Prerequisite: 145c.
   Winter, (Boyle, Staff), by arrangement, alternate years, to be given in 1965–66

   Autumn, winter, spring, (Mullen), by arrangement

251. Advanced Figure Modeling—Prerequisite: 150a.
   4 units, autumn, winter, spring, (Mullen)

252. Advanced Carving, Modeling, and Construction—Prerequisite: 150c.
   4 units, autumn, winter, spring, (Mullen)

253. Metal Casting—Prerequisite: 150c.
   4 units, autumn, winter, spring, (Mullen)

255. Individual Work: Design.
   Autumn, winter, spring, (Kahn, Staff), by arrangement

257. Seminar in Design Theory—Prerequisites: senior or graduate standing, and experience in design.
   3 or more units, autumn, spring, (Faulkner)

258. Studio Seminar in Advanced Color—Individual studio and research projects
   4 units, winter, (Faulkner)

259a. Textile Design—Laboratory projects in various types of fabrics with concentration in screen printing. Prerequisite: 155a.
   5 units, autumn, (Kahn)

259b. Product Design—Laboratory projects in the design of useful articles through craft and industrial processes. Prerequisite: 155b.
   4 units, winter, (Kahn)

259c. Advanced Graphic Design—Complex two- and three-dimensional problems in advertising, display, and publication design through traditional and modern media. Prerequisite: 155c.
   4 units, autumn, (Staff)

259d. Design for Precious Metals—Laboratory problems in jewelry and small sculpture. Prerequisite: 155b.
   4 units, winter, (Kahn), alternate years, to be given in 1965–66

   Spring, (Staff), by arrangement

261. Advanced Lithography.
   Winter, (Oliveira), by arrangement
262. Advanced Intaglio Processes.
   Spring, (Staff), by arrangement

   Any quarter, (Staff), by arrangement

341. Master's Project (Studio).
   Any quarter, (Staff), by arrangement

342. Advanced Creative Studies—Intensive emphasis in areas of personal specialization, with comparative analysis.
   Autumn, winter, spring, (Kahn), by arrangement

345. Advanced Painting and Criticism—Special problems for mature students with extended criticism.
   Any quarter, (Oliveira, Staff), by arrangement

RELATED COURSES

Rapid Visualization—See Mechanical Engineering 112a.
Introduction to Product Design—See Mechanical Engineering 112b.
Philosophy of Design—See Mechanical Engineering 214a.
Design in the Industrial Environment—See Mechanical Engineering 214b.

COURSES IN ARCHITECTURE

BASIC COURSES

#70. Introduction to Architecture—Theories, design factors and practice.
   3 units, autumn, (---), MWF 10

#71a. Architecture Before 1500—Building cultures of the world.
   4 units, autumn, (Thompson), MWF 9

#71b. Architecture Since 1500—Building cultures of the world.
   4 units, spring, (---), MWF 9
   summer, (Thompson), MWF 10

75. Graphics Laboratory—Review of drafting procedures.
   Autumn, (Staff), Th 7-9 p.m.
   Winter, (Staff), Th 7-9 p.m.

80. Introduction to Landscape Architecture—Theories, design factors and practice.
   3 units, spring, (Faulkner), TTh 11

82. Plant Materials—Identification and use of trees and shrubs.
   2 units, spring, (Stedman), T 1:15-3:05

#90. Introduction to Urban Design—Theories, design factors and practice.
   3 units, winter, (Thompson, Rockrise, Sanders, Worsley), MWF 10

INTERMEDIATE COURSES

170. Introduction to Residential Design—Functional, social and aesthetic problems in house design.
   2 units, winter, (Faulkner), TTh 11

171. Materials and Structures—Aesthetic nature of basic building materials and structural systems.
   3 units, spring, (Staff), W 4 and F 3:15-5:05

172. Architecture Design Laboratory.
   3 units, spring, (Staff), MW 10-12
   summer, (Thompson), MW 10-12

182. Landscape Design Laboratory.
   3 units, autumn, (Faulkner), TTh 10-12

192. Community Design Laboratory.
   3 units, winter, (---), MWF 4:15-6:05
ADVANCED UNDERGRADUATE AND GRADUATE COURSES

270. Individual Work: Architecture—Independent study with permission of instructor.
   Any quarter, (Staff), by arrangement

   5 units, autumn, (McCarthy), MWF 2:15-5:05 and W 7-9 p.m.

271b. Housing—Group housing, apartments and hotels.
   5 units, winter, (Callister), MWF 2:15-5:05 and W 7-9 p.m.

271c. Commercial, Industrial, and Administrative Buildings.
   5 units, spring, (Young), TThF 2:15-5:05 and W 7-9 p.m.

272a. Theaters and Auditoria.
   5 units, autumn, (Hill), MWF 2:15-5:05 and W 7-9 p.m.

   5 units, winter, (Green), MWF 2:15-5:05 and W 7-9 p.m.

   5 units, spring, (H. Clark), MWF 2:15-5:05 and W 7-9 p.m.

273. Residential Buildings—Design, working drawings and specifications for a single family residence. Prerequisite: preliminary design of a residence prepared during previous summer.
   5 units, autumn, (Peterson), TTh 1:15-3:05

   3 units, autumn, (Hammond), TTh 8

274b. Steel Construction—Design and Technology.
   3 units, winter, (Hammond), TTh 8

274c. Reinforced Concrete Construction—Design and technology.
   3 units, spring, (Hammond), TTh 8

   2 units, autumn, (B. Clark), MW 11

274e. Materials: Use and Specification II.
   4 units, winter, (Peterson), TTh 1:15-3:05

275a. Plumbing.
   3 units, autumn, (Coddington), T 3:15-5:05

275b. Heating, Air Conditioning, and Acoustics.
   3 units, winter, (Coddington), T 3:15-5:05

275c. Electrical Wiring, Illumination, and Elevators.
   3 units, spring, (Coddington), T 3:15-5:05

276. Business Administration—Business and professional aspects of architecture.
   4 units, winter, (Peterson), Th 3:15-5:05

   2 units, spring, (Alexander), Th 7-9 p.m.

278. Construction Administration—Shop drawings, reports, and inspection.
   3 units, spring, (Peterson), Th 3:15-5:05

279. Apprentice Training—Office internship in cooperating architectural firms.
   1 unit, autumn, (Peterson), T 3:15-5:05

301a. Independent Project I.—Independent work extending over three quarters evidencing the student's ability to solve a significant architecture problem.
   1 unit, autumn, (Spencer), Th 10-12

301b. Independent Project II.
   5 units, winter, (Thompson, Stromquist), TTh 10-12

301c. Independent Project III.
   5 units, spring, (Peterson, I. Thompson), TTh 10-12 and W 7-9 p.m.

382. Seminar: Landscape Architecture.
   2 units, spring, (Rolfs), W 7-9 p.m.
471. **Advanced Individual Study: Architecture.**

*Any quarter, (Staff), by arrangement*

**COURSES IN ART EDUCATION**

261a, b. **Curriculum and Instruction in Secondary School Art I**—(Enroll in Education 261a, b.)

261c, d. **Curriculum and Instruction in Secondary School Art II**—(Enroll in Education 261c, d.)

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: 380.

*2 to 5 units, (Staff), by arrangement*

480i. **Individual Study in Curriculum and Instruction in Art**—(Enroll in Education 480i.)

**ASIAN LANGUAGES**

*Emeritus: Frederic Spiegelberg (Professor)*

*Executive Head: Patrick D. Hanan*

*Professors: Robert H. Brower, Shau Wing Chan, Edward G. Seidensticker, Jr.*

*Associate Professors: Patrick D. Hanan, David S. Nivison. Visiting: Burton Watson*

*Assistant Professors: Albert E. Dien, William H. McCullough*

*Instructor: Kung-yi Kao*

**CHINESE-JAPANESE LANGUAGE AND AREA CENTER**

*Director: Patrick D. Hanan*

*Professors: Robert H. Brower, Shau Wing Chan, Nobutaka Ike, Edward G. Seidensticker, Jr., Thomas C. Smith, Kurt Steiner*

*Associate Professors: Patrick D. Hanan, David S. Nivison. Visiting: Burton Watson*

*Assistant Professors: Albert E. Dien, William H. McCullough, Lyman P. Van Slyke*

*Instructor: Kung-yi Kao*

**OFFERINGS**

The Department of Asian Languages offers courses in the languages and literatures of China and Japan. The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts, and Doctor of Philosophy. It also gives a minor in Chinese or Japanese language and literature for the degree of Doctor of Philosophy.

**PROGRAMS OF STUDY**

**Bachelor of Arts**

The degree of Bachelor of Arts is granted both in Chinese and in Japanese. The following courses must be completed:

1. Concentration in Chinese: C103, C151, C152, C153
2. 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, and the candidate must:

1. Meet the Department's requirements for the degree of Bachelor of Arts in Chinese (or Japanese) or their equivalent.
2. Complete C221 (or J221), C222 (or J222), C299 (or J299). In addition, students in Chinese must complete C162, C163 plus at least 20 units of courses above the level of 230, while students in Japanese must complete at least 24 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 of a text of appropriate difficulty 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:

1. 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.

2. Further requirements:
   a) The candidate must complete at least 4 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.

3. Preparation for University oral examinations. 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.

4. 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 programs of the Inter-University Program for Chinese Language Study in Taipei and the Inter-University Center for Japanese Studies in Tokyo (both of which are administered by Stanford University). They are described elsewhere in this Bulletin.

Summer Program of Intensive Language Courses—A ten-week program, which begins at the same time as the University's general summer program and continues two weeks beyond it, is held each summer. Intensive instruction is offered, on four different levels, in both Chinese and Japanese. The intensive courses provide the equivalent in instruction to regular academic-year courses. (See courses C5, C25, C105, C135, J5, J25, J105, and J135 as described below.) For detailed information about these and other aspects of the summer program, apply directly to the Department of Asian Languages, preferably before the end of the preceding autumn quarter.
COURSES NOT REQUIRING A KNOWLEDGE OF AN ASIAN LANGUAGE

#C151. Ancient Chinese Literature in Translation—(Freshmen and sophomores may be admitted by permission of instructor.)
4 units, autumn, (Watson), 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, (Brocker), 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.
C1. 5 units, autumn, (Kao), MTWThF 9
C2. 5 units, winter, (Kao), MTWThF 9
C3. 5 units, spring, (Kao), MTWThF 9

C5. Intensive First-Year Modern Chinese—Equivalent to C1, C2, C3 combined. Prerequisite: consent of instructor.
15 units, summer, (———), MTWThF 8-12

#C21, C22, C23. Second-Year Modern Chinese—Further study in grammar, reading, conversation, composition. Prerequisite: C3 or equivalent.
C21. 5 units, autumn, (Dien), MTWThF 1:15
C22. 5 units, winter, (Dien), MTWThF 1:15
C23. 5 units, spring, (Hanan), MTWThF 1:15

C25. Intensive Second-Year Modern Chinese—Equivalent to C21, C22, C23 combined. Prerequisites: C3 or equivalent and consent of instructor necessary.
15 units, summer, (———), MTWThF 8-12

C31, C32, C33. Intermediate Conversation—Prerequisite: C3 or equivalent.
C31. 2 units, autumn, (———), TTh 11
C32. 2 units, winter, (———), TTh 11
C33. 2 units, spring, (———), TTh 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.
C41. 10 units, autumn, (Kao, ———), MTWThF 9 and 1:15
C42. 10 units, winter, (Kao, ———), MTWThF 9 and 1:15
C43. 10 units, spring, (Kao, Hanan, ———), MTWThF 9 and 1:15
### Advanced

C101, C102, C103. **Introduction to Classical Chinese**—Reading, syntax, composition. Prerequisite: C23 or equivalent.
- **C101.** 5 units, autumn, (Nivison), MTWThF 1:15
- **C102.** 5 units, winter, (Watson), MTWThF 1:15
- **C103.** 5 units, spring, (Watson), MTWThF 1:15

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.
- **C121.** 2 units, autumn, (Kao), TTh 11
- **C122.** 2 units, winter, (Kao), TTh 11
- **C123.** 2 units, spring, (Kao), TTh 11

C131, C132, C133. **Modern Expository Chinese**—Newspapers, documents. Prerequisites: For C131, C23 or equivalent; for C132 and C133, C131 and C101 or equivalent.
- **C131.** 3 units, autumn, (Chan), MWF 2:15
- **C132.** 3 units, winter, (Chan), MWF 2:15
- **C133.** 3 units, spring, (Chan), MWF 2:15

C135. **Modern Expository Chinese**—Newspapers, documents. Prerequisite: C23 or equivalent.
- 15 units, summer, (——), MTWThF 9–12

C162. **History of Chinese Literature: Ancient to T'ang Period**—Lectures and discussion. Prerequisite: C23 or equivalent.
- 3 units, winter, (Watson), MWF 10

C163. **History of Chinese Literature: Sung Period to the Present**—Lectures and discussion. Prerequisite: C23 or equivalent.
- 3 units, spring, (Hanan), MWF 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.
- **C221.** 3 units, autumn, (Dien), M 2:15–4:05
- **C222.** 3 units, winter, (Dien), M 2:15–4:05

C251, C252. **Chinese Philosophical Texts.**
- **C251.** 4 units, winter, (Nivison), WF 2:15–4:05
- **C252.** 4 units, spring, (Nivison), WF 2:15–4:05

C254, 255. **Chinese Historical Texts.**
- **C254.** 4 units, winter, (Dien), by arrangement
- **C255.** 4 units, spring, (Dien), by arrangement

C257. **Fiction and Essays in Classical Chinese.**
- 4 units, spring, (Watson), by arrangement

C261, C262. **Chinese Poetry.**
- **C261.** 4 units, autumn, (Watson), WF 2:15–4:05
- **C262.** 4 units, winter, (Watson), by arrangement

C271, C272. **Vernacular Chinese Fiction.**
- **C271.** 4 units, winter, (Hanan), TTh 2:15–4:05
- **C272.** 4 units, spring, (Hanan), by arrangement

C274. **Chinese Drama.**
- 4 units, spring, (Hanan), by arrangement

C281, C282. **Modern Chinese Literature.**
- **C281.** 4 units, autumn, (Chan), TTh 2:15–4:05
- **C282.** 4 units, winter, (Chan), TTh 2:15–4:05
C291. **History of the Chinese Language**—Lectures and discussion. Prerequisite: C103 or equivalent.
4 units, spring, (Dien), MW 2:15-4:05

C299. **Translation.**
A total of 5 units, which may be taken in one or more quarters, autumn, winter, spring, (Staff), by arrangement

C321. **Seminar**—May be repeated for credit.
5 units, autumn, (Hanan), M 2:15-4:05

C361. **Seminar in Chinese Literary Criticism**—May be repeated for credit.
5 units, spring, (Watson), T 2:15-4:05

C399. **Dissertation.**
By arrangement, (Staff)

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**II. COURSES IN JAPANESE**

#J1, J2, J3. **First-Year Modern Japanese**—Conversation, grammar, reading, elementary composition.
- J1. 5 units, autumn, (——), MTWThF 9
- J2. 5 units, winter, (——), MTWThF 9
- J3. 5 units, spring, (——), MTWThF 9

J5. **Intensive First-Year Modern Japanese**—Equivalent to J1, J2, J3 combined. Prerequisite: consent of instructor.
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.
- J21. 5 units, autumn, (——), MTWThF 1:15
- J22. 5 units, winter, (——), MTWThF 1:15
- J23. 5 units, spring, (——), MTWThF 1:15

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.
- J31. 2 units, autumn, (——), TTh 11
- J32. 2 units, winter, (——), TTh 11
- J33. 2 units, spring, (——), 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.
- J41. 10 units, autumn, (——), MTWThF 9 and 1:15
- J42. 10 units, winter, (——), MTWThF 9 and 1:15
- J43. 10 units, spring, (——), MTWThF 9 and 1:15

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**ADVANCED**

J101, J102, J103. **Modern Written Japanese**—Reading texts representative of various modern written styles. Prerequisite: J23 or equivalent.
- J101. 5 units, autumn, (McCullough), MTWThF 10
- J102. 5 units, winter, (McCullough), MTWThF 10
- J103. 5 units, spring, (Brower), 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.
J121. 2 units, autumn, (——), T 2:15-4:05
J122. 2 units, winter, (——), T 2:15-4:05
J123. 2 units, spring, (——), T 2:15-4:05

J131, J132, J133. Readings in the Social Sciences—The reading of modern Japanese writings in history and the social sciences.
J131. 3 units, autumn, (McCullough), MWF 9
J132. 3 units, winter, (Seidensticker), MWF 9
J133. 3 units, spring, (Seidensticker), MWF 9

J135. Readings in the Social Sciences. Prerequisite: J23 or equivalent.
15 units, summer, (——), MTWThF 9-12

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.
J221. 3 units, autumn, (McCullough), M 2:15-4:05
J222. 3 units, winter, (McCullough), M 2:15-4:05

J231. 4 units, autumn, (Seidensticker), WF 2:15-4:05
J232. 4 units, winter, (Seidensticker), WF 2:15-4:05
J233. 4 units, spring, (Seidensticker), by arrangement

J241. 4 units, autumn, (Brower), TTh 2:15-4:05
J242. 4 units, winter, (Brower), TTh 2:15-4:05
J243. 4 units, spring, (McCullough), TTh 2:15-4:05

4 units, spring, (McCullough), by arrangement

J261. 4 units, autumn, (Brower), by arrangement
J262. 4 units, winter, (Brower), by arrangement

J291. History of the Japanese Language—Prerequisite: J103 or equivalent.
4 units, to be given in 1966-67

J299. Translation.
A total of 5 units, which may be taken in one or more quarters, autumn, winter, spring, (Staff), by arrangement

J321. Seminar—May be repeated for credit.
5 units, autumn, (Seidensticker), by arrangement

J361. Seminar in Japanese Literary Criticism—May be repeated for credit.
5 units, spring, (Brower), M 2:15-4:05

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, Economics, Geography, Graduate Division Special Programs, History, Hoover Institution, Humanities (Special Programs), Philosophy, Political Science, Senior Colloquia, Social Sciences (Special Program).
BEHAVIORAL SCIENCES (HONORS PROGRAM in QUANTITATIVE METHODS)

Committee in Charge: Patrick Suppes (Chairman), Kenneth J. Arrow, Gordon Bower, Bernard P. Cohen, Herbert Solomon

GENERAL STATEMENT OF PURPOSE

The Honors Program in Quantitative Methods is designed to supplement the curricula of able students in the behavioral sciences with an integrated program of quantitatively oriented work. It is intended that students participating in the Program will acquire a firm mastery of certain mathematical tools and also become familiar with substantive theoretical developments in the behavioral sciences which require mathematical methods.

ADMISSION TO THE PROGRAM

A University average of B is required for admission to, and continuation in, the Program. Because many of the courses require specific mathematical background, candidates are urged to apply for admission not later than their sophomore year. Any member of the Committee may be consulted on admission. Information may also be obtained from the Program's secretary in Ventura Hall.

REQUIREMENTS OF THE PROGRAM

1. The Honors Program supplements rather than replaces a regular departmental major. Consequently a major in one of the following seven participating departments is required: Communication, Economics, Mathematics, Philosophy, Psychology, Sociology, and Statistics. It is possible to combine this Honors Program with departmental honors programs.

2. The following required courses totaling approximately 45 units in addition to the elementary calculus sequence are listed according to the year in which it is recommended they be taken. Students majoring in mathematics or statistics will be required to take a somewhat different list of courses.

FIRST YEAR

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 41, 62, 63. Differential and integral calculus</td>
<td>5, 5, 5</td>
<td></td>
</tr>
<tr>
<td>(The sequences 41, 42, 43, or 10, 11, 21, 22, 23 are also acceptable.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philosophy 3: Introduction to Logic</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

SECOND YEAR

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 64. Partial derivatives, multiple integrals, infinite series</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Course in Matrix Theory</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Statistics 50, Psychology 60, or Economics 7</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

THIRD YEAR

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistics 116. Theory of Probability</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Statistics 119. Statistical Inference</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Statistics 206, 207. Mathematical models in the Behavioral Sciences</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
FOURTH YEAR

Psychology 104, or Behavioral Sciences 199. Senior Thesis in Quantitative Methods ........................................... 5
Three of the following: .................................................. 9
   Economics 272. Econometrics I
   Mathematics 115. Fundamental Concepts of Analysis
   Mathematics 116. Fundamental Concepts of Analysis
   Mathematics 120. Modern Algebra
   Mathematics 130. Ordinary Differential Equations
   Mathematics 131. Partial Differential Equations I
   Mathematics 132. Partial Differential Equations II
   Mathematics 137. Numerical Analysis
   Philosophy 161. Introduction to Set Theory
   Statistics 217a. Introduction to Stochastic Processes
   Statistics 217b. Introduction to Stochastic Processes
   Statistics 221. Analysis of Variance

3. The Senior Thesis will be written under supervision of a designated faculty adviser. It may properly be concerned with empirical or experimental problems whose investigation requires use of mathematical techniques. The Thesis may be written as part of a Departmental Honors Program.

4. Each student will be required to take three courses designated by the department in which he is majoring. In general these three courses will exemplify the application of mathematics to the student’s major subject.

COURSE

199. Senior Thesis in Quantitative Methods.
   1 to 5 units, each quarter, (Staff), by arrangement

BIOLOGICAL SCIENCES


Executive Head: Donald Kennedy
Assistant Professors: Peter H. Raven, Norman K. Wessells, Dow Woodward
Instructor: Charles H. Baxter
Lecturers: Walter C. Brown, Laurence M. Klauber, Alan E. Leviton, Oswald H. Robertson, Oscar E. Sette, John H. Thomas
Research Biologists: Isabella A. Abbott, Dorothy Newmeyer, Virginia M. Page

ORGANIZATION

The Department of Biological Sciences comprises facilities and personnel 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 Executive Head 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 degree of Bachelor of Arts must complete: (1) a group of specified core courses in biology or their equivalents, and (2) sufficient units of elective courses in the biological sciences or closely related fields to make, when added to the units taken in the core curriculum, a total of 40 units. Elective courses may be selected from the offerings in the Department of Biological Sciences or from a list of courses in other departments (see Note 1 below). Students are expected to decide upon, in consultation with their Departmental adviser, a program of specialization in biology and to select elective courses which fit meaningfully into this program. Courses included under “1” and “2” must be completed with an average grade of not less than C.

**Required Core Courses in Biology**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 10</td>
<td>Fundamentals of Biology</td>
<td>5</td>
</tr>
<tr>
<td>Biology 11</td>
<td>Plants as Organisms</td>
<td></td>
</tr>
<tr>
<td>Biology 12</td>
<td>Animals as Organisms</td>
<td></td>
</tr>
<tr>
<td>Biology 113</td>
<td>Molecular Biology</td>
<td>3 or 5</td>
</tr>
<tr>
<td>Biology 114</td>
<td>Cell Physiology</td>
<td>5</td>
</tr>
<tr>
<td>Biology 115</td>
<td>Population Biology</td>
<td>3</td>
</tr>
</tbody>
</table>

Students majoring in Biological Sciences will ordinarily take Biology 10 during their sophomore year after having completed Chemistry 1, 2, and 3 during their freshman year.

**Required Courses in Cognate Fields**

A year (three quarters) of General Chemistry
A half year (two quarters) of Organic Chemistry
A year (three quarters) of General Physics
Mathematics through Calculus

It is expected that many students will meet a portion of these requirements by advanced placement on the basis of their high school education. The following Stanford courses fulfill these requirements: Chemistry 1, 2, and 3; Chemistry 121 and 123, or 120; Physics 21, 23, and 29; and Mathematics 10, 11, 21, 22, and 23, or 41, 42, and 43. It is strongly recommended that students majoring in the Department of Biological Sciences complete one year of a modern European language, preferably German.

**Typical Schedule for a Four-Year Minimum Program**

**FIRST YEAR**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem. 1, 2, 3</td>
<td>General Chemistry</td>
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<td>English 1, 2, 3</td>
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### BIOLOGICAL SCIENCES

#### HISTORY
- History 1, 2, 3. Western Civilization .......... 4 4 4
- Math. 10, 11, 21. Analytic Geometry and Calculus ... 3 3 3
- Group Activities .................................. 0 0 0

**Totals ........................................... 14 14 15**

#### SECOND YEAR

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<tr>
<th>Course No.</th>
<th>Subject</th>
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<tr>
<td>Biology 10. Fundamentals of Biology ..........</td>
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<td>Biology 11. Plants as Organisms ..........</td>
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<td>Biology 12. Animals as Organisms ..........</td>
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<td>Chem. 121, 123. Organic Chemistry ..........</td>
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<td>Math. 22, 23. Analytic Geometry and Calculus ...</td>
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<td>German 1, 2, 3. Introductory German ..........</td>
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<td>Social Science ................................</td>
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<td>Electives <em>(Note 1)</em> ......................</td>
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**Totals ........................................... 15 15 17**

#### THIRD YEAR

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<td>Biology 114. Cell Physiology ..........</td>
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<td>Biology 115. Population Biology ..........</td>
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<td>Physics 21, 23, 29. Introductory Physics ...</td>
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<td>Humanities ................................</td>
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<td>Social Science ..........................</td>
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**Totals ........................................... 16 16 14**

#### FOURTH YEAR

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**Totals ........................................... 15 15 15**

*Note 1—Elective courses may be chosen from those offered by the Department of Biological Sciences or by other departments of the University. Courses offered by other departments which may be of interest to biology majors include: Geology 2, 112, 113, 114; Anatomy 112, 121, 122, 209; Biophysics 200, 220; Obstetrics and Gynecology 401; Pathology 210; Biochemistry 101-102, 102a, 211; Genetics 201, 301, 306; Medical Microbiology 101; Physiology 101, 102, 203, 208; 90-91 (for Secondary Credential Candidates with Life Science Major only); Pharmacology 213; Psychology 148.*

### Senior Honors Program

(See Biology 198 under “Courses.”) This program is open to students of superior scholarship (overall grade average of B or better) or of outstanding interest and ability in biology. The aim of the program is to aid superior students in gaining greater in-
dependence of thought and a more professional approach to biological problems. Emphasis will be placed on the importance of original ideas in research rather than on the mastery of established facts. Satisfactory completion of the program will lead to graduation "With Departmental Honors."

Premedical Students

It is recommended that premedical students who are not biology majors take at least the following courses in biology: 10, 11, 12, and 116. For specific requirements of various medical schools, consult departmental advisers.

Predental Students

The Council on Dental Education has fixed as the minimum basis for admission to an approved dental school the successful completion of two full academic years of work in an accredited college of liberal arts and science. The college course must include at least a year's credit in English, in biology, in physics, and in inorganic chemistry, and a half-year's credit in organic chemistry. All courses in science should include both class and laboratory instruction.

The predental requirement in biology may be fulfilled by taking either Biology 1, 2, and 3, or Biology 10, 11, and 12.

The Teacher's Recommendation

Programs are provided for candidates seeking either (a) the Standard Teaching Credential (Secondary) with a teaching major or a teaching minor in biology, or (b) the Junior College Credential. Candidates holding the A.B. degree may satisfy the requirements for a General Secondary Credential by completing approved courses of study in biology and education in a minimum of three quarters of graduate study. Candidates who hold the degree of Master of Arts or Doctor of Philosophy may qualify for a Junior College Credential in Biological Sciences with a teaching major or minor in biological sciences, botany, or zoology. In satisfying the requirements for a teaching credential the candidate may offer units transferred from other institutions, but at least one course of advanced character should be taken in this Department. For the details of these programs the prospective candidate should consult the statement on credentials in the section "School of Education" in this Bulletin, his adviser in the Department of Biological Sciences, and the Credential Secretary in the School of Education.

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

Advanced Study and Research

Advanced courses and research are offered to qualified students in the various biological disciplines represented on the campus and at the Hopkins Marine Station by members of the Departmental faculty. Information concerning these research areas, and facilities and financial aid available to graduate students, will be found in the brochure, Graduate Study in the Biological Sciences at Stanford University (available upon request to the Executive Head of the Department).

It should be noted that graduate programs in specialized areas of biology are offered in other departments on the campus, e.g., Genetics, Physiology, Medical Microbiology, Pharmacology, etc. Students interested in these areas should contact the appropriate department, or should specify that their inquiries or applications to this Department may be routed to others if desirable.
All applications for admission to graduate status in Biological Sciences will be acted upon at one time each year, during March, for admission in September (or June). Applications and supporting materials are due in the Admissions Office not later than March 1.

**Advanced Degrees**

A student who has fulfilled the requirements for the degree of Bachelor of Arts, or their approximate equivalent as determined by the Department, may apply for admission to the Graduate Division. An applicant must file a report of his scores (aptitude and advanced biology) on the **Graduate Record Examination** as part of his application. This examination may be taken at most American colleges (see your Registrar for further information).

Before admission to candidacy for an advanced degree a prospective candidate must conform to the regulations of the Department as stated below and of the University as outlined in the section “Degrees” in this Bulletin.

Students who have had their undergraduate training in biology at Stanford are ordinarily encouraged to undertake graduate study elsewhere to insure breadth of experience. If a Stanford undergraduate does wish to seek readmission as a graduate student in Biological Sciences, he should provide the Department with the same completed application forms, recommendations, and transcripts that are required of applicants from outside the University. Printed information regarding choice of a graduate school can be obtained from the Departmental secretary.

**Doctor of Philosophy**

*Preparation for graduate study*—It is expected that students seeking entrance to graduate study in biology ordinarily will have the equivalent of an undergraduate major in biology at Stanford (see above). It is recognized, however, that students trained in zoology or botany departments, or who may wish to concentrate on biological problems after undergraduate training in another science, may require special consideration. Such students will be advised at the time of initial registration as to how they should complete their background training during the first year of graduate study. In addition to the usual basic undergraduate courses in Biology, it is recommended that wherever possible preparation for graduate work include courses in chemistry through organic chemistry, general physics, mathematics through calculus, and foreign languages (preferably German and French, at least 2 years).

The Master’s degree is not required in order to proceed for a doctorate, although it may be recommended in specific cases.

*Courses required of all Ph.D. candidates*—Beyond the background requirement stipulated above, each student must take in graduate standing at Stanford: (a) A minimum of 15 units of advanced biology courses (beyond Biology 115 and exclusive of special problems and research courses) of which 10 units should be in areas other than the field of specialization and fields closely allied to it; (b) Specific course training in the field of specialization, determined in each individual case by the needs of the student, in consultation with his research adviser and sponsor.

The **Ph.D. Qualifying Examination**—Before being recommended for admission to candidacy for the degree of Doctor of Philosophy, the prospective candidate will be required to pass a qualifying examination, normally during the fourth quarter of registration as a graduate student. The qualifying examination is given once a year near the end of the autumn quarter. The status of the student remains probationary until this examination is completed, at which time his eligibility to continue work toward the Ph.D. degree is determined on the basis of his total academic performance during the first four quarters of graduate study.

**Graduate Seminars**, devoted to the discussion of current literature and research in particular fields of biology, are an important means of attaining professional perspective and competence.
Language Examinations—Proficiency in reading scientific literature in two foreign languages, normally German and French. The reading examinations must be taken by the end of the second year of residence.

Dissertation—"A contribution to knowledge and the result of independent work, expressed in satisfactory form." Abstracts of Ph.D. theses are published in Dissertation Abstracts.

The Oral Examination—Normally a three-hour examination, taken when the dissertation is at or near completion, the oral examination is conducted by a committee composed of members of the Department and others appointed by the Chairman of the University Committee on the Graduate Division. A candidate is expected to demonstrate a knowledge of the factual basis and theoretical implications of his thesis and an adequate mastery of his field of research. He must also show a grasp of the fundamental principles of biology and be able to show how these apply to his field of specialization. More detailed information concerning the oral examination and thesis will be found in the section "Degrees" in this Bulletin. Additional information and a suggested schedule for completion of requirements may be obtained from the secretary of the Department.

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

Students are not normally admitted to the Department for a terminal Master of Arts degree in the Biological Sciences. Students who wish to qualify for this degree will be informed of the requirements on request to the Executive Head of the Department.

COMBINED SCHOLARSHIP AND TEACHING ASSISTANTSHIP PROGRAM

Qualified graduate students who wish to combine graduate study with part-time teaching may apply for a teaching assistantship carrying a stipend of $2,100 annually plus a tax-free grant to cover the cost of tuition and fees for the half-time course load a teaching assistant may carry. Scholarships of approximately $300 to $500 will also be available as awards to a limited number of teaching assistants in addition to the stipend and tuition grant.

All prospective Ph.D. candidates, regardless of the source of their financial support, will be expected to gain teaching experience as an integral part of their graduate training. Before completing his degree, each student may be called upon to assist part-time in laboratory instruction for 2 or 3 academic quarters.

The Department of Biological Sciences makes the majority of the teaching assistantship awards on or before April 1 for the coming year, and for these awards, and for half-tuition scholarships to accompany them, application forms (Application for Fellowship, Scholarship, or Assistantship) should be submitted to the Office of Admissions not later than March 1. However, assistantships occasionally become vacant at other times of the year, and graduate students who desire to be considered for such vacancies may apply at a later date by completing the regular forms and in addition addressing a letter of application to the Executive Head of the Department.

Predoctoral Fellowships—Qualified applicants are urged to take the initiative in applying for predoctoral fellowships from the National Science Foundation and the U.S. Public Health Service (Forms and information: National Science Foundation Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D.C. Deadline: Early January. Research Fellowships Branch, Di-
vision of Research Grants, National Institutes of Health, Bethesda 14, Maryland. No
deadline, but 3 to 4 months required between application and decision). These at-
tractive 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 as-
sistantship 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 institu-
tions, and are announced in the weekly University calendar. Students are urged to
attend.

COURSES

The letter h following a number indicates that the course is given at the Hopkins
Marine Station.

#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 11 and subsequent courses leading to fulfillment of degree
or premedical requirements. Lectures, laboratory, demonstrations. Enrollment only
by signing class lists.

1. 3 units, autumn, (Regnery, Baxter), WF 11; lab. (I) T 9–12, (II) T 2:15–5:05,
2. 3 units, winter, (Kennedy, Baxter), WF 11; lab. (I) T 9–12, (II) T 2:15–5:05,
3. 3 units, spring, (Regnery, Baxter), WF 11; lab. (I) T 9–12, (II) T 2:15–5:05,

10. Fundamentals of Biology—A concentrated introduction to biology for those
    intending to major in the subject and to take Biology 11–115. Emphasis on funda-
    mental facts, concepts and questions which underlie later more detailed considera-
    tion in the core curriculum. Readings, lectures, and discussion-demonstrations. Prerequi-
    sites: Chemistry 1, 2, and 3.

   5 units, autumn, (Staff), TWThF 9 Demonstrations (I) M 1:15–3:05, (II) M
   F 3:15–5:05

11. Plants as Organisms—Structure and functions of plants at the organism level.
    Prerequisite: 10.

   5 units, winter, (Page), MWF 8; lab. (I) TTh 9–12, (II) TTh 2:15–5:05, (III)
   W 2:15–5:05

12. Animals as Organisms—Basic functions of organisms as carried on by animals.
    Prerequisite: 11.

   5 units, spring, (Oliphant, Kennedy), MWF 9; lab. (I) TTh 1:15–4:05, (II) WF
   1:15–4:05

100h. Marine Algae—Lectures, laboratory, field work on various classes of algae.
    Open to elementary students.

   5 units, summer (first term), (———), TWThS

101h. Natural History of Marine Animals—Lectures, laboratory, field work
    stressing adaptive adjustments of marine animals. Prerequisite: general biology or
    zoology (or concurrent registration in 111h).

   5 units, summer (first term), (———), MWF
103. Comparative Histology—Microscopic structure of animal tissues; special reference to vertebrates. Prerequisite: 12.

3 units, autumn, (Oliphant), TTh 10; lab. Th 1:15-4:05

105. Immunobiology—Principles of immunology as related to certain problems in biology.

2 units, winter, (Regnery), TTh 10, alternate years, to be given in 1966-67

111h. Marine Invertebrates—Structure, classification, biology, phylogeny of lower marine invertebrates, echinoderms, protochordates. Prerequisite: an elementary zoology course.

5 units, summer (first term), (Abbott), TThS

112h. Marine Invertebrates—Continuation of 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 111h.

5 units, summer (second term), (Abbott), TThS

113a. Molecular Biology—The synthesis, function, interactions of the various molecular components of cells with emphasis on molecular genetics. Prerequisites: 10 and Organic Chemistry.

3 units, autumn, (Woodward), MWF 10

113b. Molecular Biology Laboratory—By permission.

2 units, autumn, (Woodward), TTh 2:15-5:05


5 units, winter, (Giese), MWF 9; lab. (I) TTh 1:15-4:05, (II) W 1:15-4:05

115. Population Biology—Introduction to the properties of aggregations of organisms. Prerequisite: 114.

3 units, spring, (Holm, Ehrlich, Raven), MWF 11

116. Biology of Vertebrates—Structure, function, development, evolution of vertebrates. Prerequisites: 10, 11, and 12.

5 units, autumn, (Wessells), MWF 9; lab. (I) TTh 8-11, (II) TTh 1:15-4:05

124. Comparative Parasitology: Protozoa, Helminths—Principal attention to forms parasitic in man, animals, plants of importance in human economy.

4 units, winter, (Oliphant), TTh 10; lab. TTh 1:15-4:05

128. Classification of Flowering Plants—Lectures, laboratory, field studies. Prerequisite: 11.

4 units, spring, (Thomas), W 2:15-5:05; field trips on alternate Saturdays, by arrangement

129. Fungi—Prerequisite: 11.

4 units, spring, (Page), TTh 9; lab. TTh 10-12 and two hours by arrangement

130. The Plant Kingdom: Algae and Fungi—Structure, development, evolutionary relationships of algae, fungi. Lectures, laboratory, field trips. Prerequisite: 11.

4 units, autumn, (Page), TTh 1; lab. TTh 2:15-5:05

131. The Plant Kingdom: Mosses and Ferns—Structure, development, evolutionary relationships of liverworts, mosses, the seedless vascular plants. Lectures, laboratory, field trips. Prerequisite: 11.

4 units, winter, (Briggs), TTh 11; lab. TTh 2:15-5:05

136h. General Ichthyology—Fishes, including elements of morphology, taxonomy, embryology, natural history. Prerequisite: 12.

5 units, summer (second term), (——), MWF

139. Herpetology I—Lecture, laboratory, field survey of living amphibians, with a synoptic history of herpetology. By permission.

3 units, winter, (Leziton, Myers), TTh 11; lab. W 1:15-4:05

140. Herpetology II—Lecture, laboratory, field survey of living reptiles. By permission.

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


3 units, spring, (Twitty), TTh 10
145. **Laboratory Techniques in Embryology**—Application of microsurgical, chemical, tissue culture procedures to developmental problems. Prerequisites: 116 and permission of instructor.

3 units, winter, (Wessells), TTh 1:15–5:05

150. **Evolution**—A synthesis of current evolutionary thought with emphasis on processes. Prerequisite: a course in general biology. No credit will be given for 150 following 115.

3 units, winter, (Ehrlich, Holm, Raven), MWF 11, to be given in 1966–67

151. **Evolutionary Genetics**—Application of genetics to study of evolution.

2 units, winter, (Regnery), TTh, alternate years, to be given in 1965–66

153. **The Physiological Basis of Behavior**—Properties of neurons and synapses and their relation to integrative processes; sense organs as transducers; information processing in sensory systems; organization of reflexes and the neural analysis of more complex behavior. Prerequisite: 12.

3 units, winter, (Kennedy, ), MWF 8

154. **Animal Behavior**—Behavior seen in single animals and in groups of animals; feeding, locomotion, spontaneous behavior; group behavior will consider migration, orientation, hunting, communication, social behavior. Can be taken for 3 units with instructor’s permission. Prerequisites: 12, preferably also 153.

4 units, spring, ( ), MWF 10

155. **General Ecology**—Environmental-biological interrelationships; concepts of populations, communities, energy levels, utilization and conservation of resources by man. Prerequisites: 11 and 12.

3 units, winter, (Wohlschlag), MWF 8

156. **Introductory Plant Physiology**—Principal functions of organs of higher plants; growth, mineral nutrition, water relations, movement of materials, respiration, nitrogen relations, photosynthesis. Prerequisite: 114.

5 units, spring, (Briggs), MWF 9; lab. WF 2:15–5:05

160. **Advanced Population Biology**—Interactions of individuals and populations. Prerequisite: 115.

3 units, autumn, (Raven, Ehrlich, Holm), MWF 11

170. **Readings in Paleobotany**—Structure, evolutionary relationships of fossil plants. Prerequisites: 11, 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 1965–66

175. **Problems in Marine Biology**—Field studies, laboratory, lectures, individual problems in marine biology. Designed primarily for undergraduates. Students will be in residence at the Hopkins Marine Station during the entire quarter. Prerequisites: 11 and 12; and Chemistry 1, 2, and 3; and permission of the instructors.

15 units, spring, (Abbott, Phillips), TWThFS

176. **Limnology**—Ecology of fresh waters. Lectures, laboratories, field trips. Prerequisite: 155.

4 units, spring, (Wohlschlag), TTh 9; lab. WF 2:15–5:05, alternate years, to be given in 1966–67


4 units, autumn, (Ehrlich), by arrangement, to be given in 1966–67

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. Prerequisite: Statistics 50 or equivalent, or permission of instructor.

4 units, spring, (Wohlschlag), TTh 1:15; lab. TTh 2:15–5:05, alternate years, to be given in 1965–66

198. **Senior Honors Program**—Readings or research in some phase of biology of
especial interest to the individual. Satisfactory completion leads to Departmental
recommendation for graduation with honors in biology. Open only to seniors (or
students in the last quarter of their junior year) who have maintained an overall
average grade of B or better. Not more than six units of honors work may be applied
toward the units of electives required for graduation in biology.

(Staff), by arrangement

199. Special Problems.
(Staff), by arrangement

199h. Special Problems.
(Hopkins Marine Station Staff), by arrangement

212. Evolution of the Flowering Plants—Phylogenetic relationships of angio-
sperm families. Prerequisites: 128, and permission of instructor.
3 units, winter, (Raven), MWF 10, alternate years, to be given in 1965–66

215. Biosystematics—Current methods of approach to systematic problems in
higher plants. Prerequisites: 11, and permission of the instructor.
4 units, spring, (Raven), by arrangement, alternate years, to be given in 1966–67

222h. Biological Oceanography—Intensive lecture, field, and laboratory course
dealing with marine organisms and their environment. The work is done on board
ship in oceanic regions that vary from quarter to quarter. Open only to graduate
students by arrangement with the Chief Scientist through correspondence.
15 units, autumn, winter, spring, 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 1965–66

231. Advanced Systematic Ichthyology II—Continuation of 230.
4 units, winter, (Myers), by arrangement, alternate years, to be given in 1965–66

244. Plant Growth and Development—Morphological, physiological aspects of
plant growth. Prerequisite: 156.
2 units, autumn, (Briggs), TTh 9

247. Advanced Cell Physiology—Discussion of a selected topic. Prerequisite: 114.
By permission. May be repeated for credit.
2 units, autumn, (Giese), M 1:15-3:05

248. Genetic Recombination—Emphasis on meiotic recombination and chromo-
some organization in higher microorganisms. Prerequisite: a knowledge of general
 genetics.
2 units, autumn, (Perkins), M 2:15-4:05

249. Cytogenetics—Principles and modern methods of analysis of major cellular
components. The structure and design of chromosomes from bacteriophages to
higher organisms. The influence of chromosomal changes in development and evolu-
tion. (Same as Genetics 249.) Prerequisites: 1, 2 and 3, or 10, 11 and 12, and a
knowledge of genetics, and permission of instructor.
3 units, autumn, (Ganesan), MWF 10

3 units, spring, (Yanofsky), T 10–12

260. Topics in Population Biology—Readings and discussions on research of cur-
rent or special interest. Prerequisites: 115 and 160 and permission of instructors.
May be repeated for credit.
1 unit, (Ehrlich, Holm, Raven), by arrangement

261h. Comparative Biochemistry of Marine Organisms—Prerequisites: ele-
mentary biology and organic chemistry.
5 units, summer (first term), (Phillips), MWF

262h. Comparative Biochemistry of Marine Organisms—Continuation of 261h.
5 units, summer (second term), (Phillips), MWF
269h. Ecological Physiology—Physiological responses of animals to variation in environmental factors and to organisms. Most work will deal with marine invertebrates. Prerequisites: general zoology and elementary chemistry.

5 units, summer (first term), (Giese), TThS


3 units, spring, (Ehrlich), by arrangement, to be given in 1966-67

300. Research.
(Staff), by arrangement

300h. Research.
(Hopkins Marine Station Staff), by arrangement

350. Graduate Seminars.
(Staff), by arrangement

See also Senior Colloquia.

DIVISION OF MARINE BIOLOGY AND OCEANOGRAPHY
HOPKINS MARINE STATION

Emeriti: Lawrence R. Blinks, Cornelis B. van Neil (Professors)

Director: To be announced
Associate Director: Rolf Ling Bolin
Assistant Director: Donald Putnam Abbott
Professors: Donald Putnam Abbott, Rolf Ling Bolin, Arthur Charles Giese
Associate Professor: John Howell Phillips, Jr.
Research Biologist: 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, Phillips), TWThFS

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, spring, 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.
(Statt)

Marine Fishes—Morphology, taxonomy, embryology, ecology of marine fishes.
(Abbott)

Physiology—Problems on physiology of invertebrate animals; photobiology, especially effects of ultraviolet light.
(Bolin)

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, (———), TThS

101h. Natural History of Marine Animals.
5 units, (———), MWF

111h. Marine Invertebrates.
5 units, (Abbott), TThS

199h. Special Problems—(See autumn, winter, spring quarters, above.)
(Staff), by arrangement

222h. Biological Oceanography—(See above.)

261h. Comparative Biochemistry of Marine Organisms.
5 units, (Phillips), MWF

269h. Ecological Physiology.
5 units, (Giese), TThS

300h. Research—(See autumn, winter, spring quarters, above.)
(Staff), by arrangement

Second Term

112h. Marine Invertebrates—Continuation of 111h.
5 units, (Abbott), TThS
BIological SCIENCES

136h. General Ichthyology.
  5 units, (Staff), MWF

199h. Special Problems—(See under First Term.)
  (Staff), by arrangement

222h. Biological Oceanography—(See above.)

262h. Comparative Biochemistry of Marine Organisms (continued).
  5 units, (Phillips), MWF

300h. Research—(See under First Term.)
  (Staff), by arrangement

DIVISION OF SYSTEMATIC BIOLOGY

Emeriti: Roxana S. Ferris (Curator), Willis H. Rich, Ira L. Wiggins (Professors)

Director: Richard W. Holm
Professors: Richard W. Holm, George S. Myers
Associate Professor: Paul R. Ehrlich
Assistant Professor: Peter H. Raven
Lecturers: Laurence M. Klauber, Alan E. Leviton, John H. Thomas
Curators: Paul R. Ehrlich (Entomological Collections), George S. Myers (Zoological Collections), John H. Thomas (Dudley Herbarium)
Research Associates: S. Stillman Berry (Malacology), Walter C. Brown (Herpetology), Warren C. Freihofner (Ichthyology)

The Division of Systematic Biology has for its general purpose the maintenance of provisions (1) for proper housing and care of the systematic collections of animals and plants, and (2) for instruction, investigation, and research in systematics, geographical distribution, and ecology. It is housed in the west wing of the Museum Building, where instruction and research utilizing the collections are conducted. Facilities are available for a limited number of graduate students and qualified investigators to carry forward research programs.

Advanced courses and research leading to the degree of Doctor of Philosophy, in compliance with University and Department of Biological Sciences requirements, are offered in the following fields: (a) botany (morphology, distribution, and taxonomy of vascular plants); (b) zoology (ichthyology and herpetology, including taxonomy, morphology, ecology, and distribution); and (c) population biology.

Dudley Herbarium

The Dudley Herbarium, named in honor of Professor William Russel Dudley, is especially rich in material from western North America and offers unusual facilities for critical systematic and distributional studies of the floras of that region. The Harvey Herbarium comprising about 65,000 sheets, and the herbarium of the late Dr. Herman Knoche, containing over 125,000 sheets, furnish authentic material from Europe and the Mediterranean region. They contain many historical, frequently cited specimens and are of great value to investigators studying plants recently introduced into North America or those closely related to Old World species. The collections of cryptogamic and phanerogamic plants in the Dudley Herbarium now number about 700,000 sheets.

Entomological Collections

The entomological collections are restricted to those being used in particular research projects. No general collections are maintained except for teaching purposes.

Zoological Collections

The collection of fishes is one of the largest and most important in the world, its basis being the material collected by Dr. David Starr Jordan, his associates, and his
students. The marine and fresh water fishes of both eastern and western North America, the West Indies, Central America, Japan, eastern China, the Philippines, the Malay Peninsula, Hawaii, and Polynesia are well represented. In addition, there are large bathyal collections from the North Pacific and other parts of the world, as well as extensive series of fishes of Peru, Colombia, the Galapagos Islands, Venezuela, British Guiana, the Amazon, Cameroon, South and East Africa, India, the Malay Archipelago, and Australia.

The herpetological collections contain an extensive representation of the amphibians and reptiles of the West and considerable material from southeastern Asia and tropical America.

CHEMISTRY*

Emeriti: Philip Albert Leighton, James Murray Luck, John Pearce Mitchell, George Sutton Parks (Professors)

Executive Head: William Summer Johnson
Associate Executive Head: Douglas Arvid Skoog
Associate Professors: John D. Baldeschwieler, Frank Ephraim Harris
Assistant Professors: John Brauman, Neil R. Kestner, Victor William Laurie, Robert Pecora, Paul Gravis Simpson
Lecturer: 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 algebra and plane trigonometry). Those who do not have entrance credit or equivalent training in the foregoing subjects, particularly mathematics, may experience some difficulty in meeting the Department requirements for graduation in four years, especially if they expect to pursue a program leading to professional certification to the American Chemical Society or to the B.S. degree with Honors.

Students who have taken the College Board Advanced Placement Examinations in chemistry and receive a composite score of 4 will be excused from Chemistry 1 and 2. Those receiving composite scores of 5 may be excused from Chemistry 3 on the recommendation of the Committee on Undergraduate Study.

PROGRAMS OF STUDY

Minimum Requirements for the Bachelor of Science Degree

General studies requirement; the equivalent of 18 units of German, or 12 units of German and 12 units of either French or Russian; Mathematics 10, 11, 21, 22, 23, or 41, 42, 43; Physics 51, 52, 53, 54, 55, 56, 57; Chemistry 1, 2, 3, 112, 113, 116, 121, 122,

* The curriculum leading to the B.S. degree in Chemical Engineering is described elsewhere in this Bulletin.
123, 124, 125, 171, 173, 175, 176. In addition Chemistry 177 is strongly recommended. Students may petition the Department to substitute Physics 21, 23, 29 for Physics 51-57. All candidates for graduation with chemistry as the major subject are required to have a grade point average of at least 2.00 in their chemistry courses.

American Chemical Society Certification

Students who wish to be certified as having met the minimum requirements of the American Chemical Society for professional training must complete, in addition to the above requirements, Chemistry 126, 177, and 180, and at least three units from one of the following: Chemistry 138, 139, 178, 179, 190; any chemistry course numbered above 200 for which permission to register has been granted by the instructor; Biochemistry 101; or an advanced course in mathematics or physics.

Honors Program

A limited number of undergraduates may be admitted to the Chemistry Honors Program at the beginning of the senior year. Those completing the program satisfactorily will receive the degree of Bachelor of Science in Chemistry with Honors.

To be admitted to the program, the student must have a grade point average of at least 3.00 in all course work in the University and of 3.30 in courses in chemistry, physics, and mathematics. In addition to the minimum requirements for the B.S. degree, the student must complete Chemistry 177, 178 or 179, and nine units of Chemistry 190 to be taken three units per quarter for three quarters; 3 or 4 units from Chemistry 126, 179 or 178, 180, 221, 223, 225, 233, 235, 246, 247, 272; and nine additional units of courses from the above list or from Biochemistry 101, 102, Mathematics 130, 131, 132, physics lecture courses numbered 100 and higher, or other advanced courses approved by the student's adviser and by the supervisor of his work in Chemistry 190.

Students who wish to be admitted to the Honors Program but who do not meet all of the above formal requirements, may petition the Department for admission.

Typical Schedule for Four-Year Minimum Program

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<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>
<td>5</td>
<td></td>
</tr>
<tr>
<td>English 1, 2, 3. Freshman English</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>German G1, G2, G3. First-Year German</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Math. 10, 11, 21. Analytic Geometry and Calculus</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<td>Group Activities</td>
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<td>0</td>
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<td><strong>Totals</strong></td>
<td><strong>14</strong></td>
<td><strong>14</strong></td>
<td><strong>15</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
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<tbody>
<tr>
<td>Chem. 121, 123, 125. Organic Chemistry</td>
<td>3</td>
<td>3</td>
<td>3</td>
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<tr>
<td>Chem. 122, 124. Organic Preparations</td>
<td>—</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>German G22, G23. Second-Year Reading</td>
<td>3</td>
<td>3</td>
<td>—</td>
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</tr>
<tr>
<td>Math. 22, 23. Analytic Geometry and Calculus</td>
<td>3</td>
<td>3</td>
<td>—</td>
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<tr>
<td>Physics 51, 52, 53, 54. Mechanics, Sound, Electricity</td>
<td>—</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Social Science</td>
<td>5</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Electives (Note 1)</td>
<td>—</td>
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<td>Group Activities</td>
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## Third Year

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<tr>
<td>Chem. 112, 113</td>
<td>Quantitative Analysis</td>
<td>5</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Chem. 116</td>
<td>Instrumental Analysis</td>
<td>—</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>Chem. 171, 173, 175</td>
<td>Physical Chemistry</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 176</td>
<td>Physical Chemistry Laboratory</td>
<td>—</td>
<td>—</td>
<td>3</td>
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<tr>
<td>Hist. 1, 2, 3</td>
<td>Western Civilization</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Physics 55, 56, 57</td>
<td>Light, Heat, Atomic Physics</td>
<td>5</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>Social Science</td>
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Electives *(Note 1)*

Totals 17 16 15

## Fourth Year

<table>
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<th>Course No.</th>
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<th>Spring</th>
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<tr>
<td>Humanities</td>
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<tr>
<td>Electives <em>(Note 1)</em></td>
<td></td>
<td>11 11</td>
<td>15 15</td>
<td></td>
</tr>
</tbody>
</table>

Totals 15 15 15

*Note 1*—Elective courses may be chosen from any offered by the Chemistry Department or by other departments of the University. Courses offered by other departments that may be of particular interest to chemistry majors include: Ch.E. 10, 130a, 130b, 150; 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 11, 12, 116; Biochem. 101, 102.

### Teaching Credentials

The requirements for certification to teach chemistry in the secondary schools and junior colleges of California may be ascertained by consulting the section on credentials under "School of Education" in this *Bulletin* and the Credential Secretary of the School of Education.

### Advanced Degrees in Chemistry

#### General Requirements

Qualifying examinations are given 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 do not complete the remaining requirements for an advanced degree within six years after entrance as a graduate student must repeat and pass the qualifying examinations and must meet any other requirements established by the faculty before the degree will be granted.

Candidates for advanced degrees must have a minimum grade point average of 3.00 for all chemistry lecture courses as well as for all courses taken during graduate study. All students are expected to give full time to their graduate work once they have begun research. During the period in which a thesis is being read by members of the staff, candidates must be available for personal consultation until the thesis has had final Departmental approval. In addition to Departmental requirements, candidates for advanced degrees must meet the general University regulations as stated in the section "Degrees" in this *Bulletin*.

#### Qualifying Examinations

For all students other than those majoring in chemical physics, these examinations will consist of four written examinations of two hours duration each in the fields
CHEMISTRY

of analytical, inorganic, organic, and physical chemistry, and will cover such material as ordinarily is given in a rigorous one-year undergraduate course in each of these subjects, except that the examination in physical chemistry will cover only the material described under Chemistry 171, 173, 175, 176. Students 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. Students who fail to pass these examinations in the autumn may be permitted to repeat them during the first week of the winter quarter. In addition to the above requirements, all entering graduate students are required either to pass a qualifying examination based on material covered in Chemistry 177 and 178 or to take these courses. Students majoring in inorganic or physical chemistry or chemical physics are required to pass also a qualifying examination covering the material covered by Chemistry 179 or to take this course. All qualifying examinations will be given during the period September 29–October 2, 1965, and all must be taken at this time. For those students who fail to pass one or more of the examinations, other than those based on Chemistry 177, 178, and 179, and are permitted to repeat them, the examinations will be held again during the period January 4–7, 1966.

Master of Science

All applicants for the degree of Master of Science in Chemistry are required to complete, in addition to the requirements for the Bachelor's degree, a minimum of 39 units of work. Of the 39 units approximately two-thirds must be in the Department and must include at least 12 units of advanced course work in chemistry exclusive of the thesis. Of the 12 units, at least three units must be from Chemistry 221, 223, 225, 233, 235, or 272.

Master of Arts in Teaching (Chemistry)

In cooperation with the School of Education, the Department offers a program leading to a degree, Master of Arts in Teaching (Chemistry). This degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish to strengthen further their academic preparation. Detailed requirements are outlined in this Bulletin under “School of Education, the Master of Arts in Teaching.”

Doctor of Philosophy

The graduate student does not become a formal candidate for the Ph.D. degree until he has passed the Department qualifying examinations and has been admitted to candidacy by the University Committee on the Graduate Division. Doctorate candidates will be considered responsible for an integrated knowledge of their field of specialization, which will not be limited to the content of related advanced courses offered by the Department. Normally they will register for at least 21 units of advanced lecture courses. The foreign language requirement for the Ph.D. in chemistry ordinarily will be met in German and in French or Russian. Proposals to substitute for French or Russian another language or a program of course work will be considered by the Department on petition by the candidate. 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 inorganic chemistry are required to take (1) Chemistry 177, 178, 179, and 180 or qualifying examinations in lieu thereof during the first year, regardless of background; those who fail to make a grade point average of at least 3.00 in these four courses may not become candidates for the Ph.D. degree in inor-
organic chemistry; (2) three units of advanced lecture courses in inorganic chemistry; (3) Chemistry 221 or 223 or 225; (4) six additional units of approved advanced lecture courses.

All students majoring in organic chemistry are required to take (1) a proficiency test in qualitative organic analysis, including the use of certain spectrographic and chromatographic techniques; 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 3.00 in these three courses may not become candidates for the Ph.D. degree in organic chemistry; (3) three units of Chemistry 227; (4) six units of advanced lecture courses outside of the field of organic chemistry. Beginning with the second year of graduate work at Stanford, organic chemistry majors are required to participate in a series of advanced problem sessions.

All students majoring in physical chemistry are required to take (1) Chemistry 177, 178, and 179 (or qualifying examinations in lieu thereof) during the first year, irrespective of background; those who fail to make a grade point average of at least 3.00 in these three courses may not become candidates for the Ph.D. degree in physical chemistry; (2) six units of advanced lecture courses in physical chemistry, chemical physics, or inorganic chemistry; (3) Chemistry 221, or 223, or 225; (4) six additional units of advanced lecture courses outside of the fields of chemical physics, physical chemistry, or inorganic chemistry.

Students majoring in biochemistry are required to take (1) a proficiency test in qualitative organic analysis, including the use of certain spectroscopic and chromatographic techniques; those failing to pass the test will be required to take Chemistry 126; (2) Biochemistry 101 and 102 (eight units) unless an equivalent course in general biochemistry was satisfactorily completed previously; (3) nine units of advanced biochemistry chosen from Chemistry 246, 247, Biochemistry 211, 212, 213, 217, or 218 or allied courses as approved by the Department of Chemistry, and (4) six units of advanced lecture courses outside of the fields of organic, inorganic, or physical chemistry chosen from Chemistry 180, 221, 223, 225, and 272.

In 1963 the Department instituted 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 3.00 or better, at least 12 units of chemistry courses more advanced than those
that meet the minimum requirements for the Bachelor's degree in chemistry. At least 3 units must be from Chemistry 221, 223, 225, 233, 235, or 272.

**FELLOWSHIPS AND SCHOLARSHIPS**

In addition to the University fellowships and scholarships that are open to properly qualified students, there are at present numerous Departmental fellowships in chemistry. The Allied Chemical Corporation Fellowship, Continental Oil Company Fellowship, Dow Chemical Company Fellowship, Edward Curtis Franklin Fellowship, James W. Mc Bain Memorial Fellowship, Stauffer Chemical Company Fellowship, and Frederick P. Whitaker Fellowship are granted only to graduate students. The William H. Nichols Scholarships, David L. and Lavinia E. Sloan Memorial Scholarship, John Mason Stillman Scholarship, and Ephraim and Amelia Weiss Scholarships are open to graduates and undergraduates; the Robert M. and Katherine F. Loscier 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**

*Note—Deposits required in laboratory courses, against which charges are made for breakage, loss of apparatus, chemicals, etc., are from $10 to $30 per quarter.*

### Undergraduate Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Prerequisite</th>
<th>Units</th>
<th>Terms</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1. General Chemistry</td>
<td>Prerequisite: high school algebra or Mathematics B</td>
<td>4</td>
<td>autumn, (Staff), lec. (I) MWF 8, (II) MWF 9, (III) TThS 9; lab. (I) T 9-12, (II) T 2:15-5:05, (III) W 2:15-5:05, (IV) Th 9-12, (V) Th 2:15-5:05</td>
<td>#2. General Chemistry</td>
<td>Continuation of 1.</td>
</tr>
<tr>
<td>#3. General Chemistry</td>
<td>Continuation of 2.</td>
<td>5</td>
<td>spring, (Staff), lec. (I) MWF 8, (II) MWF 9; lab. (I) TTh 9-12, (II) TTh 2:15-5:05, (III) WF 2:15-5:05</td>
<td>110. Quantitative Analysis</td>
<td>Primarily for premedical students. Not for Chemistry or Chemical Engineering majors. Concurrent registration in 111 required. Prerequisite: 3. It is recommended that 121 and 123 be completed previous to registration for 110.</td>
</tr>
<tr>
<td>111. Quantitative Analysis Laboratory</td>
<td>Concurrent registration in 110 required.</td>
<td>3</td>
<td>spring, (Loring), MWF 1:15-4:05 or TTh 1:15-4:05 and S 9-12</td>
<td>112. Quantitative Analysis</td>
<td>For Chemistry or Chemical Engineering majors. Concurrent registration in 113 required. Prerequisite: 3.</td>
</tr>
<tr>
<td>113. Quantitative Analysis Laboratory</td>
<td>Concurrent registration in 112 required.</td>
<td>2</td>
<td>autumn, (Skoog), MW 1:15-4:05 or TTh 1:15-4:05</td>
<td>116. Instrumental Analysis</td>
<td>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.</td>
</tr>
<tr>
<td>120. Organic Chemistry</td>
<td>Aliphatic, aromatic compounds. For students other than Chemistry, or Chemical Engineering majors. Prerequisite: 3.</td>
<td>5</td>
<td>summer, (Staff), MTWThFS 9</td>
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<td></td>
</tr>
</tbody>
</table>
121. Organic Chemistry—Carbon compounds. Prerequisite: 3.
    3 units, autumn, (Staff), lec. (I) MWF 11, (II) TTh S 10

122. Organic Preparations—Laboratory course. Prerequisite: 120, or previous or concurrent enrollment in 123.
    3 units, winter, (Mosher), MT 1:15-5:05 or WTh 1:15-5:05

123. Organic Chemistry—Continuation of 121.
    3 units, winter, (Staff), MWF 11

124. Organic Preparations—Continuation of 122.
    3 units, spring, (Mosher), MWF 1:15-4:05

125. Organic Chemistry—Continuation of 123.
    3 units, spring, (Noller), MWF 11

126. Qualitative Organic Analysis Laboratory—Prerequisites: 124 and 125.
    4 units, autumn, (Bonner), MWF 1:15-5:05

138. Nuclear Chemistry—Properties of nuclei and radioisotopes; nuclear reactions; fission, fusion, reactors, and accelerators; radiation detection and measurement; radiation safety; radiation chemistry, radiotracers, radioactivation analysis, and their applications. Prerequisites: 3, Mathematics 23, and Physics 57, or equivalent.
    3 units, autumn, (Kruger), TTh 11

139. Radiochemistry Laboratory—Nuclear reactions, radiochemical separations, radioactivity genetics, radioisotope production, neutron activation analysis and flux measurements; nuclear fission, radiotracers in physical chemistry and engineering. Prerequisite: 138 or consent of instructor.
    3 units, winter, spring, (Kruger), Th 1:15 and one lab. by arrangement

171. Physical Chemistry—Chemical thermodynamics: fundamental principles, Gibbsian equations, equilibrium conditions, phase rule, systematic deduction of equations, gases, solutions. Prerequisites: 3, Mathematics 10, 11, 21 (or equivalent) and Physics 51, 52, 53, 54 and previous or concurrent registration in Physics 55 (or Physics 21, 23, 29 on petition).
    3 units, autumn, (Hutchinson), MWF 8

173. Physical Chemistry—Chemical thermodynamics (continued): electrochemical thermodynamics, especially the galvanic cell, conductance phenomena, colloid and surface chemistry. Prerequisite: 171.
    3 units, winter, (Hutchinson), MWF 8

175. Physical Chemistry—Chemical kinetics of homogeneous and heterogeneous reactions. Prerequisite: 173.
    3 units, spring, (Boudart), 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, (Brauman, Pecora), lec. T 10; lab. TTh 1:15-4:05 or WF 1:15-4:05

177. Physical Chemistry—Introduction to quantum mechanics. Prerequisites: 175 and Physics 29 or 57.
    3 units, autumn, (Harris), MWF 11

178. Physical Chemistry—Introduction to molecular structure. Prerequisite: 177.
    3 units, winter, (Laurie), MWF 11

179. Physical Chemistry—Introduction to statistical mechanics. Prerequisite: 178.
    3 units, spring, (Baldeschwiler), MWF 11

180. Inorganic Chemistry—A systematic discussion of the chemistry of some of the nonmetallic elements, emphasizing the application of equilibrium, rate, and structural principles. Prerequisite: 171.
    3 units, winter, (Taubde), MWF 10
Graduate Courses

Undergraduates may register for chemistry courses numbered 200 and above only if admitted to the Honors Program or if special permission has been granted by the instructor in the course.

221. Advanced Organic Chemistry—Lectures. Prerequisites: 125 and 175.
   3 units, autumn, (Brauman), M 10 and WF 9

223. Advanced Organic Chemistry—Continuation of 221. Prerequisite: 221, or permission of instructor.
   3 units, winter, (Johnson), MWF 9

225. Advanced Organic Chemistry—Continuation of 223. Prerequisite: 223, or permission of instructor.
   3 units, spring, (van Tamelen), MWF 9

227. Selected Topics in Organic Chemistry—May be repeated for credit. Prerequisite: 225, or permission of the instructor.
   3 units, autumn, (Djerassi), M 8-10 and W 8

230a. Thermodynamics of Irreversible Processes—A course dealing with the main developments in the thermodynamic treatment of irreversible chemical and electrochemical processes, transport processes, coupling phenomena, etc., with special emphasis on topics and methods of interest to students of chemical engineering, physical chemistry, and related fields. (Enroll in Chemical Engineering 230a.) Prerequisite: physical chemistry with elementary thermodynamics.
   3 units, autumn, (Van Rysselberghe), by arrangement, alternate years, to be given in 1965-66

230b. Thermodynamics of Irreversible Processes—Complements 230a; separately open to qualified students.
   2 units, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1965-66

   2 to 3 units, spring, (———), TTh 10

235. Advanced Inorganic Chemistry—Selected topics. Prerequisite: 175.
   2 units, autumn, (———), TTh 10

240. Organic Chemistry Seminar—Attendance is required of all graduate students majoring in organic chemistry.
   No credit, autumn, winter, spring, (Staff), F 4

   2 units, autumn, (Loring), TTh 9, alternate years, to be given in 1966-67

   2 units, autumn, (Loring), TTh 9, alternate years, to be given in 1965-66

272. Selected Topics in Physical Chemistry—May be repeated for credit. Prerequisite: 179 or permission of instructor.
   3 units, autumn, winter, spring, (Staff), MWF 10

274. Fundamental Concepts—A study of elementary chemistry from a higher point of view, including chemical composition, chemical species, component, chemical reaction, equilibrium, rate of reaction, reaction mechanism. Precise definitions and some of their implications. Problems. Prerequisites: Chemistry 2, and either Chemistry 171 or permission of the instructor.
   3 units, spring, (Kocniq), TThS 9

276. Electrochemical Concepts and Conventions—A survey of the fundamentals of electrochemistry. Prerequisite: 175.
   1 unit, winter, (Van Rysselberghe), by arrangement, alternate years, to be given in 1965-66

277a. Electrochemical Thermodynamics and Kinetics—Thermodynamic treat-
ment of reversible cells, electrodes; irreversible phenomena in electrochemical systems, kinetics of electrode processes, polarization and overvoltage, Tafel law, electrochemical procedures in physical, analytical chemistry. Prerequisite: 175.

2 units, winter, (Van Rysselberghe), TTh 9, alternate years, to be given in 1966–67

277b. Electrochemical Thermodynamics and Kinetics—Continuation of Chemistry 277a. Prerequisite: 276 or 277a.

2 units, spring, (Van Rysselberghe), TTh 9, alternate years, to be given in 1966–67

278. Selected Topics on Macromolecules—Lectures. May be repeated for credit.

2 units, autumn, (Flory), by arrangement

280a. Chemical Physics—Lectures. Prerequisite: 175 or permission of instructor.

3 units, autumn, (McConnell), MWF 9, alternate years, to be given in 1965–66

280b. Chemical Physics—Continuation of 280a. Prerequisite: 280a or permission of instructor.

3 units, winter, (McConnell), MWF 9, alternate years, to be given in 1965–66

280c. Chemical Physics—Continuation of 280b. Prerequisite: 280b or permission of instructor.

3 units, spring, (McConnell), MWF 9, alternate years, to be given in 1965–66

297. Physical and Inorganic Chemistry Seminar—Attendance is required of all graduate students majoring in physical or inorganic chemistry.

No credit, autumn, winter, 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, 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, Anthony E. Raubitschek

Associate Professors: Edwin Joseph Doyle, Edwin Marshall Good (Religion and Hebrew)

Assistant Professors: Charles R. Beye, 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 latest in the winter quarter of their sophomore year and if possible in their freshman year.

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 1: Classics (Latin and Greek), or 2: 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.

1. Latin and Greek. 28 units in Latin courses and 28 units in Greek, all in courses at the 100 level or higher. At least 4 units at the 100 level in Latin composition and 4 units in Greek composition must be included, and if recommended by the student's adviser, one or both of the 170 series (L171–173; G171–173). For the Senior Comprehensive Examination, see below. (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.)

2. Latin or Greek

a) There are two types of Latin Major: the Latin Major and the Latin Major with a related minor. For the Senior Comprehensive Examination, see below.

1) The Latin Major: 28 units in Latin courses, all at the 100 level or higher, including at least 4 units at the 100 level in Latin composition and, if recommended by the student's adviser, the 170 series (L171–173); two courses in Roman history (H111–113); Humanities 61 or some work in Greek history or ancient art or some study of Greek.

2) 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.
b) There are *two* types of Greek Major: the Greek Major and the Greek Major with a related minor. For the Senior Comprehensive Examination, see below.

1) The Greek Major: 28 units in Greek courses, all at the 100 level or higher, including at least 4 units at the 100 level in Greek composition and, if recommended by the student's adviser, the 170 series (G171-173); two courses in Greek history (H101-103); Humanities 61 or some work in Roman history or ancient art or some study of Latin.

2) 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.

**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).

**Senior Comprehensive Examinations**

All seniors with Majors in Classics, Greek or Latin will take a comprehensive examination at the end of their spring term. This examination will contain reading tests in the languages (or language), and essay questions in literature and history.

**Honors Program in Humanities**

For acceptable majors in Classics an Honors Program in Humanities is offered, a description of which will be found under "Humanities (Special Programs)."

**Teaching Credentials**

For information concerning the requirements for teaching credentials, consult the "School of Education" section of this *Bulletin* and the Credential Secretary, School of Education.

**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 graduate students, and in some cases first-year students, who are candidates for the Ph.D. degree may also (on the recommendation of the Department) become candidates for the A.M. degree. In their case the thesis requirement above will be waived provided that they have completed some work beyond the course requirements listed under 2 and 3 above.

**Doctor of Philosophy**

University regulations regarding admission and application for candidacy are discussed in the section "Degrees" of this Bulletin.

All candidates for the Ph.D. degree in Classics must fulfill the following requirements:

1. They must complete at least three years (nine quarters) of full-time work, or equivalent, in study beyond the Bachelor's degree. At least 72 approved units 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) Reading examinations in French and German.
   b) Examinations in Greek and Latin composition.
   c) Examinations in translation into English from Greek and Latin authors included in an approved list (drawn up by the Department and available from the Department secretary).
   d) An examination in four classical authors, two Greek and two Latin. (The selection of authors varies from year to year; a detailed syllabus of study for the examination will be available at the beginning of each autumn term.)
   e) A colloquium on the candidate's dissertation and an oral examination on two or more special topics, such as selected authors, or selected aspects of Greek or Roman literature, history, archaeology, philosophy, epigraphy or palaeography.

3. The examinations in translation from Greek and Latin authors will normally be taken in the autumn term of the second or third year of graduate work, the four-author examination in the spring term of the same year, the dissertation colloquium and special topics examination in the spring following. The period between the translation and four-author examinations will be devoted largely to an intensive preparation for the latter examination, during the course of which candidates will be expected to make full use of relevant secondary material in modern languages. They should therefore plan to satisfy the requirements in composition and French and German as soon as possible, preferably before the time of the translation examination. Except in very special circumstances they will not be allowed to take the four-author examination until the other three sets of examinations have been successfully completed.

4. Each candidate (not later than the end of the quarter in which he takes his 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 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

Students may begin the study of Greek in autumn quarter with the series of courses G1-3, or in winter quarter with the series Gla, Ib which is intended to cover approximately the same ground at a faster pace. In the second year, one meeting in each week will be normally devoted to grammar and composition exercises.

#G1. First-Year Greek—For beginners.
4 units, autumn, (Doyle, Staff), MTWF 10

#G2. First-Year Greek—Continuation of G1.
4 units, winter, (Doyle, Staff), MTWF 10

#G3. First-Year Greek—Continuation of G2 and selected Greek readings.
4 units, spring, (Doyle, Staff), MTWF 10

#G1a. First-Year Greek—Accelerated course.
5 units, winter, (Doyle, Staff), MTWThF 1:15

#G1b. First-Year Greek—Continuation of G1a.
5 units, spring, (Doyle, Staff), MTWThF 1:15

#G22. Second-Year Greek—Xenophon, Plato.
3 to 4 units, autumn, (Raubitschek, Staff), MWF 10

#G23. Second-Year Greek—Homer’s Odyssey.
3 to 4 units, winter, (Raubitschek, Staff), MWF 10

1 to 2 units, by arrangement

#G100. Second-Year Greek—Euripides.
3 to 4 units, spring, (Raubitschek, Staff), MWF 10

Third- and Fourth-Year Courses

The series G101-103 and G111-113, and G151-153 and G161-163 will be offered in alternate years but may be taken in succession.

#G101. Tragedy—Sophocles.
3 to 4 units, autumn, (Otis, Staff), MWF 9

#G102. Homer’s Iliad.
3 to 4 units, winter, (Otis, Staff), MWF 9

#G103. Plato: Symposium, Phaedo.
3 to 4 units, spring, (Otis, Staff), MWF 9

#G111. Tragedy—Euripides.
3 to 4 units, autumn, (Otis, Staff), MWF 9
#G112. Homer’s Odyssey.
3 to 4 units, winter, (Otis, Staff), MWF 9

#G113. Plato: Republic.
3 to 4 units, spring, (Otis, Staff), MWF 9

G151. Historians—Herodotus.
3 to 4 units, autumn, (Raubitschek, Staff), by arrangement

G152. Comedy—Aristophanes.
3 to 4 units, winter, (Raubitschek, Staff), by arrangement

3 to 4 units, spring, (Raubitschek, Staff), by arrangement

G161. Historians—Thucydides.
3 to 4 units, autumn, (Beye, Staff), by arrangement

G162. Menander, Callimachus.
3 to 4 units, winter, (Beye, Staff), by arrangement

G163. Lyric Poetry—Sappho, Anacreon, Theocritus.
3 to 4 units, spring, (Beye, Staff), by arrangement

G160. Individual work.
By arrangement

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

G171. History of Greek Literature: Epic and Lyric.
4 units, autumn, (Otis, Staff)

G172. History of Greek Literature: Comedy, Tragedy.
4 units, winter, (Otis, Staff)

4 units, spring, (Otis, Staff)

See also Classical Courses (Latin and Greek) listed after Hebrew (III)

GRADUATE COURSES

G202. The Hellenistic Epic.
4 units, spring, (Otis), by arrangement

G204. The Constitution of Athens.
4 units, (Raubitschek), to be given in 1966–67

G205. Composition for Graduates.
2 units, autumn, winter, spring, (Raubitschek, Staff), by arrangement

G206. Homer.
4 units, winter, (Beye), by arrangement

G207. Herodotus.
4 units, spring, (Raubitschek), by arrangement

G208. Greek Epigraphy.
4 units, (Doyle), to be given in 1966–67

G209. Thucydides.
4 units, (Raubitschek), to be given in 1966–67

G211. Church Fathers of the Fourth Century.
4 units, (Otis), to be given in 1966–67

G212. Aristophanes.
4 units, (Doyle), to be given in 1966–67

G213. Sophocles.
4 units, (———), to be given in 1966–67

G214. Topography of Athens.
4 units, autumn, (Raubitschek), by arrangement

4 units, (Pearson), to be given in 1966–67
G216, G217. Seminar in Demosthenes.
   G216. 4 units, winter, (Pearson), by arrangement
   G217. 4 units, spring, (Pearson), by arrangement

   G218. 4 units, autumn, (——), by arrangement
   G219. 4 units, spring, (——), by arrangement

G260. Directed reading.
   By arrangement


See also L210, L211-212, and C201, C207, and C208.

II. COURSES IN LATIN

FIRST- AND SECOND-YEAR COURSES

A placement test will be set for entering freshman (and for others by arrange-
ment), to determine at what stage students should begin; they will be ranked as
follows on the basis of the test:
1. General Studies requirement completed—eligible for third-year course.

#L1. First-Year Latin—Accelerated course, with special sections for graduate
students in other departments.
   4 units, autumn, (Wigodsky, Staff), MTWF 8

#L2. First-Year Latin—Continuation of L1.
   4 units, winter, (Wigodsky, Staff), MTWF 8

#L3. First-Year Latin—Continuation of L2.
   4 units, spring, (Wigodsky, Staff), MTWF 8

   3 units, autumn, (Pearson, Staff), MWF 11

   3 units, winter, (Pearson, Staff), MWF 11

L25, L26. Grammar and Composition (Second Year).
   L25. 2 units, autumn, (Wigodsky, Staff), by arrangement
   L26. 2 units, winter, (Wigodsky, Staff), by arrangement

   1 to 3 units, by arrangement

#L100. Second-Year Latin—Virgil’s Aeneid.
   3 units, spring, (Pearson, Staff), MWF 11

THIRD- AND FOURTH-YEAR COURSES

The series L101-103 and L111-113, and L151-153 and L161-163 will be offered
in alternate years but may be taken in succession.

#L101, L102, L103. The Ciceronian Age—Cicero, Catullus, Sallust.
   L101. 3 to 4 units, autumn, (Pearson, Staff), MWF 9
   L102. 3 to 4 units, winter, (Pearson, Staff), MWF 9
   L103. 3 to 4 units, spring, (Pearson, Staff), MWF 9

L105. Composition (Elementary).
   2 units, autumn, (Wigodsky, Staff), by arrangement

   L111. 3 to 4 units, autumn, (Otis, Staff), MWF 9
   L112. 3 to 4 units, winter, (Otis, Staff), MWF 9
   L113. 3 to 4 units, spring, (Otis, Staff), MWF 9

#L151. Plautus and Terence.
   3 to 4 units, autumn, (Wigodsky, Staff), by arrangement

#L152. Roman Satire—Horace.
   3 to 4 units, winter, (Wigodsky, Staff), by arrangement
#L153. Tacitus.  
3 to 4 units, winter, (Wigodsky, Staff), by arrangement

L155, L156. Composition (Advanced).  
L155. 2 units, winter, (Wigodsky, Staff), by arrangement  
L156. 2 units, spring, (Wigodsky, Staff), by arrangement

#L161. Lucretius.  
3 to 4 units, autumn, (Beye, Staff), by arrangement

#L162. Roman Satire—Martial, Juvenal, Petronius.  
3 to 4 units, winter, (Beye, Staff), by arrangement

#L163. Roman Elegy—Ovid, Propertius, Tibullus.  
3 to 4 units, spring, (Beye, Staff), by arrangement

### COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

4 units, autumn, (Otis, Staff), by arrangement

4 units, winter, (Otis, Staff), by arrangement

4 units, spring, (Otis, Staff), by arrangement

#### GRADUATE COURSES

4 units, (Wigodsky), to be given in 1966-67

L205. Composition for Graduates.  
2 units, autumn, winter, spring, (Pearson, Staff), by arrangement

4 units, winter, (———), by arrangement

L211, L212. Seminar on Pindar and Horace.  
L211. 4 units, autumn, (Otis), by arrangement  
L212. 4 units, winter, (Otis), by arrangement

L214. Tacitus.  
4 units, autumn, (Pearson), by arrangement

4 units, spring, (Wigodsky), by arrangement

L216. Cicero.  
4 units, (Pearson), to be given in 1966-67

L218. 4 units, winter, (———), by arrangement  
L219. 4 units, spring, (———), by arrangement

L260. Directed Reading.  
By arrangement


See also C201, C207, and C208.

### 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), TWTThF 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

#T161. The Classical Epic: Homer, Apollonius, Virgil—A study of the epic in respect to structure, character, theme, and imagery.
3 units, autumn, (Beye, Staff), MWF 1:15

#T162. Tragedy: Aeschylus, Sophocles, Euripides, Seneca—A study of the origin, function, and purpose of tragedy.
3 units, winter, (Beye, Staff), MWF 1:15

3 units, spring, (Beye, Staff), MWF 1:15

V. COURSES IN ANCIENT HISTORY

The series H101, 102, 103 and H111, 112, 113 will be offered in alternate years but may be taken in succession.

H101. Greek History: The Early Period.
4 to 5 units, autumn, (Doyle, Staff), MTWTh 2:15

H102. Greek History: The Classical Period.
4 to 5 units, winter, (Doyle, Staff), MTWTh 2:15

H103. Hellenistic Greece.
4 to 5 units, spring, (Doyle, Staff), MTWTh 2:15

H111. The Roman Republic.
4 to 5 units, autumn, (Pearson, Staff), MTWTh 2:15

H112. The Augustan Age.
4 to 5 units, winter, (Pearson, Staff), MTWTh 2:15

H113. The Roman Empire.
4 to 5 units, spring, (Pearson, Staff), MTWTh 2:15

For more advanced students—especially for majors and graduate students in Classics or History—work will be offered on an individual basis:

H201. Individual Work in Greek History.
By arrangement

H202. Individual Work in Roman History.
By arrangement

VI. COURSES IN ARCHAEOLOGY

These will be announced in autumn, 1965.

#A105. Art and Monuments of the Romans.
3 units, winter, (Wigodsky), by arrangement

VII. COURSES IN CLASSICS

C201. Introduction to Classical Scholarship.
3 units, autumn, (Doyle), by arrangement

C207, C208. Comparative Grammar of Greek and Latin.
C207. 4 units, (———), to be given in 1966–67
C208. 4 units, (———), to be given in 1966–67
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
Associate Professors: Edwin B. Parker, William L. Rivers
Instructor: Henry S. Breitrose (on leave)
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 professional curriculum are to provide a broad program in the social and humanistic studies; to present courses in the processes and effects of communication, and to equip the student with an adequate set of professional values.

A secondary objective is to provide that amount of training in skills and techniques that will sustain the student's interest in his chosen profession and will assist him in beginning his career.

The technical courses provide not only practice but a content that is an application of some of the principles of the behavioral sciences and humanities. The technical curriculum in this sense is like the curricula of the Schools of Medicine and Engineering which apply the principles of the biological and physical sciences.

ADMISSION

Undergraduate students who have been admitted by the University are accepted as majors provisionally for one quarter. Thereafter, the student's record is reviewed quarterly by the Department.

Students who wish an undergraduate minor in the Department may arrange for a suitable sequence of preprofessional courses.

Prospective undergraduate students should write the Office of Admissions.

Prospective graduate students should write to: Executive Head, Department of Communication, Stanford University, Stanford, California.

The Department requires that applications for admission to Master's degree programs include verbal and quantitative scores from the Graduate Record Examination (area scores are optional). Scores from the Miller Analogies Test are required of applicants who hope to work toward a Ph.D. and are optional, but welcomed, for Master's degree candidates.

PROGRAMS OF STUDY

Bachelor of Arts

Two Bachelor of Arts degree programs are offered, one in the Journalism Division and one in the Broadcasting and Film Division. Requirements are as follows:

1. Two courses in general or English literature; Psychology 1; Sociology 1 or Anthropology 1. In addition, Journalism Division students are required to take Economics 1 and Political Science 1 and 10 or 20.
2. A unified program totaling not less than 20 units of courses numbered 100 or higher shall be arranged, with the approval of the adviser, from one or two other departments such as Anthropology, Art, Economics, English, History, Music, Philosophy, Political Science, Psychology, Sociology, or Speech and Drama.

3a. Broadcasting and Film Division: Communication 1, 100a, b, and c, 105a, b, and c, and 110a or b or c, 113, 114, 141 or 142, 180.

3b. Journalism Division: Twenty-five to thirty units in communication of which the following courses are required: 1, 50, 51, 103, 107, and 140. In addition, the student preparing for newspaper or press association editorial work will take Communication 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 150 and 169.

While the Department offers no courses in such subjects as science reporting, technical writing, or public relations, appropriate programs of study can be arranged for interested students. For example, a prospective science writer could be permitted to substitute a unified program of courses in the physical sciences in lieu of requirement "2" above.

 Majors in Communication may elect one of the following interdisciplinary honors programs:

- Behavioral Sciences (Honors Programs in Quantitative Methods)
- Humanities Undergraduate Honors Program
- Social Sciences (Honors Program in Social Thought and Institutions)

Communication Honors Program

In addition to the regular undergraduate programs in communication, a Communication Honors Program is designed for those exceptionally able students who wish, in their major, to pursue an intensive and somewhat independent study of communication. This program is directed toward the integration of a substantial body of theoretical and factual information and the development of both communication skills and creative scholarly skills by independent study, tutorial guidance, small seminars, and research experience. Particular emphasis is placed on the planning of an individual program for the student that will combine his specialized interests with a body of basic knowledge about communication processes. The plan will be aimed at helping the student prepare for a comprehensive examination to be taken in the final quarter of his senior year, over his entire area of communication study. The plan will include arrangements for continuous supervised work in 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

The Master of Arts degree is awarded by the Department in the fields of Journalism, Broadcasting and Film, or Communication Research. Requirements are as follows:

1. The candidate must earn 45 units in graduate residence at Stanford; he must earn an average grade of B on his entire program of study. An independent project under the direction of a major professor must be undertaken. Three to six hours of credit in independent study may be applied to this requirement. A report of the project must be made to the professor directing the independent study. A candidate may petition the Department by the end of the second week of the second quarter for permission to submit the report as a thesis.

2. A unified program of advanced course work is to be arranged with the ap-
proval of the adviser. This includes appropriate grounding in research methodology and communication theory; it includes training in one or more communication media; and, it includes the equivalent of a minor in a related field—or a cohesive group of courses in several fields.

3. Students electing a program in Broadcasting and Film are required to attend the Summer Institute; to spend an internship of three months with a professional radio or television station, film production unit, or a related organization; and, to take a comprehensive written examination at the end of the course work. (No tuition is charged for the internship period.)

No particular specialization in undergraduate work is expected of a candidate. Special programs of study may be tailored for individual candidates, which will take account of the nature of their previous preparation.

**Doctor of Philosophy**

In addition to fulfilling the residence requirement for the degree, Ph.D. candidates are required to:

1. Complete course requirements for a Master's degree in Communication, and complete a research project. Holders of the Master's degree may be excused from this first year research requirement if the faculty feels that the previous research has been sufficient.

2. Complete the following courses: Communication 211, 212, 213; 217, 218, 219, Statistics 151, and Psychology 152.

3. Complete courses in experimental psychology, social psychology, and sociology in preparation for comprehensive written and oral examinations in these areas.

4. Complete additional optional courses selected from the list given below, up to a total (including courses required above) of not less than 45 units beyond the Master's degree or 90 units beyond the Bachelor's degree. Such additional courses are intended as preparation for the comprehensive examinations and to achieve competence in depth in a field from which the candidate's dissertation topic may be selected.

5. Pass a comprehensive written examination in the subjects required of all candidates and in the area of advanced specialty of the particular candidate.

6. Demonstrate reading knowledge of a foreign language. Except by special permission, this language will be Russian, French, or German.

7. Pass the University oral examination, which may be either a comprehensive examination covering the same areas as the written examination or a defense of the dissertation.

8. Complete at least one year of research experience in the Institute for Communication Research, or in comparable research activities.

9. Have some familiarity with at least one medium of mass communication. Such familiarity may be obtained prior to graduate study by working for a communication medium. Students without such practical experience will be expected to take some media-oriented courses, such as the Summer Radio-Television-Film Institute or journalism courses, as part of their graduate program.

10. Complete a dissertation satisfactory to (a) a Departmental committee of two or more 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.

The following is an example of a typical Ph.D. program:

1. Communication Theory
   Comm. 211. Theory of Communication I
   Comm. 212. Theory of Communication II
   Comm. 213. Theory of Communication III
2. Methodology
   Comm. 217. Research Methods I
   Comm. 218. Research Methods II
   Comm. 219. Research Methods III
   C.S. 126. Computing for Nonscientists

3. Statistics
   Psych. 60. Statistical Methods
   Stat. 151. Statistical Methodology
   Psych. 152. Analysis of Data

4. Experimental Psychology (at least two of the following)
   Psych. 103a. Experimental Psychology: Higher Mental Processes
   Psych. 103b. Experimental Psychology: Perception
   Psych. 103c. Experimental Psychology: Animal Learning
   Psych. 103d. Experimental Psychology: Social Processes

5. Social Psychology and Personality
   Psych. 212. Advanced Social Psychology
   Psych. 261. Seminar in Social Psychology
   Psych. 220. Human Motivation
   Psych. 213. Advanced Personality

6. Sociology
   Sociol. 137. Advanced Organizational Behavior
   Sociol. 161. Advanced Interpersonal Behavior
   Sociol. 165. Advanced Social Stratification

Preparation for examinations and for the dissertation should include selected courses from among the following:
   Comm. 220. Mass Communications in Society
   Comm. 255. International Communication
   Psych. 209. Advanced Perception
   Psych. 211. Advanced Developmental Psychology
   Psych. 221. Organizational Processes and Task Performance
   Psych. 231. Psychopathology
   Psych. 254. Principles of Behavioral Modification I
   Psych. 267. Seminar in Interpersonal Processes
   Phil. 157a, b. Logic
   Phil. 164. Philosophy of Science
   Anthr. 167. Language and Culture
   Anthr. 158. Culture and Personality
   Pol.Sci. 382aR, 382bR. Research Seminar in Political Behavior
   Pol.Sci. 312R. Research Seminar in Comparative Politics—Problems in Politics of Development

Other courses and special advanced reading courses may be selected in conference with the adviser.

Ph.D. candidacy expires five years after admission to candidacy by the University Committee on the Graduate Division. Reapplication will require reexamination.

Other programs leading toward the Ph.D. and involving communication may be pursued in the Graduate Division Special Programs. Such programs are individually planned for unusually well-qualified students.

Minor for the Degree of Doctor of Philosophy—Candidates for the degree of Doctor of Philosophy in other departments who elect a minor in Communication will be required to complete a minimum of 15 units of graduate courses in the Communication Department, including one research methods course and either Communication 211 or Communication 212. The Communication 217 requirement may be waived when comparable research methodology courses have been taken in some other de-
partment. The remainder of the course program will be adapted to the particular needs of each candidate.

THE INSTITUTE FOR COMMUNICATION RESEARCH

The Institute for Communication Research operates as an office of project research for the faculties of the Department of Communication and other departments, on grants from foundations, communication media, and other agencies, on government contracts, and on its own funds. A few research assistantships are available to qualified graduate students. Among the qualifications which will be highly valued in applicants are high scholarship, training in the behavioral sciences (preferably psychology and sociology, including training in statistics and research methodology), and training for or experience with the mass media.

COURSES OPEN TO UNDERGRADUATES AND GRADUATES

I. GENERAL


5 units, winter, (Parker), MTW 10 and section

70. Introduction to Survey Research—An introductory course in survey research methods. Formulation of problems, study design, sampling, interviewing, data processing and analysis, and writing of reports of public opinion surveys. Designed primarily for undergraduate non-majors. Prerequisite: Psychology 60 or equivalent.

3 units, spring, (Maccoby)

190. Comparative Communication Systems—Foreign press, broadcasting, and film: their control and support; their relations to economic and social development, political systems, and cultural patterns; and their roles in public opinion and national policy.

4 units, spring, (Schramm), by arrangement

199. Individual Work—Major students with high academic standing are permitted to undertake individual work.

1 to 3 units, any quarter, (Staff), by arrangement

II. JOURNALISM

50. Editorial Techniques I—Theory and techniques of news communication for newspapers and radio-TV; analysis of journalist's audience; representative media; journalistic vocations. To be taken concurrently with Communication 51. Open to non-majors.

3 units, autumn, (Rivers), MWF 9

spring, (———), MWF 9

51. Editorial Techniques I Laboratory—Practice in news writing. Weekly conferences, laboratory, outside assignments. To be taken concurrently with Communication 50. Open to non-majors. Prerequisite: typing skill of 35 words per minute.

1 unit, autumn, (Rivers), by arrangement

spring, (———), by arrangement


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


3 units, winter, (Weigle), MW 9; lab. by arrangement
115. Advertising I—Fundamentals of marketing, consumer research, media, copy, layout. Open to non-majors.
   3 units, autumn, (——), MWF 11

   3 units, winter, (——), MWF 11

140. History of Anglo-American Journalism—Open to non-majors.
   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: 50 and 51 or consent of instructor.
   3 units, winter, (Rivers), TTh 11
   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, (Rivers), to be given in 1966-67

169. Legal Aspects of Journalism—Libel, contempt, constitutional guaranties, privacy, copyright, inspection of public records. Open to non-majors.
   3 units, spring, (——), MW 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, Quad, and Chaparral; weekly conferences. Open to undergraduate students who qualify by election or appointment; not open to graduate students. Students limited to total of 7 units credit. Credit may not be offered in fulfillment of Communication unit requirements for degrees in communication.
   1 to 2 units, each quarter, (Staff), by arrangement

183. San Francisco Newspaper Practice—Majors who have made a high record in their entire program, and especially in 175, are permitted to work in San Francisco in the senior year, by arrangement with San Francisco newspapers. Work is under supervision of specially appointed San Francisco newspapermen and faculty of the Department.
   5 units, 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, (——), MWF 9
   100b. Broadcasting II.
      3 units, spring, (——), MWF 10
   100c. Film.
      4 units, autumn, (——), 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, (______), TTh 1:15-3:05

105b. Television.
4 units, winter, (______), TTh 1:15-3:05

105c. Film.
4 units, autumn, (______), MW 2:15-4:05

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, (______), T 10-11 and Th 10-12

110b. Television.
3 units, spring, (______), T 1:15 and Th 1:15-3:05

110c. Film.
3 units, winter, (______), 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, (______), 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, (______), 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, (______), MW 2:15-4:05

141. History of Film—Studies in the development of the motion picture as an art form and a means of communication. Lab.: Screenings of films announced in class.
4 units, spring, (______), 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. Prerequisite: consent of instructor.
3 units, spring, (Donner), MWF 11

Summer Radio-Television-Film Institute

R201. Noncommercial Station Operation—A course taught in the studios of KQED for advanced students who wish to learn the philosophy, administration, origination, planning, and coordination of noncommercial television programs. (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. Laboratory work in campus classroom studio with video tape playback and evaluation. (Same as Education 342s; see Summer Session Bulletin.)
3 units, summer, (Staff), by arrangement

R204. Modern Broadcasting—The key questions of broadcasting from the viewpoint of station management, programming and sales in relations with government, personnel, ratings, and sponsors. Emphasis on FM, multiplexing, modern production methods, and international broadcasting. Laboratory work through one unit of R204a taken concurrently.
3 units, summer, (KNBR 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. All students registered for R204 must take at least one unit of this course. It may be taken separately from R204 for 1–2 units. Recommended for all students.

1 unit, summer, (Staff), by arrangement

R205. Film Production—Basic theory and techniques of film making. Individual student productions from script to release print. Cameras, lighting, sound, editing. Limited to 15 students. Students with prior work in film production may register for Communication 299, Advanced Individual Work, 1–4 units, with the consent of the instructor.

4 units, summer, (Staff), by arrangement

R207. Radio and Television Writing—Theory and practice in writing for radio and television. Special emphasis on the documentary and other nondramatic forms.

3 units, summer, (Staff), by arrangement

R209. Radio and Television News—Practical course to train students for work in the radio and television newsroom; gathering, selection, rewriting, editing and reporting of news for broadcast and TV newsfilm; production and direction of feature material and special events broadcasts. Students handle news department of KZSU.

3 units, summer, (KNBR Staff), by arrangement


3 units, summer, (KPIX Staff), by arrangement

R214. Television Production—Practice in television planning, direction, and performance through student production of a variety of program types, both educational and commercial. Programs are video taped for analysis and criticism.

3 units, summer, (KPIX Staff), by arrangement

(Mass Communications in Society—See Communication 220. Required of all students.)

COURSES PRIMARILY FOR GRADUATES

201. Process and Effects of Mass Communication—Theory of the communication process; language and meaning; content of the mass media; audiences and motivations for attending; relation of mass to interpersonal communication, and of group memberships to response to the media; social effects of the media; cases and experiments. For A.M. candidates in the mass media.

5 units, autumn, (Schramm), T 1:15–3:05

207. Survey of Communication Research Methods—For A.M. students.

5 units, autumn, (——), M 4:15–6:05

211. Theory of Communication I—Theory, structure, and effects of mass communication. Analysis of the literature.

5 units, autumn, (Schramm), M 2:15-4:05 and additional meetings by arrangement

212. Theory of Communication II—Theory of the communication process. Analysis of the experimental literature in attitude change. Prerequisite: consent of instructor.

5 units, winter, (Maccoby), MW 2:15–4:05


5 units, spring, (——), M 2:15–4:05, 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, winter, (Maccoby, Donner), Th 7-10 p.m.

217. Communication Research Methods I—Methods of research in mass, group and interpersonal communication. Application of scientific method to communication research. Design of communication studies for laboratory and field experiments and sample surveys. Conceptualization of variables, sampling, data collection, interview techniques, data processing and data analysis. Report preparation. Prerequisite: previous or concurrent registration in elementary statistics.

4 units, autumn, (Parker), TTh 2:15-4:05

218. Communication Research Methods II—Continuation of 217.

4 units, winter, (———), TTh 2:15-4:05


4 units, spring, (Parker), TTh 2:15-4:05

220. Mass Communications in Society—The nature and social responsibilities of the media, the structure of the industry, problems of regulation, management, educational and commercial interests.

3 units, autumn, (Rivers, Donner), T 4:15-6:05

summer, (Staff), by arrangement

222. Documentary Film—Analysis of the techniques and strategies of films designed to effect attitudinal and behavioral change. Prerequisite: consent of instructor.

4 units, spring, (———), by arrangement

255. International Communication—Chief patterns of mass communications throughout the world; philosophies behind them; economic, social, political reasons why a given kind of pattern develops where it does; channels by which nations, cultures communicate with each other; kinds of barrier which intervene in those channels; manipulative communication between nations which is characteristic of the "cold war."

4 units, winter, (———), M 2:15-4:05

270. Advanced Communication Theory and Method Seminar—May be repeated for credit. Prerequisites: 219 and 213.

3 units, autumn, (Parker, Staff), 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, audience research, 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, (———), by arrangement
COMPUTER SCIENCE

Executive Head: George E. Forsythe
Professors: George E. Forsythe, John George Herriot, John McCarthy, William F. Miller
Associate Professor: Edward A. Feigenbaum
Assistant Professors: Gene H. Golub (on leave 1965-66), Niklaus E. Wirth. Acting: John C. Reynolds, Richard W. Watson
Lecturers: R. Wade Cole, Donald D. Fisher, Roger W. Hockney, Harwood G. Kolsky, Harold R. Van Zoeren
Affiliated Faculty: Robert Vernon Oakford (Professor of Industrial Engineering)

OFFERINGS AND FACILITIES

The Department aims to acquaint a variety of students with the technological and intellectual roles of automatic digital computers, and to educate research workers in computer science. In spite of the diversity of the applications, the methods of attacking problems with computers show a considerable unity, and computer science is concerned with the underlying principles. The field is still young, and the student will find many more questions than answers.

Of the numerous areas of computer science, the Department has competence in numerical analysis, artificial intelligence, programming systems and languages, logical design of computer systems, and computer control of external devices.

Courses in data processing are offered by the Industrial Engineering Department and in the Graduate School of Business.

Since computer science is inherently interdisciplinary, graduate students of computer science are expected to include in their study program a good deal of work in other departments; see the list of suggested courses below.

There is no Bachelor's degree in computer science. Undergraduates who wish to enter the field are advised to major in mathematics and include Computer Science 136, 137, 138, and 139 in their course of study.

In connection with its courses and research, the Department makes considerable use of the Computation Center. See the section “Computation Center” in this Bulletin.

PROGRAMS OF STUDY

Master of Science

The University's basic requirements for the Master's degree are discussed in the section “Degrees” in this Bulletin. The following are Departmental requirements:

A candidate is expected to complete an approved course program of 45 units; at least 36 units will be in this Department, or in the Mathematics Department, or selected from the list of suggested courses in other departments which appears at the end of the course offerings in Computer Science. These 36 units must include 6 units of Computer Science 239 and 15 additional units of courses numbered 200 or above.

A student whose primary interest is in the numerical aspects of computing should include in his program Mathematics 106, 114a, b, 115, 130, 131, and Computer Science 136, 137, 138, 237a, b, unless as an undergraduate he has taken these courses or equivalent ones elsewhere.

A student whose primary interest is in the nonnumeric aspects of computing should include in his program Mathematics 114a, 130, Philosophy 160a, b, and Computer Science 136, 137, 139, 231, 236a, b, 238, unless as an undergraduate he has taken these courses or equivalent ones elsewhere.

The candidate must have a 2.50 average in his course work and a 3.00 average in his courses taken in the Computer Science Department.
Doctor of Philosophy

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" in this Bulletin. The following are Departmental requirements:

Candidates for the degree of Doctor of Philosophy will follow such courses as are approved by the Department faculty, subject to general University regulations. Each student's program should be arranged to include work in computer science, mathematics, mathematical logic, and possibly such other subjects as statistics or electrical engineering, the proportions depending on the student's previous education and his planned research. Since computer science is becoming increasingly formal and abstract, we place considerable emphasis on the student's mathematical education and ability.

In any case there are the following requirements:

1) Complete, as a graduate student, an approved coherent program of at least 60 units, including Computer Science courses 225, 231, 236a, b, 237a, b, 238, 239 (6 units), 382 (2 units of presenting papers), and either 224 or 245. An especially well written paper for course 239 is required.

2) Possess a substantial reading knowledge of one of the languages: French, German, or Russian.

3) Pass a qualifying examination before admission to candidacy.

The most important requirement for the Ph.D. degree is the dissertation. The Department is now prepared to supervise dissertations in the mathematical theory of computation, numerical analysis, programming languages, artificial intelligence, computer control of external devices, and in certain applications of computers.

TEACHING AND RESEARCH ASSISTANTSHIPS

There are graduate assistantships available in both the Computer Science Department and the Computation Center. Assistants will receive a tuition scholarship up to nine units of study per quarter during the academic year, and in addition will receive stipends for the nine-month academic year ranging approximately from $2300 to $2600. They will have desks in Polya Hall at the Computation Center. Some may work full time in the summer for $500 to $550 per month.

Duties in the academic year involve less than twenty hours of work per week. Part of this is in assisting Stanford people with their programs and methods for solving problems with computers, often in connection with formal or informal programming courses. Part of the time is spent in developing programs and systems for solving problems of general interest on computers, or in assisting senior staff members with research in computer science. Approximately two hours of the work week are spent in attendance at Computer Science Department colloquia and seminars.

Applicants for assistantships are expected to have a background in computing at least as deep as that achieved in course 136, together with some knowledge of a machine language. A deeper background is preferable. An applicant's major field may be computer science, mathematics, statistics, physics, psychology, electrical engineering, or other discipline in which there is significant research involving the use of automatic digital computers. Because of the great need for improved computing and programming systems as tools for research, preference will generally be given to students of computer science.

Further information may be obtained from the Executive Head of the Computer Science Department. Applications for assistantships should be made to the Financial Aids Office, together with an application for admission to graduate study in some department. Unless the applicant is also applying for admission to the Computer Science Department, he should at the same time write to the Executive Head of the
Computer Science Department of his desires to have an assistantship in computing and stating his desired major department.

COURSES FOR UNDERGRADUATE STUDENTS

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

   2 units, autumn, ( ), WF 11
   winter, (Oakford), TTh 1:15
   spring, ( ), WF 11

6. **Introduction to Programming**—Continuation of 5. Courses 5 and 6 together include approximately the same material as course 136, with emphasis on scientific applications. This course is limited to undergraduate students.

   2 units, winter, ( ), TTh 1:15

COURSES FOR UNDERGRADUATE AND GRADUATE STUDENTS

126. **Computing for Nonscientists**—This course is directed to students of social science and the humanities, and is not open to students who have the prerequisites for course 136. The syllabus is roughly that of course 136, but the problems are selected more from nonnumeric applications. Prerequisite: Mathematics B or equivalent.

   3 units, autumn, ( ), MWF 2:15

136. **Introduction to Algorithmic Processes**—Concept and properties of an algorithm; language and notation for describing algorithms; analysis of computational problems and development of algorithms for their solution; use of a specific procedure-oriented language to solve simple numerical and nonnumerical problems using an automatic digital computer. Prerequisite: Mathematics 23 or 43.

   3 units, autumn, (Herriot), MWF 11; ( ), MWF 1:15; ( ), TTh 9:30-10:45
   winter, ( ), MWF 10; ( ), MWF 1:15
   spring, ( ), MWF 11; ( ), MWF 1:15

137. **Numerical Analysis**—This course and 138 are designed to acquaint seniors and graduate students of science and engineering with methods of solving mathematical problems on automatic digital computers. Problems discussed include numerical differentiation and integration, solution of linear and nonlinear equations, solution of differential equations, and approximation of functions. Introduction to the analysis of convergence and errors. Pitfalls in automatic computation and their remedies. Prerequisites: 136 and Mathematics 130, or equivalents.

   3 units, winter, ( ), MWF 2:15

138. **Numerical Analysis**—Continuation of 137. Also the numerical analysis of functions of several variables, including problems of linear algebra. Prerequisites: 137 and Mathematics 114a, or equivalents.

   3 units, spring, ( ), MWF 2:15


   3 units, autumn, (Watson), TTh 9:30-10:45
   winter, ( ), MWF 1:15

COURSES INTENDED PRIMARILY FOR GRADUATE STUDENTS

224. **Computer Simulation of Cognitive Processes**—Introduction to computer simulation techniques and information-processing models of thought processes. Sur-
vey of various computer simulation models. This research area lies at an interface between psychology and computer science, and the course is expressly designed for graduate students in both fields. Some knowledge of experimental and theoretical psychology is advisable but not mandatory. Prerequisite: 136 or equivalent.

3 units, autumn, (Feigenbaum), by arrangement

225. Artificial Intelligence—Introduction to problem solving and heuristic programming. Survey of chess- and checker-playing programs; theorem-proving programs; General Problem Solver; mathematical, linguistic, and industrial applications. Question-answering programs, and natural-language communication with machines. Advice-taker and Inquiring System concepts. Other topics as time allows. The course is designed to dovetail with 224 with minimum overlap, but 224 is not a prerequisite. Prerequisite: 136 or equivalent.

3 units, winter, (Feigenbaum), by arrangement

231. Structure of Digital Computers—Boolean algebra; analysis and synthesis of combinatorial and sequential networks; electronic components used in logical gates. The design of a simple digital processor, arithmetic unit, program control, memories. Use of this processor and its simulation on another computer. Various existing forms of machine organization. Prerequisite: 139 or equivalent.

3 units, winter, (Watson), MWF 2:15

233. Topics in Numerical Analysis—Selected topics in numerical analysis. Prerequisite: 138 or equivalent.

3 units, spring, ( ), by arrangement

236a, b. Systems Programming and the Theory of Formal Languages—The technique of constructing systems programs: supervisory programs (monitors), input-output systems, interpreters and compilers for procedure-oriented languages, in particular ALGOL. Selected topics from the theory of formal languages: syntactic analysis and semantic interpretation. Prerequisite: 139 or equivalent.

236a. 3 units, winter, (Wirth), TTh 9:30-10:45
236b. 3 units, spring, (Wirth), TTh 9:30-10:45


237a. 3 units, autumn, ( ), MWF 3:15
237b. 3 units, winter, ( ), MWF 3:15
237c. 3 units, spring, ( ), MWF 3:15

238. Computing with Symbolic Expressions — The LISP programming language with applications to symbolic differentiation, integration, simplification of algebraic expressions and compiling. Design of list-processing systems. Prerequisite: 136 or substantial programming experience.

3 units, autumn, (McCarthy), TTh 11:00-12:15

239. Computer Laboratory—A substantial computational program is undertaken and well documented. Prerequisite: 138 or 139 or equivalent.

Any quarter, (Staff), by arrangement

243. Mathematical Theory of Computation—Semantics and syntax of programming languages; formal systems for proving equivalence of programs; computability and unsolvability; computer proof procedures; related topics in mathematical logic. Prerequisite: 238.

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

245. Advanced Topics in Artificial Intelligence—Analysis and discussion of selected frontier research problems in the field, e.g., advice-taker, game-playing programs, pattern recognition, man-machine interaction, proof procedures. Term paper focusing on research problems will be required. Prerequisites: 225 and 238.

3 units, spring, (McCarthy), TTh 11:00-12:15
246. Data Reduction and Control Programming—Organization and programming of automatic data reduction systems: data collection, storage, and retrieval; machine-to-machine data transmission; control programs; interrupt processing; list-processing applications; decision processes. Prerequisites: 137, 231, 236a, 238.
   3 units, spring, (Miller), MWF 9

360. Advanced Reading and Research.
   Any quarter, (Staff), by arrangement

382. Computer Science Seminar—There are ordinarily two or more sections on different topics.
   1 or 2 units, any quarter, (Staff), by arrangement

The following courses offered in other departments may be of especial interest to students of computer science:

**Analog Computation**—See Electrical Engineering 268.
**Data Processing**—See Industrial Engineering 141, 156, 210, 257, 261, and 263.
**Data Processing in Business Problems**—See Business 366, 367 and 368.
**Mathematical Logic**—See Philosophy 160a, b, 161, and 292a, b, c.
**Mathematical Models in Behavioral Sciences**—See Behavioral Sciences courses.
**Mathematics**—See Mathematics courses.
**Organizational Processes and Task Performance**—See Psychology 221.
**Recursion Theory**—See Philosophy 293a, b, c.
**Science in Management and Operations Research**—See Business 366, and Industrial Engineering 152, 252, 253, and 257.
**Statistical Methods of Econometrics**—See Economics 272.
**Theory of Automata**—See Philosophy 162.
**Theory and Design of Systems and Adaptive Systems**—See Electrical Engineering 248, 249, 250a, b, 251a, b, and 286.
**Theory of Switching and Digital Computer Circuitry**—See Electrical Engineering 261, 262, and 266.

**ECONOMICS**

**Emeriti:** Theodore Harding Boggs, Elmer Daniel Fagan, Bernard Francis Haley, Eliot Jones, Albert Conser Whitaker (Professors)

**Executive Head:** To be announced

**Directors:** —— (Undergraduate Study), Marc Nerlove (Graduate Study)

**Professors:** Moses Abramovitz, Kenneth Joseph Arrow, Emile Despres, John Grey Gurley, Julius Margolis, Marc Nerlove, Melvin Warren Reder (on leave spring quarter 1965-66), Edward Stone Shaw, Lorie Tarshis (on leave spring quarter 1965-66)

**Assistant Professors:** Paul Allan David, Paul Marcel Hohenberg, Ronald Ian Mckinnon (on leave 1965-66), G. S. Maddala, Roy Emerson Murphy, Jr., Earl Albert Thompson

**Affiliated Faculty**

**Professors:** Alan S. Manne (Graduate School of Business), Helen Cherington Farnsworth, Roger W. Gray, Richard J. Hammond, Bruce F. Johnston, William Orville Jones (Food Research Institute)

**OFFERINGS AND FACILITIES**

The Department's purposes are to acquaint students with the economic aspects of modern society, to familiarize them with techniques for the analysis of contemporary economic problems, and to develop in them an ability to exercise judgment in evalu-
ating public policy. There is training for the general student as well as for those who plan careers as economists in civil service, private enterprise, teaching, or research. Associated with the Department are the Research Center for Economic Growth in Encina Hall, for research and graduate training in problems of economic growth in both industrialized and developing countries, and comparable facilities in Serra House for mathematical economics and econometrics.

The University Library is well supplied with literature in all fields of economics. The Hopkins Transportation Library holds invaluable material on transportation problems, and there are special collections on the institutions and commerce of Latin America, the Orient, and Pacific Coast development. Advanced students have access to the Hoover Institution, with its comprehensive collections of original and secondary materials on many foreign nations.

Qualified graduate students in economics are given the opportunity for training and research in the special fields of the Food Research Institute. A few courses for undergraduates are conducted by the Institute, as well. Courses offered by the Institute count toward completion of requirements for degrees in economics.

PROGRAMS OF STUDY

Bachelor of Arts

The following Departmental requirements are in addition to the University’s basic requirements for the Bachelor's degree:

Enrollment in the Department—Students who have not yet taken any economics courses at Stanford may be enrolled in the Department upon request. All other students will be enrolled only if they have had a C average or better in their previous work in economics at Stanford; however, deficiencies in this average may be made up by repeating courses although no University credit will be given for such repetitions.

Graduation—The student is urged to select his program of study carefully, with a view to his own special needs and interests. His Departmental adviser will be prepared to advise him on his program at any time.

To be recommended by the Department for the degree of Bachelor of Arts in economics, the student must have satisfied the following requirements:

1. Completion of 45 units in courses in economics, and with the permission of the student’s adviser, in the curricula of the Food Research Institute and of Engineering-Economic Systems.

   a) Economics 1, 5, 105, 10, 110, and 111 or their equivalent shall be included in the 45 units. Economics 5 and 10 shall be completed by the end of the junior year.

   b) Economics courses taken at other universities may be included in the 45 units. The Director of Undergraduate Study for the Department will establish the amount of credit to be granted toward completion of the Departmental requirements. However, if the elementary course is repeated at Stanford, credit will not also be given for the elementary course taken at another institution toward the required 45 units, and in any case no more than 5 units credit will be given for such a course.

   c) A minimum of 30 units of courses numbered 100 or above, of which 20 must be taken at Stanford, shall be included in the 45 units, except that for this requirement Economics 191 will be counted as a first- or second-year course.

2. An average grade of C or better shall have been received for all course units completed at Stanford in economics and the curricula of the Food Research Institute and Engineering-Economic Systems, and an average grade of C or better shall have been received for Economics 1, 5, and 10.
Completion of a program, approved by the student's adviser, of at least 25 units of courses numbered 100 and above (in history, courses numbered 20 or above) in not more than two of the following subjects: cultural anthropology, history, industrial engineering, mathematics including computer science and statistics (including courses in differential and integral calculus numbered below 100 for which partial credit is given), philosophy, political science, psychology, and sociology.

The Undergraduate Honors Program—All economics majors who qualify are urged to complete the requirements for a degree with honors. The purpose of this program is to encourage the study of economics beyond the ordinary requirements for the degree of Bachelor of Arts. The Bachelor of Arts degree with honors in economics will be granted upon application to all of those who have met the following requirements in addition to those listed above:

1. The student must have received a grade point average of at least 3.00 in all economics courses at Stanford.
2. The student must present a minimum of 55 units in economics and the curricula of the Food Research Institute and of Engineering-Economic Systems, including 10 units of Honors Seminars.

A candidate for admission to the Honors Program should apply to the Director of Undergraduate Study in the third quarter of his junior year if possible.

Advanced Degrees

Master of Arts

The University's basic requirements for the Master's degree (residence, thesis, etc.) are set forth in the section "Degrees" in this Bulletin. The following are Departmental requirements:

Admission to Candidacy—Completion of the Stanford requirements for a Bachelor of Arts degree in economics, or an approximately equivalent training, is required of students who undertake a program of study for the degree of Master of Arts in economics. Provisional enrollment may be permitted, however, in cases in which previous training has been deficient, with the understanding that the deficiency will be remedied in advance of departmental approval of candidacy. Admission to candidacy for the degree will be restricted to students whose record bears promise of successful graduate work.

Recommendation for the Degree—To be recommended to the University Committee on the Graduate Division for the degree of Master of Arts in economics, the student must have satisfied the following requirements:

1. Completion of a program of study at Stanford amounting to not less than 45 units of credit. No courses numbered below 100 and no courses completed with a grade less than C may be counted toward the 45 units required. Ordinarily the program will include at least 30 units of economics, of which at least 15 units (or 10 units in addition to the thesis) must be in courses at the 200 level. Courses in subjects closely related to economics may be included with the approval of the Director of Graduate Study in Economics.
2. Completion of a thesis acceptable to the Department, or of two term papers of acceptable quality in courses numbered 200 or over. Credit will be allowed for the thesis to a maximum of 9 units toward the 45 units required for the degree.
3. An average grade of B or better shall have been received for the first 45 units of course work completed and for all additional units approved by the Department.

Doctor of Philosophy

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are set forth in the section "Degrees" in this Bulletin. The following are Departmental requirements:
Admission to Candidacy—The Director of Graduate Study in Economics will recommend the student to the University Committee on the Graduate Division for admission to candidacy for the degree of Doctor of Philosophy in economics when the following conditions have been satisfied:

1. The student must have passed satisfactorily the two comprehensive field examinations in "Price and Allocation Theory" and in "Theory of Income and Economic Fluctuations." These examinations will normally be given at the end of the spring quarter and will cover the subject matter of Economics 202, 203, 204, and 210, 211, 212.

2. Candidates for the Ph.D. degree will be required to demonstrate a reading knowledge of economics in one foreign language, except that additional training may be required of students whose dissertations are concerned with foreign economic systems or require more than ordinary acquaintance with literature in a foreign language. The language selection must be approved by the Director of Graduate Study. The requirement may be satisfied in either of two ways: (a) by completion with passing grade of a second-year reading course equivalent, for the language concerned, to French 23; (b) by passing a special reading examination, to be given preferably by a qualified member of the Department of Economics or, in place of this, the relevant language department. This examination will be scheduled once annually.

3. The minimum mathematics requirement of the Department is satisfied by successful completion of Statistics 63 (also Mathematics 63) or Mathematics 43 with a grade of C or better, or its equivalent (as judged by an examination administered by the Department). This requirement should be satisfied as soon as possible after first graduate registration in the Department. Those with little or no previous mathematical background are strongly advised to register their first autumn quarter for Mathematics 41 (a prerequisite of Statistics 62, which is not ordinarily offered until winter quarter).

While the minimum requirements of the Department will be satisfied by Statistics 63, continuation in Statistics 64 is recommended. The Director of Graduate Study will advise on suitable additional mathematics and statistics courses of use to economists.

Students admitted to the Department to pursue work toward the Ph.D. are normally expected to satisfy the requirements for admission to candidacy by the end of their first year in residence. Hence, previous preparation in mathematics, a foreign language, or both is desirable.

Recommendation for the Degree—Before being recommended for the degree of Doctor of Philosophy in Economics, the student must have completed the following requirements:

1. Qualification in background subjects.
   a) For those who do not elect Econometrics as a field (see below), an acquaintance with the statistical tools used in economics equivalent to Economics 170.
   b) Economics 200. History of Economic Thought. Students will be expected to satisfy this requirement by the end of their second year in residence.

2. Qualification in six fields of study (if no minor subject is offered) or in three fields of study and a minor subject. All candidates without exception will be expected to qualify in "Price and Allocation Theory" and "Theory of Income and Economic Fluctuations." The remaining fields may be chosen according to the following options:
   a) Option A—Without a Minor Subject. The preparation required will be determined by the professor or professors in charge of each field and will normally consist of a two-quarter sequence at the 200 level or approximately equivalent preparation. An approved program of 15 units in other than economics may at the discretion of the Director of Graduate Study, be
substituted for one field. Students electing Option A are expected to complete the field requirements by the end of their second year in residence.

1) Economic Development or Economic History

2) Three other fields, one of which may be the field not chosen under 1), chosen from the following list:
   - Monetary Theory
   - Public Finance
   - Labor Economics
   - Structure of Industry
   - International Economics
   - Econometrics
   - Mathematical Economics
   - Economic Development
   - Economic History

b) Option B—With a Minor Subject. Students who elect Option B will be expected, if possible, to complete their minor requirement and the third comprehensive by the end of their second year in residence.

1) Economic History or Economic Development.

2) A minor subject, the choice of which must be approved by the Director of Graduate Study and the requirements for which are determined by the department concerned. Students interested in specializing in Mathematical Economics or Econometrics are encouraged to minor in statistics.

Comprehensive field examinations will be scheduled once annually, usually at the close of the sequence designed to prepare for them. The minimal standard of qualification in each field will be a grade of B on the appropriate examination. However, students will not typically be recommended for the Ph.D. degree with a record of only B's in the six comprehensive examinations (Option A). Successful candidates are expected to pass with distinction in some fields of economics.

3. Training in independent research. Participation in two year-long seminars in two fields and preparation of satisfactory reports or papers in each. Under normal circumstances one of the two seminars will be in the field in which the candidate's dissertation lies and his continued participation in that seminar is encouraged. Seminars will in part be designed to assist the student in locating a suitable dissertation topic. Satisfaction of this requirement is expected no later than the end of the third year of graduate residence.

4. Teaching experience. Candidates for the Ph.D. in economics are expected to acquire minimal teaching experience equivalent to that of a teaching assistant in the Department for one quarter. Under exceptional circumstances and upon recommendation of the Departmental Graduate Study Committee, the Director of Graduate Study may excuse a student from this requirement. It is not permitted to satisfy this requirement during the first year of graduate study; it will normally be satisfied by the end of the third year of residence.

5. Satisfactory performance in the University oral examination. Except in special cases, the first four stages of preparation must be completed before the student is admitted to the University oral examination. This examination is held for each student after his Departmental dissertation committee has certified to the Director of Graduate Study in Economics that the dissertation is complete in at least rough-draft form. The examination is based on the dissertation and on the field or fields of economics within which it lies.
6. Completion of the dissertation in form satisfactory both to the Departmental committee and to a committee appointed by the University.

Minor for the Degree of Doctor of Philosophy—To be recommended for the degree of Doctor of Philosophy with economics as a minor subject, the student is required to qualify in three fields of economics, one of which must be either Price and Allocation Theory or Theory of Income and Economic Fluctuations. Qualification in these fields is tested in the Departmental comprehensive written examinations that are given once annually. The standard of achievement in these examinations is the same for minor as for major candidates.

FELLOWSHIPS AND ASSISTANTSHIPS

The attention of prospective graduate students is directed to the fact that the Department awards a number of fellowships for graduate study in economics. These grants range up to $4,000 (inclusive of tuition) with special allowance for dependents under certain circumstances. Furthermore, students who make a good record during their first year may be assured of favorable consideration for further support for a period of up to three more years. This is true regardless of whether the student has come on a Departmental or an outside (NSF, Woodrow Wilson, etc.) fellowship initially.

Completed application forms for graduate fellowships should be filed before January 15 at the Office of Financial Aids and at the same time as completed application forms for admission are filed with the Admissions Office.

Opportunities for employment as research assistants are also available. The salary scale for half-time employment depends upon the student’s experience and ability. Qualified graduate students who wish to combine their studies with part-time teaching may apply for teaching assistantships which carry a stipend of $2,100 for three quarters of half-time teaching and a tuition scholarship covering up to half-time tuition and fees. Graduates 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 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 January 15.

Entering students are not normally considered for research or teaching assistantships.

COURSES

Note—It is not possible at the date this announcement goes to press to schedule courses accurately for the year. Application should be made to the secretary of the Department after March for information about the exact times at which courses will be given in 1965–66.

#1. Elementary Economics—The functioning of a modern market economy: the determination of national income and its distribution; the composition of output; the growth of economy.

5 units, autumn, winter, spring, (Staff), MTWThF 9
4 units, summer, (Staff), MTWThF 9

5. Economics of Prices and Markets I—The role of prices in the allocation of economic resources; behavior of consumers and firms; market structure. (May be taken as 105a by graduate students.) Prerequisite: 1 or equivalent.

5 units, autumn, winter, spring, (Staff), MTWThF 9
4 units, summer, (Staff), MTWThF 9

7. Introduction to Statistics—Especially designed for students of economics, sociology and other social sciences. (Same as Statistics 7.)

5 units, autumn, (Staff), MTWThF 1:15
10. **Money, Income, and Employment I**—An analysis of major sectors and markets in the economic system and of national economic accounts. (May be taken as HOa by graduate students.) Prerequisite: 1 or equivalent.
   5 units, autumn, winter, (Staff), MTWThF 10
   4 units, summer, (Staff), MTWThF 10

105. **Economics of Prices and Markets II**—Distribution of income; problems in marginal cost pricing; monopoly power, its sources and impact. Prerequisite: 5.
   5 units, autumn, winter, (Staff), MTWThF 9

110. **Money, Income, and Employment II**—An analysis of equilibrium, instability, and growth in the economic system as a whole. Prerequisite: 10.
   5 units, winter, spring, (Staff), MTWThF 10

111. **Money, Income, and Employment III**—An analysis of policies and techniques of regulation for stability, growth, and other objectives in the economic system as a whole. Prerequisites: 5 and 110.
   5 units, winter, spring, (Staff), MTWThF 11

115. **Economic History of Europe**—Forces in the development of the European economy since the Middle Ages. Focus on problems of economic growth in a historical setting. Prerequisites: majors 5 and 10; non-majors 1.
   5 units, (Staff), MTWThF

117. **Economic History of the United States**—Historical trends in the American Economy from Colonial Times to the Great Depression; special references to problems of national and regional economic development, including social and political influences thereon. Prerequisites: majors 5 and 10; non-majors 1.
   5 units, (Staff), MTWThF

118. **Underdeveloped Economies**—Characteristics of backward economies. Elements and mechanism of development. Emphasis on theory, but attention will be given to policy problems and case studies. Prerequisites: majors 5 and 10; non-majors 1.
   5 units, (Staff), MTWThF

120. **Comparative Economic Systems**—Working principles and institutions of different capitalist and non-capitalist economies. Some emphasis on the Soviet economy. Comparisons of performance. Prerequisites: majors 5 and 10; non-majors 1.
   5 units, (Staff), MTWThF

141. **Public Finance and Fiscal Policy**—Effects of government expenditure, borrowing, and taxation upon resource allocation, national income and employment, prices, and income distribution. Prerequisites: 5 and 10.
   5 units, (Staff), MTWThF

   5 units, (Staff), MTWThF

158. **Organization and Social Control of Industry**—Methods of evaluating economic efficiency; anti-trust laws and the attempts to preserve competition; economic regulation of public utilities, communications, and transportation. Emphasis on independent study. Prerequisites: 5 and 105, or consent of instructor.
   5 units, (Staff), MTWThF

165. **International Economics**—Comparative advantage in production and trade among nations; international monetary mechanism; domestic monetary, fiscal and tariff policies and their relationship to foreign trade. Prerequisites: majors 5 and 10; non-majors 1.
   5 units, (Staff), MTWThF

170. **Econometrics**—Introduction to econometrics; selected topics in the literature of econometrics; statistical methods of special application to economic problems and
special statistical problems encountered in testing economic hypotheses with non-experimental data; emphasis on conceptual understanding rather than technique. Prerequisites: 5, 10, 7 (or Statistics 50), Mathematics 41 or equivalent, or consent of the instructor.

5 units, (Staff), MTWTThF

199. Senior Seminar in Economics—Advanced specialized topics to be arranged with instructor. Required of all Honors students. To be offered in five sections. Each section will meet throughout the year under the guidance of one instructor. Maximum number of students in each section is ten. Prerequisite: Admission to Honors Program or seniors majoring in economics with a minimum grade point average in economics of 3.00, or consent of instructor.

10 units, (Staff)

COURSES PRIMARILY FOR GRADUATE STUDENTS


In each group below, courses marked (*) constitute continuous courses. Registration will be accepted and grades given only for the entire sequence.

Only six seminars will be offered in any one year.

A. CORE THEORY CURRICULUM

[Professors Abramovitz, Arrow, McKinnon, Reder, Shaw, Tarshis, and Thompson]

200. Topics in the History of Economic Thought—Landmarks in the development of classical, neoclassical and institutionalist economics; their relation to economic conditions in their time and to modern economics.

5 units, winter, (Staff)

202. Price and Allocation Theory I—Perfect competition. Meaning, conditions of efficiency in economic organization. General and partial equilibrium. Open to advanced undergraduates with consent of the instructor. May be omitted by graduate students with adequate background in the subject. Prerequisite: consent of instructor.

5 units, 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)


5 units, spring, (Staff)

*210, *211, *212. The Theory of Income and Economic Fluctuations—Theory of money, employment, income considered from points of view of comparative statics, causes of instability and long-term change. 210 is prerequisite for 211; 210, 211 are prerequisites for 212.

210. 5 units, autumn, (Staff)
211. 5 units, winter, (Staff)
212. 5 units, spring, (Staff)

301a, b, c. Seminar in Microeconomics.
10 units, (Staff), by arrangement

310a, b, c. Seminar in Macroeconomics.
10 units, (Staff), by arrangement
B. Economic Development
[Professors David, Despres, Hohenberg, and Manne]

5 units, winter, (Staff)

5 units, spring, (Staff)

225. Historical Experience of Economic Growth — (See under Economic History.)

315a, b, c. Seminar in Economic Development.  
10 units, (Staff), by arrangement

C. Economic History
[Professors Abramovitz, David, and Hohenberg]

225. Historical Experience of Economic Growth — Topics in European and Japanese economic history with emphasis on problems and issues relevant to growth. Change in pre-industrial and industrializing economies in historical perspective.  
5 units, autumn, (Staff)

5 units, winter, (Staff)

325a, b, c. Seminar in Economic History.  
10 units, (Staff), by arrangement

D. Monetary Theory and Institutions
[Professors Gurley, Maddala, and Shaw]

230. Monetary Theory — Advanced topics in monetary theory with special reference to policy criteria and control techniques.  
5 units, (Staff)

330a, b, c. Seminar in Monetary Theory and Institutions.  
10 units, (Staff), by arrangement

E. Public Finance
[Professors Arrow, Gurley, Margolis, and Thompson]

*241, *242. Public Finance and Taxation I and II — Role of government expenditures in light of welfare economics; direction and development of expenditures; types of taxes, their distributional and allocative effects; pricing policies in government enterprises; compensatory finance; the public debt. Prerequisites: 204 and 212.  
241. 5 units, (Staff)  
242. 5 units, (Staff)

341a, b, c. Seminar in Public Finance — Prerequisite: 241 or consent of instructor.  
10 units, (Staff), by arrangement
F. Economics of Labor
[Professor Reder]

5 units, (Staff)

248. Wages and Income Distribution—Wage levels, structure; income distribution, effects of education on earnings, special reference to empirical data.
5 units, (———)

345a, b, c. Seminar in Labor Economics.
10 units, (Staff), by arrangement

G. Economics of Industry
[Professors Maddala, Margolis, Murphy]

254. Dynamic Processes in the Firm—Mathematical analysis of the dynamic effects of investment in facilities, inventories, research, and advertising in the firm. Applications to specific problems concerning the optimal operation of the firm. Prerequisites: 105 and a knowledge of differential equations.
5 units, (Staff)

256. Industrial Structure and Market Performance—Economies of scale; the size of establishments and firms; integration; the structure of industries; characteristics and performance of markets; problems of public policy.
5 units, (Staff)

355a, b, c. Seminar in Structure of Industry.
10 units, (Staff), by arrangement

H. International Economics
[Professors Despres, McKinnon, Tarshis]

5 units, (Staff)

5 units, (Staff)

365a, b, c. Seminar in International Economics.
10 units, (Staff), by arrangement

I. Mathematical Economics
[Professors Arrow and Murphy]

280. Linear Programming — Fundamentals Theorems; variations of the simplex methods; parametric programming; standard model formulations; quadratic programming; discussion of current developments. (Same as Business 435.) Prerequisite: matrix algebra.
5 units, (Staff)

5 units, (Staff)

283. Dynamic Programming—The theory and application of dynamic program-
Special Topics in Mathematical Economics—The topics for 1965-66 will be announced. May be repeated for credit. Prerequisites: consent of instructor and working knowledge of differential calculus are required.

5 units, (Staff)

385a, b, c. Seminar in Mathematical Economics.
10 units, (Staff), by arrangement

J. ECONOMETRICS

[Professors Arrow, Maddala, 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, winter, spring, summer, (Staff)

271. Elementary Statistical Inference—Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. (Enroll in Statistics 219.) Prerequisite: 270.
3 units, winter, (Solomon), MWF 9

*272. Econometrics I—First quarter of two dealing with the statistical methods of econometrics. Emphasis on multiple regression analysis, tests of linear restrictions, and other single equation methods and problems. Selected applications in economics. Multivariate normal distribution. Introduction to maximum-likelihood methods. Prerequisites: 271 and Statistics 63, or consent of instructor. Mathematics 114a desirable.
5 units, autumn, (Nerlove)

*273. Econometrics II—Continuation of 272 emphasizing simultaneous equations, methods and problems. Selected applications in economics. Special topics may be introduced in some years. Prerequisites: 272 and consent of instructor.
5 units, spring, (Staff)

370a, b, c. Seminar in Econometrics.
10 units, (Staff), by arrangement

ENGLISH

Emeriti: Hardin Craig, Richard Foster Jones, (Professors); Margaret Dille Hudson (Instructor)

Executive Head: Thomas C. Moser
Associate Executive Head: Charles N. Fifer
Associate Professors: Charles N. Fifer, H. Bruce Franklin, W. Wesley Trimpi, Jr.
Visiting: Robert T. Oliphant
Assistant Professors: Alfred Appel, Jr., Walter Bliss Carnochan, J. Martin Evans, John Felstiner, Larry Friedlander, Verdel A. Kolve, Robert M. Polhemus, Ronald A. Rebholz, Lucio P. Ruotolo
Instructor: S. Dale Harris
Lecturers: Blair Fuller, Edward P. McClanahan, Nancy Huddleston Packer
The Department of English offers work in English and American Literature, English Philology, and Creative Writing. In connection with these programs, it maintains the William Dinsmore Briggs Memorial Library for the use of graduate students and the Jones Room in the University Library as a center for its work in Creative Writing. The Jones Room includes a library, records, and facilities for small meetings.

PROGRAMS OF STUDY

Bachelor of Arts

The following Departmental requirements are in addition to the University's basic requirements for the Bachelor's degree. Only students who have achieved a C average in courses counting toward the Departmental major will be recommended for graduation.

1. Prospective English majors may profitably elect one or more of the following courses: English 25 and 76; Humanities 61.

2. All students majoring in English are required to take the following Departmental courses:

   English 102. Introduction to the English Language.
   English 141. Chaucer.
   English 143. Shakespeare.
   English 183. English Literature: Neoclassicism and Romanticism.

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.
   1) One course from each of the following groups:
      (a) English 100, 142, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155.
      (b) English and American literature courses numbered 200 and above.
   2) English 192. Senior Seminar in English Literature.

b) American Literature. The undergraduate major in American Literature should plan to take English 177 and 178 in sequence during the junior year, and 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 1855.
   2) English 178. American Literature, 1855 to the present.
   3) One additional course from the following list: English 155, 172, 255, 264, 265, 266, 267, 268, 269, 270, 278; Speech and Drama 206.
   4) English 196. Senior Seminar in American Literature.

c) Creative Writing. All students wishing to major in creative writing must have maintained at least a B record in preliminary writing courses.
   1) One course from each of the following groups:
      (a) English 142, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155.
      (b) English 171, 172, 173, 265, 266, 269, 270; Speech and Drama 206.
   2) Completion of at least 12 units of work in one of the programs listed below:
(a) Fiction. English 255, The Development of the Short Story; plus 8 units of English 133, Directed Writing, or a more advanced course, with grades of B or better.
(b) Poetry. English 251, The English Lyric, and English 201, The Writing of Poetry, which may be repeated for a total of 8 units of credit.

3. In addition to the English major 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.

Honors Program in English

Students with at least a B average in their university work and special interest in literary studies may apply for admission to the Honors Program in English literature, preferably by the start of the sophomore year and not later than the junior year. Admission is selective.

The program offers more intensive and more independent work in the field. Course requirements are as follows: English 102, 141, 143, 182, 183, 184, and four elective advanced courses in English or American literature. There will be special seminar sections for honors candidates in the basic surveys (182, 183, 184); or, with the approval of the adviser, three advanced courses in the appropriate period may be substituted for any one of the basic surveys. (Not more than two such substitutions will be permitted.) The requirements in a minor field are the same as for all English majors.

Honors candidates will take a qualifying examination, on an assigned reading list, early in the fall of their senior year. Those who pass with at least a B will follow a plan of independent study, carrying seventeen units of credit and culminating in a senior essay of 10,000-15,000 words. If a student is a member of the Honors Program in Humanities, the same essay may normally be submitted to each program. Since the major in creative writing is limited to students with special aptitudes, it is also regarded as 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 Standard Teaching Credential (Secondary) entitling them to teach in grades 7-14 in the public schools of California, or a Junior College Credential for grades 13 and 14, should consult the statement on credentials under "School of Education" in this Bulletin and the Credential Secretary of the School of Education for the requirements.

1. General Secondary Credential. Candidates for the Stanford General Secondary Credential with a teaching major in English are required to take the following Departmental courses or their equivalents:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<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: The Renaissance</td>
<td>5</td>
</tr>
<tr>
<td>English 183. English Literature: Neoclassicism and Romanticism</td>
<td>5</td>
</tr>
<tr>
<td>English 184. English Literature: Victorian and Modern</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American Literature (preferably in the chief American poets and American novelists)</td>
<td>8</td>
</tr>
<tr>
<td>Education 184. Literature for Adolescents</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 120a. Exposition</td>
<td>3</td>
</tr>
<tr>
<td>Speech and Drama 164a. Principles of Directing or Communication 50 and 51. Editorial Techniques and Lab.</td>
<td>4</td>
</tr>
<tr>
<td>Electives (courses in literary criticism and oral interpretation of literature are strongly recommended)</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>70</td>
</tr>
</tbody>
</table>

All candidates for a Stanford credential with a teaching major in English are required to take at least three courses in the Stanford Department of English; for the teaching minor, two such courses are required.

Graduate transfer students who are qualified for a teaching major or minor in English should confer with Professor Grommon before taking English 182, 183, or 184.

Teaching Minor

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1, 2, 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: Victorian and Modern</td>
<td>5</td>
</tr>
<tr>
<td>Courses in American Literature</td>
<td>8</td>
</tr>
<tr>
<td>Electives, preferably in the English Novel or English 208, Introduction to Modern Linguistics</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
</tr>
</tbody>
</table>

A candidate for the Stanford Junior College Credential must begin the program during the summer or autumn quarter. He should apply to the Department of English in advance of registration. The Department will accept only those applicants who seem promising candidates for an advanced degree offered by the Department and meet the standards for college instructors—in other words, those fully qualified...
to study for the Ph.D. degree, whether or not they plan to do so. Other graduate
students interested in obtaining a teaching credential are advised to work for the
Stanford General Secondary Credential.

2. Stanford Junior College Credential. Candidates for the Stanford Junior Col-
lege Credential must meet the following requirements:
   a) Completion of the Master's degree in English.
   b) Completion of 24 quarter units in a teaching minor, 12 units of which are ad-
      vanced undergraduate or graduate units.
   c) Completion of the following professional courses in education:
      1) Education 347. The Junior College (3 units), offered in the winter quar-
         ter by the School of Education.
      2) 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 En-
         glish; 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.
      3) Education 262a or b. Curriculum and Instruction in Secondary School
         English (3 units), offered only during summer and autumn quarters, or
         English 399, Seminar in the Teaching of Composition.
      4) 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.
   d) Fulfillment of the Constitution Requirement.

3. Master of Arts in Teaching. The degree of Master of Arts in Teaching is
offered jointly by this Department and the School of Education. The degree is in-
tended 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 Educa-
tion section.

Advanced Degrees

For University regulations governing advanced degrees see the section “Degrees”
in this Bulletin.

Eligibility—A student may enter upon graduate work toward an advanced degree
in English at Stanford if he has received a Bachelor's degree of acceptable quality.
(Formal application for candidacy is a separate step taken somewhat later.) Students
whose previous preparation falls short of the requirements for the degree of Bachelor
of Arts in English at Stanford must expect to spend more than the minimum time in
residence. Credits for previous graduate work at Stanford or elsewhere more than
five years old may be reevaluated or rejected.

Only candidates for the Ph.D., or for the Master's degree in an approved Cre-
dential Program or for the Master's degree in Creative Writing in English, will be
accepted as graduate students.

Candidates in an approved Credential Program may earn the Master's degree by
passing satisfactorily 36 units of specified work, one foreign language examination,
and the qualifying examination for the Ph.D. in English. No thesis is required.

Candidates for the Master's degree in Creative Writing must submit a sample of
their writing with their application. Should this sample be approved, the candidate
will be provisionally admitted to the program, but will not be finally accepted until he has demonstrated his ability through one quarter's work in an advanced writing course. A candidate may then earn the Master's degree by passing satisfactorily 36 units of specified work (including English 310 and the qualifying advanced writing course) and one foreign language examination, and by submitting a piece of imaginative writing of substantial length and merit. This must be submitted at least four weeks before the close of the quarter in which the degree is to be granted.

Candidates for the Master's degree in Creative Writing who, after a quarter's work, are not accepted as degree candidates in the writing program, may earn the Master's degree in English by completing satisfactorily 36 units of specified work, by passing one foreign language examination, and by passing the qualifying examination for the Ph.D. in English.

**Doctor of Philosophy**

University regulations regarding this degree are discussed in the section "Degrees" in this *Bulletin*. The following Departmental requirements, dealing with such matters as residence, dissertation, and examinations, are in addition to the University's basic requirements for the doctorate.

A candidate for the Ph.D. degree must complete three years (nine quarters) of full-time work, or their equivalent, in graduate study beyond the Bachelor's degree. He will be expected to offer at least 72 units of graduate work in addition to his doctoral dissertation. At least three consecutive quarters of graduate work, and also the last course work in the doctoral program, must be taken at Stanford.

A candidate for the Ph.D. degree may concentrate in English literature or in English philology, or may take the Ph.D. in English and American literature, in English and comparative literature, or in English and humanities. Applicants interested in a Ph.D. in English philology should determine the requirements of the program through correspondence with Professors Meritt or Ackerman.

Requirements of the Ph.D. program in English literature are as follows:

1. Old English and Middle English language and literature (English 310 and 312 or equivalent work elsewhere).

2. A minimum of four seminars, insuring coverage in genres and periods.

3. A minimum of 32 additional units of graduate courses and seminars (200-300), distributed according to the adviser's judgment and the candidate's needs.

4. One of the following minor programs, amounting to at least 16 units of graduate credit at Stanford or elsewhere:

   a) A minor in a related department, the choice of minor to be approved by the Department of English, but the program itself to be prescribed by the department in which it is taken;

   b) a supplementary program in American literature or English philology;

   c) a special interdepartmental program of studies related to the student's projected research.

A student who wishes to begin the study of English on the graduate level, and who has had a strong undergraduate major in a subject normally accepted for the Ph.D. minor, may petition the Department to waive the minor requirement so that he may devote equivalent time to strengthening his foundation in English.

5. A written qualifying examination to be taken at the end of the summer after the first year of graduate work. This examination will be based largely upon a reading list supplied the student at the time of his acceptance at Stanford.

6. A university oral examination to be taken no later than the winter quarter of the student's third year of graduate work. This examination will cover the period of the dissertation, the minor, and plans for the dissertation itself based upon a prospectus approved by the adviser.
Requirements of the Ph.D. program in English and comparative literature are as follows:

1. English 310 and either 311 or 312, except that the candidate may omit 312 instead of 311 only if he has had a course in Chaucer or other Middle English writers.
2. A minimum of 28 units of graduate courses (200-300) in American literature and 28 units in English literature, including at least two seminars in each. The four seminars should be in different periods and genres as approved by the adviser; at least three must be taken at Stanford.
3. At least 8 units of electives to be distributed between English and American literature according to the adviser’s judgment of the candidate’s background.
4. A written qualifying examination to be taken at the end of the summer after the first year of graduate work. This examination will be based largely upon a reading list supplied the student at the time of his acceptance at Stanford.
5. A university oral examination to be taken no later than the winter quarter of the student’s third year of graduate work. This examination will cover the period of the dissertation, together with plans for the dissertation itself based upon a prospectus approved by the adviser.

Requirements of the Ph.D. program in English and comparative literature are as follows:

1. A knowledge of English literature since 1350 comparable to that demanded of candidates for the Ph.D. in English literature. Candidates will take the appropriate parts of the qualifying examination at the end of the summer after the first year of graduate work.
2. A knowledge of the basic structure of the English language (including the structure of Old English) and of Chaucer. This requirement may be met by examination, or by taking eight units of courses chosen from among those offered in linguistics, English philology, and early and middle English literature including Chaucer.
3. A knowledge of two foreign languages comparable to that demanded under the basic program and an advanced knowledge of a third language; or, an advanced knowledge of two foreign languages.
4. A minimum of 36 units in the history, thought, and literature of one period, in two or more languages, one of which must be English and one European. As much as 24 units of this requirement may be satisfied through courses in Reading and Research.
5. A minimum of four seminars, of which at least three must be in the English Department. No more than two of the four required may be in the same genre or period.
6. A university oral examination covering the period of the dissertation and plans for the dissertation itself. This examination, based on a reading list established by the candidate in consultation with his adviser, should be taken no later than the winter quarter of the third year of graduate study.

Language Requirements—All candidates for the Ph.D. degree (except those in English and comparative literature) must demonstrate a reading knowledge of Latin, German, and French by passing the examinations in these languages. These examinations are normally given on Friday of the eighth week in the autumn, winter, and spring quarters, unless that Friday falls on a holiday; and on Friday of the sixth week in the summer quarter. Another modern foreign language may be substituted for German or French if it is required for the student’s projected research.

The student should pass one foreign language examination before his qualifying examination; a second foreign language before his university oral examination; a third foreign language before he submits his dissertation.

Dissertation—As early as possible during his graduate study, a Ph.D. candidate will be expected to find a topic requiring extensive original research and to enlist the services of a 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 should take this crucial step as early in his graduate career as possible. The committee may well advise extra preparation within or outside the Department, and time should be allowed for such work.

Immediately after the dissertation topic has been approved by the adviser, the candidate should file a formal application for candidacy as prescribed by the University. Ph.D. dissertations must be completed and approved within five years from the date of that application. A candidate taking more than five years will be required to reinstate his candidacy by passing the written qualifying examination again.

The dissertation must be submitted to the adviser in rough draft but in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive his Ph.D. degree. Dissertations may not be submitted during the summer quarter.

GRADUATE PROGRAM IN HUMANITIES

The Department of English participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in English and Humanities. Candidates for this degree may omit English 311 or 312 from their requirements, but must offer a reading knowledge in the three foreign languages (Latin, French, German) required by the Department of English. For a description of the Humanities program, and fellowships offered in connection with it, see the section “Humanities (Special Programs).”

FRESHMAN AND SOPHOMORE COURSES

The Department does not offer a prescribed course in remedial English. Students with special problems are offered tutorial help by instructors in regular Freshman English classes, or by special instructors, according to individual needs.

#1, 2, 3. Freshman English—Writing, chiefly expository, emphasizing the control of meaning through critical and creative thinking, and through mastery of style. Introduction to the criticism of literature. (Appel and Guerard, Directors, with Felstiner, Fifer, Franklin, Friedlander, Grommon, Harris, Moser, Polhemus, Ruotolo, Scothcroft, Stone, Watt, and Staff.)

1. A course in writing, reading, and thinking designed to help the student write lucid and persuasive prose. Study of the serious essay as an instrument of social criticism and of humane discourse on man and his environment.
3 units, autumn

2. Continuation of 1. Emphasis on tone and style, and on the imaginative enrichment of prose; introduction to the novel and the short story.
3 units, winter

3. Continuation of 2. Exercises in precise and evocative writing of various kinds; study of poetry, drama, and literary criticism.
3 units, spring

#1F, 2F. Freshman English—For foreign students.
1F. A specially designed course in expository writing which undergraduate foreign students may substitute for 1.
3 units, winter

2F. Continuation of 1F.
3 units, spring

#1S, 2S, 3S. Freshman English (Special)—Sections of 1, 2, and 3 for students of exceptionally high aptitude and achievement, paralleling the regular sections, but offering more advanced training. Open by invitation. (Kolve, Director, with Carnochan, Evans, Polhemus, Rebholz, Trimpi.)
1S. A course in advanced composition with study of expository prose.
3 units, autumn
2S. Continuation of 1S, with emphasis on prose fiction.  
3 units, winter

3S. Continuation of 2S, with emphasis on poetry, drama, and literary criticism.  
3 units, spring

4. Freshman English (Seminars)—Open by invitation to a limited number of students of creative ability who have already shown (in English 1, 2, 1S, or 2S) the capacity to write lucid expository prose. There will be small groups devoted to various kinds of writing, including fiction and poetry. The seminar may replace, for those invited, one quarter of regular or special Freshman English. Where 4 is substituted for 3 or 3S, an introduction to poetry will be included.  
3 units, winter, spring, (Appel, Guerard, Directors, Staff)

5. Narration—Basic problems of narrative and imaginative writing. Prerequisite: 3.  
3 units, autumn, (Packer), (I) MWF 1:15; (———), (II) MWF 1:15; (———)  
winter, (Fuller), (I) MWF 1:15; (———), (II) MWF 1:15; (———)  
(III) MWF 1:15  
spring, (Fuller), (I) MWF 1:15; (Harris), (II) MWF 1:15

#7. Masterpieces of English Literature—Intensive study of a few masterpieces of English literature from various centuries, including poetry, drama, the essay, the novel.  
4 units, autumn, (Watt), TWThF 10

#9. Masterpieces of American Literature—Intensive study of a few masterpieces of American literature, including poetry, drama, the essay, the novel.  
4 units, spring, (———), MWThF 10

#25. Shakespeare—Rapid reading of about half the plays and poems in chronological sequence.  
4 units, autumn, (Friedlander), MTWF 9  
winter, (Rebholz), MTWF 10

#75, 76, 77. 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, spring, (Ruotolo), MWThF 9

76. Introduction to Poetry—Prosody, poetic forms and types, critical theories regarding poetry. Masterpieces of English poetry will be studied in the light of these theories.  
4 units, winter, (Stone), MTWF 10

77. Introduction to the Drama—Principal dramatic forms; development of dramatic art; masterpieces of the theater from various periods, countries.  
4 units, winter, (Friedlander), MTWF 9


JUNIOR AND SENIOR COURSES

The following courses (100-184) are open to juniors and seniors of all departments. Well-prepared sophomores may be admitted, but only by special permission of the instructor. Freshmen and sophomores who do not have such permission may be refused admission to the courses. Students in other departments may be especially interested in the following introductory courses: 100, The English Bible as Literature; 102, Introduction to the English Language; 177-178, an introductory survey of American literature; and 182-184, an introductory survey of English literature.
100. The English Bible as Literature—Readings in Old and New Testaments and selected books of the Apocrypha, with some attention to the history of the English Bible and use made of Biblical themes in English literature.

4 units, to be given in 1966–67

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
spring, (Oliphant), 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, or 11
winter, (______), MWF 9, 10, or 11
spring, (______), MWF 9, 10, or 11
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. May be repeated for credit. Prerequisite: 5.

3 to 5 units, autumn, (Packer), (I) MW 2:15-4:05; (Fuller), (II) TTh 2:15-4:05
winter, (Scowcroft), (I) MW 2:15-4:05; (Packer), (II) TTh 4:15-6:05
spring, (McClanahan), (I) TTh 2:15-4:05; (Fuller), (II) MW 2:15-4:05
summer, (McClanahan), MW 2:15-4:05

134. Directed Writing: Poetry—Intermediate course in writing various types of verse. May be repeated for credit.

4 units, winter, (Trimpi), MW 2:15-4:05

141. Chaucer—Enrollment in any given term limited to 70. Each student must sign up in the Department office during May preregistration for a place in one of the sections taught the following year.

4 units, autumn, (Ryan), MTWF 9
winter, (Kolve), MTThF 1:15
spring, (Oliphant), MTWF 9

142. Spenser.

4 units, to be given in 1966–67

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, to be given in 1966–67

145. Donne and Jonson.

4 units, spring, (Trimpi), MTWF 9

146. Swift and Pope.

4 units, to be given in 1966–67

147. Johnson and His Circle.

4 units, to be given in 1966–67


4 units, to be given in 1966–67

149. Byron, Shelley, and Keats.

4 units, to be given in 1966–67

150. Dickens and Trollope.

4 units, winter, (Polhemus), MTWF 9

151. Matthew Arnold.

4 units, to be given in 1966–67
152. Browning and Tennyson.
4 units, autumn, (Stone), MTWF 10

154. Modern British Comic Writers—The nature and uses of comic modes—Wilde, Shaw, Waugh and others.
4 units, winter, (Felstiner), MTWF 10

4 units, spring, (Moser), MTWF 10

#171. Contemporary Drama—Ibsen, subsequent dramatists—English, Continental, American. Lectures, discussions; critical papers.
4 units, winter, (Dodds), MTWTh 9
summer, (Dodds), MTWThF 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 1966-67

173. Twentieth Century English Fiction.
4 units, summer, (Ruotolo), MTWThF 11

177. American Literature to 1855.
4 units, winter, (Levin), TWThF 9

178. American Literature, 1855 to the Present.
4 units, spring, (Simpson), TWThF 9

182, 183, 184. English Literature—A basic survey required of all English majors. Students will attend two or three general lectures weekly and participate in a two-hour seminar.

182. English Literature: the Renaissance.
5 units, autumn, (Rebholz, Ryan), MWF 10; seminars by arrangement

183. English Literature: Neoclassicism and Romanticism—Prerequisite: 182.
5 units, winter, (Fifer), MWF 10; seminars by arrangement

184. English Literature: Victorian and Modern—Prerequisite: 183.
5 units, spring, (Ruotolo), MWF 10; seminars by arrangement

189. Special Work—Under exceptional circumstances advanced undergraduate students may enroll for special work under supervision of some member of the Department for credit not to exceed four units a quarter.
Any quarter, by arrangement

190. Tutorial Work, Department Honors Program.
Any quarter, by arrangement

English 192 and 196 are open only to senior English majors and to juniors in the English Honors Program. Enrollment is strictly limited. Each student must sign up for a senior seminar during the previous May preregistration period. The class lists, under Professor Evans' jurisdiction, will contain specific topics and prerequisites. Topics will vary from instructor to instructor and quarter to quarter.

192. Senior Seminar in English Literature.
4 units, autumn, (Harris), (I) MW 2:15-4:05; (Trimpi), (II) MW 4:15-6:05; (Carnochan), (III) TTh 4:15-6:05; (Oliphant), (IV) TTh 2:15-4:05
winter, (Ruotolo), (I) MW 4:15-6:05; (Watt), (II) TTh 2:15-4:05; (Loftis), (III) TTh 4:15-6:05
spring, (Friedlander), (I) MW 2:15-4:05; (Felstiner), (II), MW 4:15-6:05

196. Senior Seminar in American Literature.
4 units, autumn, (Franklin), TTh 2:15-4:05
winter, (Grommon), (I) MW 2:15-4:05; (Appel), (II) TTh 2:15-4:05
spring, (Levin), TTh 4:15-6:05
ADVANCED UNDERGRADUATE AND GRADUATE COURSES

[N.B.] Though these courses are designed primarily for English majors, graduate students in other departments who wish to broaden their programs will find many of them useful on the same basis as the Graduate Division Special Courses.

201. The Writing of Poetry—Primarily for students seriously interested in the composition of poetry. First- and second-year students may be admitted to this course and to 251 upon application. 251 must be taken simultaneously with 201 or before it. Permission of the instructor required. May be repeated for credit.

2 units, autumn, (Winters), TF 1:15
winter, spring, (Winters), TTh 1:15

203. Advanced Fiction Writing—A workshop group open by permission to graduates and exceptionally advanced seniors. All applicants should leave samples of writing with the Creative Writing secretary at least ten days before the beginning of each quarter.

2 to 5 units, autumn, winter, (Stegner), TTh 2:15-4:05
spring, (Scowcroft), TTh 2:15-4:05

204. Advanced Exposition—Advanced course dealing with problems of writing for professional purposes. Prerequisite: 3 or equivalent

3 units, 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, (Oliphant), MWF 3:15


4 units, to be given in 1966-67

231. Medieval Literature—An introduction to the literature of medieval England, exclusive of Chaucer. The Anglo-Saxon poems are read in translation, the major poems of the fourteenth and fifteenth centuries in the original language. Prerequisite: 141 or equivalent.

4 units, spring, (Kolve), MTWF 9

237. The English Drama to 1642.

4 units, winter, (Loftis). TWThF 11

238. Drama of the Restoration and Eighteenth Century.

4 units, summer, (Loftis), MTWF 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, (Watt), MTWF 10

242. The English Novel in the Nineteenth Century—Study of the most significant novels, with emphasis on development of the form.

4 units, spring, (Stone). TWThF 1:15

244. The Impressionist and Experimental Novel—Prerequisite: 172 or graduate standing.

4 units, summer, (Guerard). MW 2:15-4:05

251. The English Lyric—Historical examination of lyric poetry considered in respect to distinctions and historical relationships of schools and movements.

4 units, autumn, (Winters), TWThF 11

252. English Poetry of the Nineteenth Century.

4 units, spring, (Guerard). TWThF 11

255. The Development of the Short Story.

4 units, winter, (Stegner), TWThF 11


4 units, spring, (Simpson), TWThF 11

265. Hawthorne and Melville.

4 units, winter, (Franklin), MTWF 10
SCHOOL OF HUMANITIES AND SCIENCES

266. Chief American Poets, from 1630 to the Present.
4 units, winter, (Winters), TWThF 11
267. Emerson and Thoreau.
4 units, spring, (Gronnon), MTWF 1
268. Narrative Prose in America—A study of most significant nonfictional narrative works, with emphasis on history and biography, including autobiography.
4 units, autumn, (Levin), TWThF 11
269. Twain, Howells, and James.
4 units, autumn, (Simpson), TWThF 9
270. Contemporary American Fiction—Study of representative novels and stories from Wharton to Nabokov.
4 units, autumn, (Appel), MTWF 1:15
278. Popular Ballad and Folksong.
4 units, winter, (Simpson), TWThF 11
299. Advanced Work in Writing and Criticism.
Any quarter, by arrangement

Curriculum and Instruction in Secondary School English I—See Education 262.

GRADUATE COURSES

[N.B.] All graduate seminars are limited in enrollment. Students must obtain the approval of the instructor and sign his seminar list before registering.

300. Thesis.
Any quarter, by arrangement
302. Introduction to Renaissance Bibliography—An introduction to tools and methods for graduate study in the Renaissance, especially historical and textual research. Recommended for students who expect to do advanced work in the Renaissance.
1 unit, winter, (Kocher), W 1:15
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, autumn, (Dodds), MW 2:15-4:05
304. Seminar in Modern Literary Criticism—The use of literary criticism in graduate study and in teaching.
4 units, to be given in 1966-67
305. Seminar in the History of Literary Theory.
305a. The Classical and Medieval Backgrounds—(305a may be taken independently of 305b).
4 units, winter, (Trimpi), MW 4:15-6:05
305b. The Renaissance—Prerequisite: 305a.
4 units, spring, (Trimpi), MW 4:15-6:05
4 units, winter, (Winters), TTh 4:15-6:05
307. Seminar in the Novel—Prerequisite: The equivalent of 241, 242, 265, or 270.
4 units, autumn, (Scowcroft), TTh 2:15-4:05
4 units, spring, (Carnochan), TTh 4:15-6:05
4 units, summer, (Guerard), TTh 2:15-4:05
310. Old English—Elements of Old English grammar; reading exercises.
4 units, autumn, (Meritt), (I) TWThF 9; (Oliphant), (II) TWThF 10
311. **Beowulf**—Prerequisite: 310 or equivalent.  
4 units, winter, (Mcritt), TWThF 9

312. **Middle English**—History, dialects of Middle English; readings of representative selections from the literature. Prerequisite: 310 or equivalent.  
4 units, winter, (Oliphant), MTWF 10

314. **Seminar in Old English Poetry**—Exclusive of Beowulf.  
4 units, autumn, (Mcritt), TWThF 11

316. **Seminar in Elizabethan Language**—Vocabulary, pronunciation, grammar, orthography of the period. Prerequisite: 312 or equivalent.  
4 units, to be given in 1966–67

318. **Seminar in Middle English Literature**—Prerequisite: 312 or equivalent.  
4 units, to be given in 1966–67

320. **Seminar in Chaucer**—*Troylus and Criseyde* in some years, selected short poems in others; structure, history of the works, their literary significance. 1966: A study of the *Canterbury Tales* and the modes of medieval fiction. Prerequisite: 141 or equivalent.  
4 units, winter, (Kolwe), TTh 4:15–6:05

322. **Seminar in Medieval Drama.**  
4 units, to be given in 1966–67

325. **Shakespeare Seminar**—Prerequisites: The equivalent of 25 or 143, 182 or 330, and 237.  
4 units, to be given in 1966–67

330. **Proseminar: English Literature of the Sixteenth Century**—Special arrangements will be made to accommodate students who need this proseminar in 182.  
4 units, to be given in 1966–67

331. **Seminar in Literary Problems of the English Renaissance**—Prerequisite: 182 or 330, or equivalent.  
331a. **Jacobean Drama**—Additional prerequisite: 237 or equivalent.  
4 units, to be given in 1966–67

331b. **Seminar in Marlowe.**  
4 units, to be given in 1966–67

331c. **Natural and Moral Philosophy: Bacon.**  
4 units, autumn, (Kocher), MW 4:15–6:05

331e. **English Drama before Shakespeare.**  
4 units, autumn, (Kocher), TTh 4:15–6:05

331f. **Seminar in the Poetry of Spenser.**  
4 units, spring, (Rebholz), MW 2:15–4:05

334. **The Age of Milton.**  
334a. **Proseminar: Seventeenth Century Backgrounds**—Special arrangements will be made to accommodate students who need this proseminar in 182.  
4 units, to be given in 1966–67

334b. **Seminar: Problems in Seventeenth Century Literature**—Prerequisite: 330 or 334a, or equivalent.  
4 units, to be given in 1966–67

340. **Proseminar: Eighteenth Century Backgrounds.**  
4 units, autumn, (Fifer), TTh 2:15–4:05

341. **Literary Problems of the Restoration and Eighteenth Century**—Prerequisite: 183 or 340, or equivalent.  
341a. **Seminar in Eighteenth Century Fiction.**  
4 units, winter, (Watt), MW 2:15–4:05
4 units, summer, (Loftis), TTh 2:15-4:05

341c. Johnson and His Circle.  
4 units, to be given in 1966-67

4 units, to be given in 1966-67

351. Literary Problems of the Romantic Period—Prerequisite: 184 or 350, or equivalent treatment of Romantic period.  
351c. Nineteenth Century Poetry.  
4 units, summer, (Ruotolo), MW 4:15-6:05

354. Victorian Prose: Carlyle and Arnold.  
4 units, to be given in 1966-67

358. Seminar: Literary Problems of the Nineteenth Century—Prerequisite: 184 or 350, or equivalent.  
358a. Nineteenth Century Comic Fiction.  
4 units, autumn, (Polhemus), MW 2:15-4:05

358b. George Eliot and Her Milieu.  
4 units, spring, (Stone), TTh 2:15-4:05

358d. The Bloomsbury Group.  
4 units, to be given in 1966-67

361. Seminar in American Critics—Prerequisite: 266 or equivalent.  
4 units, to be given in 1966-67

4 units to be given in 1966-67

371. Seminar in American Historians as Men of Letters—Prerequisite: 268 or equivalent.  
4 units, spring, (Levin), MW 4:15-6:05

4 units, winter, (Levin), TWTthF 11

377. Seminar in American Literature of the Colonial Period—Prerequisite: 177 or equivalent.  
4 units, to be given in 1966-67

381. Seminar in Problems in American Literature of the Nineteenth Century.  
4 units, to be given in 1966-67

381b. Studies in Realism and Naturalism.  
4 units, autumn, (Simpson), MW 4:15-6:05

381c. Utopian Fiction.  
4 units, spring, (Franklin), MW 4:15-6:05

381d. Faulkner.  
4 units, winter, (Moser), TTh 4:15-6:05

395. Research Course—Student pursues a special subject of investigation under supervision of some member of Department. Thesis work not to be registered under this course.  
Any quarter, by arrangement

399. Seminar in the Teaching of Composition—Open only by permission of the Director of Freshman English.  
2 units, spring, (Gencard), W 7-9 p.m.

The English Review Club meets two times quarterly to discuss recent publications and creative work of interest to graduate students in English.

See also Senior Colloquia.
FRENCH and ITALIAN

Emeriti: Georges Edouard Lemaitre, Roberto B. Sangiorgi, Stanley Astredo Smith (Professors); Earl Kendall Carter, Jessie E. Smith (Assistant Professors)

Executive Head: John Clarke Lapp

Professors: Giovanni Cecchetti, Robert G. Cohn, Raymond Giraud, Alphonse Georges Juilland, John Clarke Lapp, Robert Louis Politzer, Leo Weinstein

Associate Professors: Alexander E. A. Naughton, Pauline Newman-Gordon

Assistant Professors: William C. Calin, Michael T. Cartwright, Ralph M. Hester, Vincenzo Paolo Traversa

Instructors: John George Barson, Marc Bertrand, Jean Bessière, Cosimo Donaldo Corsano, Henri Diament, Carla Federici

Lecturers: Clio P. Dorr, Jacqueline Ollivier

The Department accepts candidates for the degrees of Bachelor of Arts, Master of Arts (see below under "Advanced Degrees"), and Doctor of Philosophy in French and for certification as high school and junior college teachers. Special consideration is given to the needs of those who intend to make teaching their profession.

PROGRAMS OF STUDY

Bachelor of Arts in French

Candidates must have completed the first- and second-year courses in reading, composition, and conversation (or their equivalent) offered in French.

Candidates are expected to complete a minimum of 39 units, selected with the approval of their adviser, from courses numbered 100 and higher. These 39 units must include:

For French majors: Fr111, Fr112, Fr113, Fr121, and Fr130, Fr131, and Fr132, plus 24 additional units in literature, to include two of Fr151, Fr152, Fr153.

Teaching Credentials

For information concerning the requirements for teaching credentials, consult the "School of Education" section of this Bulletin and the Credential Secretary, School of Education.

Master of Arts in Teaching

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

Stanford Program in Nantes—(For French majors only.)

Each year French majors, in their junior year, may apply for the Departmental program at the University of Nantes during the winter and spring quarters. Students reside in the Cité Universitaire, attending courses both at the University and with the faculty supervisor who accompanies the group. Applications must be received by June 30 of the preceding year. Forms and information may be obtained from the Department.
Intensive Language Work in European Study Centers—(Open to all students.)

Each student accepted by the Committee on General Studies for work at a Stanford center in Tours, France or Florence, Italy will complete twelve units of Intensive French or Italian during the six months of his residence abroad. The intensive work is oriented to the development of the student's individual ability to understand, speak, write, and read French or Italian. All courses regardless of the level at which the work is completed bear the designation Fr80, 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.

ADVANCED DEGREES

Candidates should read carefully the general regulations governing advanced degrees in the section “Degrees” in this Bulletin. Applicants for admission to graduate studies must have an undergraduate major in French with an average grade of B (or the equivalent). They should have reached a high level of speaking proficiency, to be demonstrated either through a personal interview or by a tape recording forwarded to the Department. They must also have a minimum of two years of high school Latin or the equivalent and be prepared to take examinations testing their ability to read Latin, German, and one additional Romance language, preferably Italian.

In general, only applicants who seem fully qualified to attempt the Ph.D. will be admitted to graduate standing in the Department (except for candidates for the Master of Arts in Teaching). The course requirements for the A.M. are prerequisite for the Ph.D., but the degree of Master of Arts is not a prerequisite, and the program for the A.M. is maintained primarily for graduate students who may wish to write a Master's thesis or who may for one reason or another find themselves unable to continue to the Ph.D.

Master of Arts: French

1. Language requirements. Reading knowledge of the second Romance language should be demonstrated by passing an examination not later than the second quarter of residence.

2. Course requirements:

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>a) Advanced composition Fr201 ........................................ 4</td>
</tr>
<tr>
<td>b) History of the French Language Fr225 ............................. 3</td>
</tr>
<tr>
<td>c) Three graduate courses in literature, of which one must be a 12</td>
</tr>
<tr>
<td>seminar ..................................................</td>
</tr>
<tr>
<td>d) Electives, to be chosen with the approval of the graduate adviser 14–15</td>
</tr>
<tr>
<td>(students preparing for a degree with specialization in French Linguistics should take linguistics courses as electives)</td>
</tr>
<tr>
<td>e) Thesis ..................................................... 6</td>
</tr>
</tbody>
</table>

Total .................................................... 39–40

Note—Students already holding the A.M. must satisfy the Department that they have met the equivalent of these requirements before admission.

Doctor of Philosophy: French

General Requirements—Candidates are expected to have completed the equivalent of the above course requirements for the Master of Arts degree in French. All candidates, regardless of their field of specialization, are expected to fulfill the following general requirements:
1. Language requirements. A reading knowledge of Latin and German, to be tested by examination.

2. Course requirements. The equivalent of nine units of literature in Italian or Spanish (at the level of 130, 131, 132). French 310 and either French 311 or 320. Four seminars in literature, at least two of which are to be outside the candidate’s special field of interest.

3. Oral and written examinations
   a) The student must pass, normally at the end of the second year of graduate study, oral and written examinations in four fields of French literature, a field being defined as a century.
   b) The student must pass, normally at the end of the second year of graduate study, a written examination in the history of the French language and the principles of general and descriptive linguistics.

4. Submit a doctoral dissertation worthy of publication as a contribution to study in the field.

Specialisation—Requirements of specialization in linguistics or literature are as follows:

1. 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.

2. 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 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).”

COURSES OPEN TO ALL STUDENTS

The courses in this section do not require a knowledge of any language other than English.

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, (______), to be given in 1966–67

AF, French

#AF160. Molière—Representative comedies of Molière in English translation.

3 units, spring, (Weinstein), TTh 10

#AF170. The Nineteenth Century French Novel in Translation.

3 units, winter, (Naughton), TTh 10
Contemporary French Novelists—Significant authors of contemporary France: Proust, Gide, Malraux, Sartre, Camus, etc. Lectures, readings in English.

3 units, winter, (Cohn), TTh 11

Dante in English—Reading, interpretation of Vita Nuova and The Divine Comedy in translation.

3 units, autumn, (———), to be given in 1966–67

The High Renaissance—Given only at Stanford in Italy.

2 units, autumn, (Frulla)

The Contemporary Italian Novel in Translation—Reading, discussion of significant novels of such authors as Silone, Berto, Moravia, Verga, Pratolini.

3 units, spring, (Traversa), to be given in 1966–67

FR. FRENCH COURSES

FIRST- AND SECOND-YEAR
[Under the direction of Ralph M. Hester]

Note—Students registering for the first time in a first- or second-year course must take a placement test, if they have had any training in French before entering Stanford. Tests will be given September 23, 27, 29 and October 4 (for autumn quarter); November 22 and January 3 (for winter quarter); February 23 and March 28 (for spring quarter).

First-Year French.

Fr1. First-Year French.
4 units, autumn, winter, spring, (Staff), MTWThF

Fr2. First-Year French—Continuation of Fr1.
4 units, autumn, winter, spring, (Staff), MTWThF

Fr3. First-Year French—Continuation of Fr2.
4 units, autumn, winter, spring, (Staff), MTWThF

Intensive French for Beginners—(Equivalent to Fr1 and Fr2.) Offers preparation in speaking, writing, and reading the language.
8 units, summer, (Staff), MTWThF

Elementary French—A reading course in French for students seeking to fulfill the University requirement of a reading knowledge for the Ph.D. degree. Open to seniors and graduate students only.
2 units, winter, spring, (Staff), MWF 8
summer, (Staff), MTWTh 8

Second-Year French—Prerequisite: Fr3.
3 units, autumn, winter, spring, (Staff), MTWTh

Second-Year French—Continuation of Fr22.
3 units, autumn, winter, spring, (Staff), MTWTh

Second-Year French—Continuation of Fr23.
3 units, autumn, winter, spring, (Staff), MTWTh

Conversation française premier degré—Prerequisite: Fr3 or equivalent.
1 unit, autumn, winter, spring, (Staff), TTh 9 and TTh 1:15

Conversation française deuxième degré—Prerequisite: Fr23 or equivalent.
1 unit, autumn, winter, spring, (Staff), TTh 9 and TTh 1:15

Cours pratique de littérature—Composition littéraire, lecture et explication de textes littéraires divers. Satisfies General Studies requirements under "C." Prerequisite: Fr23 or equivalent.
4 units, autumn, winter, spring, (Staff), MTWThF
#Fr82–86. Intensive French—Given only at Stanford in France.
6 units for each of two quarters, autumn-winter, spring-summer, (Staff), MTWTh two hours daily

Third- and Fourth-Year
Language Courses
[Under the direction of Ralph M. Hester]

Fr110. Cours de Phonétique—Prerequisite: Fr24 or equivalent.
3 units, autumn, winter, (Hester, Diamant), MWF 11

Fr111. Third-Year French Grammar and Composition—Prerequisite: Fr24 or equivalent.
3 units, autumn, (Cartwright), MWF 11; (Diamant), MWF 1:15

Fr112. Third-Year French Grammar and Composition—Continuation of Fr111.
3 units, winter, (Cartwright), MWF 11; (Diamant), MWF 1:15

Fr113. Third-Year Grammar and Composition—Continuation of Fr112.
3 units, spring, (Cartwright), MWF 11; (Diamant), MWF 1:15

Fr121. Advanced French Composition and Grammar—Prerequisite: Fr54 or equivalent.
4 units, winter, (Cartwright), MTTh 2:15

Literature Courses

#Fr130. Introduction à la littérature française—Moyen-Age et 16ème siècle: choix de textes, explication de textes, composition littéraire. Prerequisite: Fr24 or equivalent.
3 to 4 units, autumn, (Cartwright), (I) MWF 8; (Calin), (II) MWF 11
spring, (Hester), MWF 11

#Fr131. Introduction à la littérature française—17ème et 18ème siècles. Prerequisite: Fr 24 or equivalent.
3 to 4 units, autumn, (Newman-Gordon), MWF 11
winter, (Bertrand), MWF 11

#Fr132. Introduction à la littérature française—19ème et 20ème siècles. Prerequisite: Fr 24 or equivalent.
3 to 4 units, winter, (Newman-Gordon), (I) MWF 11; (———), (II) MWF 1:15
spring, (Bertrand), (I) MWF 11; (———), (II) MWF 1:15

Note—Prerequisites for the following courses are Fr130, Fr131, and Fr132 or Fr85, and Fr86 or equivalent.

4 units, winter, (Calin), MWF 1:15

#Fr140. Littérature de la Renaissance I—Rabelais, les poètes lyonnais, les poètes de la Pléiade.
4 units, autumn, (Hester), to be given in 1966–67

#Fr141. Littérature de la Renaissance II—Montaigne, les poètes baroques; le théâtre.
4 units, winter, (Hester), to be given in 1966–67

#Fr150. Le XVIIème siècle I—Poésie et roman: les poètes baroques, Théophile de Viau, Saint-Amant, Tristan l'Hermite; les Fables de La Fontaine; Mme de La Fayette: La Princesse de Clèves; Boileau: L'Art poétique; Fénelon: Télémaque.
4 units, autumn, (Lapp), MWF 1:15
SCHOOL OF HUMANITIES AND SCIENCES

Fr 151. Le XVIIème siècle II—La tragédie; Racine: Andromaque, Athalie, Britannicus, Iphigénie; Corneille: Horace, Cinna, Polyèbe, Nicomède.
4 units, winter, (——), MWF 1:15

Fr 152. Le XVIIème siècle III—Moralistes et prédicateurs: Pascal, Pensées; La Rochefoucauld, Maximes; Bossuet, Sermons. Le théâtre de Molière.
4 units, spring, (Lapp), MWF 1:15

4 units, winter, (Cartwright), MTTh 12, to be given in 1966-67

Fr 161. Le XVIIIème siècle II—Roman et théâtre. Roman: Prévost, Manon Lescaut; Diderot, La Religieuse; Rousseau, La Nouvelle Héloïse. Théâtre: Lesage, Turcaret; Marivaux, Le Jeu de l'Amour et du Hasard; Beaumarchais, Le Barbier de Séville.
4 units, spring, (Cartwright), MTTh 12, to be given in 1966-67

4 units, (Giraud), MWF 10, to be given in 1966-67

4 units, (Giraud), MWF 10, to be given in 1966-67

4 units, autumn, (Giraud), MWF 10

Fr 180. Le XXème siècle I—La Poésie française de Valéry au Surréalisme.
4 units, autumn, (Newman-Gordon), MWF 9

Fr 181. Le XXème siècle II—Le Théâtre française de Claudel à Ionesco.
4 units, winter, (Newman-Gordon), MWF 9

Fr 182. Le XXème siècle III—Le Roman en France depuis 1898.
4 units, spring, (Newman-Gordon), MWF 9

Fr 190. French Poetry—French lyrical poetry, Villon to Valéry.
4 units, winter, (Naughton), MWF 11, to be given in 1966-67

Fr 199. Individual Work—Open only to majors in French and with special permission of the Department. May be repeated for credit.
1 to 3 units, each quarter, (Staff), by arrangement

Advanced Undergraduate and Graduate Courses

Fr 201. Advanced Composition and Grammar—Prerequisite: Fr 121 or equivalent.
4 units, winter, (Naughton), MWF 9

Fr 204. Études de style.
4 units, (Juilland), to be given in 1966-67

Fr 205. Modern French—Phonology, morphology, and syntax.
3 units, (——), to be given in 1966-67

Fr 210. Cours de style avancé—Perfectionnement de la langue écrite; traduction de prose et de vers; composition.
3 units, autumn, (——), TTh 1:15

3 units, autumn, (Calin), MWF 2:15

Fr 252. La Renaissance en France I—Rabelais et Montaigne.
4 units, winter, (Lapp), T 2:15-4:05

Fr 253. La Renaissance en France II—Les poètes de la Pléiade et les poètes baroques de la fin du XVIIème siècle.
4 units, spring, (Lapp), T 2:15-4:05
Fr263. Le Théâtre classique français—Corneille, Mollière, Racine.
4 units, autumn, (Lapp), TTh 2:15, to be given in 1966-67

Fr273. Le Roman au XVIIIe siècle—Rousseau, Prévost, Lacos, and others.
4 units, (Cartwright), to be given in 1966-67

Fr275. La “grande génération”—Proust, Gide, Péguy, Claudel, Romain Rolland, Valéry.
3 units, spring, (Newman-Gordon), to be given in 1966-67

4 units, (Weinstein), to be given in 1966-67

Fr288. Baudelaire.
4 units, winter, (Cohn), to be given in 1966-67

Fr289. The Symbolist Poets—Baudelaire, Verlaine, Rimbaud, Mallarmé, Laforge, etc.
4 units, (Cohn), TTh 1:15

Graduate Courses in French and French Literature

Fr310. Grammaire historique française—Elements of phonology and morphology. A knowledge of Latin is required.
3 units, spring, (——), F 3:15-5:05

Fr311. Old French Texts—Reading and philological interpretation of selected Old French Texts. Prerequisite: Fr225.
3 units, winter, (Calin), TTh 2:15

Fr320. Old and Middle French Literature—An introduction to Medieval scholarship. Prerequisite: Fr311.
4 units, spring, (——), to be given in 1966-1967

Fr325. Cours de méthode—Méthode critique et bibliographique, préparation de thèses.
2 units, (Lapp), to be given in 1966-67

Fr350. Graduate Seminar.

Corneille.
4 units, spring, (Lapp), to be given in 1966-67

Montaigne.
4 units, winter, (Lapp), to be given in 1966-67

Mallarmé.
4 units, autumn, (Cohn), W 2:15-4:05

Medieval Allegory: Le Roman de la Rose.
4 units, spring, (Calin), M 2:15-4:05

Flaubert.
4 units, spring, (Giraud), to be given in 1966-67

Claudel.
4 units, spring, (Naughton), T 2:15-4:05

Fr363. Pascal—Lectures in French.
3 units, (Naughton), MWF 9, to be given in 1966-67

Fr364. Racine—Lectures in French.
3 units, spring, (Naughton), to be given in 1966-67

Fr372. Diderot—Lectures in French.
4 units, spring, (Cartwright), to be given in 1966-67

Fr375. Rousseau—Lectures in French.
4 units, spring, (Cartwright), Th 2:15-4:05

Fr384. La Critique littéraire au XIXe siècle—Sainte-Beuve, Taine, Brunetièrè, and others.
3 units, spring, (Weinstein), W 2:15-4:05
  3 units, (Newman-Gordon), to be given in 1966–67
Fr390. Proust—Lectures in French.
  3 units, spring, (Newman-Gordon), TTh 1:15
Fr391. Gide—Lectures in French.
  3 units, spring, (Giraud), to be given in 1966–67
Fr392. Le Théâtre contemporain.
  4 units, autumn, (Giraud), Th 2:15–4:05
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.

#Itl. First-Year Italian.
  4 units, autumn, winter, spring, (Staff), MTWThF
#It2. First-Year Italian.
  4 units, autumn, winter, spring, (Staff), MTWThF
#It3. First-Year Italian.
  4 units, autumn, winter, spring, (Staff), MTWThF
#It5. Intensive Italian for Beginners—Equivalent to Itl and It2. Offers preparation in speaking, writing, and reading the language.
  8 units, summer, (Staff), MTWThF
#It10. Basic Italian—A reading course in Italian for students seeking to fulfill University requirements of reading knowledge for the Ph.D. degree. Open to senior and graduate students only.
  2 units, autumn, spring, (Staff), MTTh 10
#It22. Second-Year Italian—Prerequisite: It3 or equivalent.
  3 units, autumn, winter, spring, (Staff)
#It23. Second-Year Italian—Continuation of It22.
  3 units, autumn, winter, 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
#It11. Italian Composition and Conversation.
  3 units, autumn, (——), to be given in 1966–67
It112. Italian Composition and Conversation—Continuation of It11.
  3 units, winter, (——), to be given in 1966–67
It113. Composition, Grammar and Conversation—Continuation of It112.
  3 units, spring, (——), to be given in 1966–67
#It130. Introduzione allo studio della letteratura italiana I—Dalle origini alla fine del Quattrocento. Prerequisite: It23 or equivalent.
  3 units, autumn, (Cecchetti), MWF 1:15
#It131. Introduzione allo studio della letteratura italiana II—Dal Cinquecento al tardo Settecento. Prerequisite: It23 or equivalent.
  3 units, winter, (Cecchetti), MWF 1:15
#It132. Introduzione allo studio della letteratura italiana III—Dal tardo Settecento al Novecento. Prerequisite: It23 or equivalent.
  3 units, spring, (Cecchetti), MWF 1:15
#It151. Dante, La Divina Commedia—Studio e interpretazione.
  4 units, winter, (——), to be given in 1966–67
#It152. Dante, La Divina Commedia—Studio e interpretazione.
  4 units, spring, (——), to be given in 1966–67
Itl61. Letteratura Italiana del Medioevo—Il corso non include lo studio de La Divina Commedia. Conferenze, letture e saggi.
  3 units, autumn, (———), to be given in 1966-67

#Itl62. Umanesimo e Rinascimento—Storia della letteratura e della cultura italiana nel Quattrocento e nel Cinquecento. Conferenze, letture e saggi.
  3 units, winter, (———), to be given in 1966-67

#Itl63. Classicismo e Romanticismo—Vari aspetti del classicismo e del romanticismo italiano nell'Ottocento. Conferenze, letture e saggi.
  3 units, winter, (———), to be given in 1966-67

#Itl65. Il dramma italiano moderno—Studio delle opere drammatiche più significative da Goldoni a Pirandello.
  3 units, spring, (Cecchetti), to be given in 1966-67

#Itl66. Il romanzo italiano contemporaneo—Studio degli aspetti più rilevanti del romanzo italiano nel tardo Ottocento e nel Novecento. Conferenze, letture e saggi.
  3 units, winter, (Traversa), to be given in 1966-67

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, (———), to be given in 1966-67

L204. Introduction to Romance Linguistics — Development of Romance languages from Vulgar Latin; phonology, morphology, syntax. Prerequisite: working knowledge of Latin.
  3 units, winter, (———), MWF 2:15

L250. Seminar in Romance Linguistics—Prerequisite: L204 or equivalent.
  2 units, (———), to be given in 1966-67

L270. Topics in Structural Linguistics.
  2 units, autumn, winter, (Juilland); to be given in 1966-67

T. TEACHER TRAINING COURSES

TF288. Methods of Teaching French—(Same as Education 288.)
  3 units, winter, (Politser), M 4:15-6:05 and by arrangement

See also Senior Colloquia.

GEOGRAPHY

Emeriti: C. Langdon White, Joseph E. Williams (Professors)

Acting Associate Professor: Joseph E. Terry

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, spring, (Terry), MTWThF 8
4. Economic Geography—Relation from the world point of view of man's industries—agriculture, lumbering, mining, fishing, manufacturing, transportation, commerce—to the natural environment.

5 units, autumn, (Terry), MTWThF 11

110. Geography of the United States—A regional survey of the United States as viewed against the physical and cultural background. The major patterns of each region will be analyzed and compared within the national framework.

5 units, winter, (Terry), MTWThF 8

120. Geography of South America—Systematic study of the countries of South America; territorial structure, resources, industry, communications; with special attention to the mutual interests of the United States and South American nations.

4 to 5 units, spring, (Terry), MTWTh 11

175. Individual Study in Geography—This course may be taken to do reading and work in geography. Prerequisite: 1, 4, 191 or equivalent. Geography 175 may not be repeated.

2 to 5 units, (Terry), by arrangement

191. Political Geography—Geographical pattern of major nations, territorial structure, resources, industry, communications, national aspirations, with special consideration to role of the United States in the world. Establishes a base for analyzing current international trends.

4 to 5 units, winter, (Terry), MTWTh 11

HISTORY

Emeriti: Carl Fremont Brand, Harold Henry Fisher, Ralph Haswell Lutz, Anatole G. Mazour, Edgar Eugene Robinson, Payson Jackson Treat (Professors)

Executive Head: To be announced


Associate Professors: Gavin I. Langmuir (on leave 1965-66), Rixford K. Snyder

Assistant Professors: Philip Dawson, Terrence Emmons, Paul S. Seaver, Lyman P. Van Slyke. Acting: John Davis Wirth

Lecturer: George S. Rentz

Instructors: The Staff of the History of Western Civilization

The Department of History offers to all students of the University courses of general cultural and educational value. It seeks not only to provide knowledge in special fields, but also to equip the student for his duties as a citizen and to give him instruction which will aid him in law, journalism, library work; in local, state, and national public service; and in business where a knowledge of domestic and foreign affairs is desirable.

The course in the History of Western Civilization, which surveys the development of the Western world from earliest times to the present, is required by the University of all students as a necessary part of a liberal education, and supplies a foundation for the other work in the Department.
PROGRAMS OF STUDY

Bachelor of Arts

The Department offers a variety of courses and programs for fulfilling the requirements of an undergraduate major in history. A student majoring in history must seek breadth of view by a choice of courses in three or more of the fields offered in the Department. In addition to Western Civilization, the major program must include at least one course in European or English history prior to 1600. For the degree of Bachelor of Arts, the Department requires completion of 48 units of work in history (introductory, intermediate, and advanced courses, seminars, individual reading), with an average grade of not less than C. Included in these 48 units, a basic seminar for 5 units is required. It will normally be taken in the junior or senior year.

Each undergraduate major in history shall select a minor program of at least 30 units. These units are to be distributed over no more than two fields of study; at least 20 units must be taken in courses numbered 100 or higher; and in the fields marked with an asterisk (*) courses numbered under 20 cannot be counted toward the minor. Fields accepted for the minor are defined as follows: anthropology; history of art and architecture; Asian languages*; classics*; history and theory of communication; dramatic literature and history of drama; economics; English (excluding courses numbered 5 and under); French*; geography; German*; Humanities Honors Program; Italian*; music (except composition or performance courses); philosophy; political science (including Law in Society 104); psychology (excluding courses primarily of a laboratory nature); religious studies; Russian and other Slavic languages*; Social Thought Honors Program; sociology; Spanish and Portuguese*. (Note: General Studies senior colloquia will not count toward a minor in history.)

The Cory and 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 undergraduate majors the Department offers a special program of senior research leading to Honors in history. Students accepted for this program, in addition to fulfilling the Departmental requirements for a major, will complete 60, instead of the normal 48, units of history, including a 15-unit senior essay, the work for which will normally begin in spring quarter of the junior year and be completed by end of winter quarter of the senior year. It is expected that much of the work of the first quarter would resemble directed reading under the guidance of the essay adviser to provide an opportunity for background reading and formulation of the essay topic. To undertake this program, the student must be accepted by a member of the Department who will agree to advise him on the essay. In accepting a student for a senior project, the adviser and the Department will take into account the student's general preparation in the field of his project, and his grade standing in history and in the University (at least a B average in each). The James Birdsall Weter scholarships in history are available to a limited number of honors students; and Weter prizes may be awarded each year to authors of outstanding essays.
History in the Secondary Teacher's Credential

Applicants for the Stanford Secondary Teacher's Credential in the social studies may get details of the requirements by applying to the Credential Secretary, School of Education.

Admission to Graduate Standing

All applicants for admission to graduate work are required to take the Aptitude Test of the Graduate Record Examination. This examination may be taken at most American colleges and by arrangement may be taken in nearly all foreign countries. For details concerning this test see the Information Bulletin. Overseas applicants, who may not receive the Information Bulletin promptly, should write directly to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey.

Graduate Study

Graduate students who are candidates for advanced degrees will be given personal guidance, but the purposeless graduate student will not be accepted by the Department. Work toward the Ph.D. degree is offered in a number of fields in which staff and library resources are unusually strong:

1. European History—(a) Middle Ages and the Renaissance and Reformation, especially the history of religion and technology; (b) Modern European History, especially the French Revolution and the Napoleonic period, for which Stanford has the Jarbo Collection; (c) History of Germany and France in the twentieth century; (d) History of Russia since 1914; (e) History of the Near East since 1914; (f) European History, 1914 to the present, with special reference to the origins, conduct, and results of World War I and World War II.

The rich, and in some respects unique, collections of the Hoover Institution on the causes, conduct, and results of World War I are being augmented for World War II and the period between these two wars. The materials include government documents, newspaper and serial files, and organization and party publications (especially British and German labor movements and the German Socialist parties). There are also important manuscript collections, including unpublished records of the Paris Peace Conference of 1919 and the Herbert Hoover Archives, which contain the records of the Commission for Relief in Belgium; the American Relief Administration; the various technical commissions established at the close of World War I for reconstruction in Central and Eastern Europe; the personal papers of Herbert Hoover as United States Food Administrator; and the personal papers of other important individuals. Other important materials for the period since 1914 relate to 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.

2. British History—(a) English History since 1200, for which the Library contains important documentary sets; (b) The British Empire and Commonwealth.

3. United States History—(a) British North America to 1783, for which the Library has an unusually complete collection of printed sources; (b) diplomatic history, for which Stanford has recently acquired virtually complete microfilmed records of the Department of State to 1906; (c) The National Period, for which the Library has extensive documents, newspapers, and manuscript collections; (d) History of the Far West, particularly California since 1848, for which use may be made of the Borel Collection.

4. Latin American History—particularly Brazil, for which the Library contains the important Branner Collection.
5. The Far East—(a) Diplomatic History of the Far East; (b) History of Japan; (c) History of China. The Stanford Library and Hoover Institution have important materials for Far Eastern History, including large holdings of works in Western languages, such as runs of important serials and newspapers and extensive documentary collections of World War II in Asia, and also basic source and reference materials in the Chinese and Japanese languages, especially for the nineteenth and twentieth centuries.

**Master of Arts**

The Department requires for the Master's degree the completion of 45 units of graduate study, at least 36 of which must be in the Department. The candidate's program must include two graduate seminars involving the preparation of research papers. A reading knowledge of one modern foreign language is required. The Department will not recognize for the degree requirements any work that has not received the grade of A, B, or plus.

**Master of Arts in Teaching (History)**

The Department cooperates with the School of Education in offering the Master of Arts in Teaching degree. For the general requirements, see description under section “School of Education” in this Bulletin. For certain additional requirements made by the Department of History, inquiry should be made to the History Department Office. Note that this program is open only to those with at least one year's teaching experience.

**Doctor of Philosophy**

General requirements relative to time, examination, and dissertation are stated in the section “Degrees” in this Bulletin. The Department requires a reading knowledge of two foreign languages, selected as having the greatest relevance to the student's dissertation and research program. In special cases, a coherent program of graduate courses outside the major and minor departments may be substituted for one foreign language.

The candidate is expected to plan his work and write his dissertation under the direction of the member of the Department designated as his adviser and sponsor. The Department requires preparation in one major field and two secondary fields. The major field is to be selected from the following: (1) Europe, 300-1400; (2) Europe, 1400-1789; (3) Europe since 1700; (4) Russia and East Central Europe; (5) The Near and Middle East; (6) East Asia; (7) Britain and the British Empire since 1485; (8) Latin America; (9) The United States (including Colonial America). The secondary fields are somewhat more limited in scope, and normally cover about half of one of the major fields listed above. Ancient Greece or Rome may also be chosen as a secondary field.

A minor in another department or a supporting program of not fewer than 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 several 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)
#2. History of Western Civilization—Major developments in Western Civilization in later Middle Ages, Renaissance, seventeenth and eighteenth centuries.
   4 units, winter, (Staff)
#3. History of Western Civilization—Nineteenth, twentieth centuries.
   4 units, spring, (Staff)

II. INTERMEDIATE COURSES

Courses numbered 10-99 are designed primarily for sophomores and juniors.

20. Medieval Europe, 300-1400—Emphasis on transition from ancient Mediterranean to European civilization, development of medieval social, cultural institutions and ideas.
   5 units, autumn, (Bark)
30. Europe in the Seventeenth and Eighteenth Centuries—Economic, political, cultural survey of seventeenth, eighteenth centuries.
   5 units, autumn, (Dawson)
   5 units, winter, (Harris)
32. Twentieth Century Europe—Political, social, economic, cultural developments to present. Not open to students who have had an advanced course in twentieth century European history.
   5 units, spring, (Wright)
60. Interpretive Survey of United States History.
   4 to 5 units, spring, (Bailey)
62. Nineteenth Century America—The period from 1800 to 1900 viewed as a whole in a series of topics selected because of their continuing relevance in the twentieth century.
   4 to 5 units, autumn, (Fehrenbacher)
91. East Asian Civilizations—The origin and development of the civilizations of China and Japan.
   5 units, winter, (——)
92. East Asian Civilizations—The development of the civilizations of China and Japan in the modern era.
   5 units, spring, (——)
93. Asia in the Modern World—Middle of nineteenth century to recent times.
   5 units, autumn, (Buss)
95. Masterpieces of Historical Literature.
   4 units, (Staff), offered at overseas campuses only

III. ADVANCED COURSES

Courses numbered 100 and 101 (basic seminars and colloquia) are open only to juniors and seniors majoring in history. Requests for admission to basic seminars and colloquia are submitted to the Department office and involve permission of the instructor. Lecture courses numbered 105-199 are open to juniors, seniors and graduate 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. UNDERGRADUATE SEMINARS AND COLLOQUIA

100. Basic Seminar—An introduction to the method and problems of historical research and writing. Required of undergraduate majors in history.
   5 units, autumn, winter, spring, summer, (Staff)

101a. Undergraduate Colloquium; Aspects of Stuart England.
   5 units, autumn, (Seaver)

   5 units, winter, (Pease)

101c. Undergraduate Colloquium: European Socialisms in the Nineteenth and Twentieth Centuries.
   5 units, winter, (Wright), to be given in 1966–67

101d. Undergraduate Colloquium: Rationalism and Irrationalism in European Thought.
   5 units, spring, (Craig)

101e. Undergraduate Colloquium: Problems in Nineteenth Century American History.
   5 units, winter, (Fehrenbacher)

101f. Undergraduate Colloquium: Interpretations of the American Character.
   5 units, spring, (Potter)

101g. Undergraduate Colloquium: Ideas and Society in Twentieth Century America.
   5 units, spring, (Knoles)

B. THE ANCIENT WORLD

See Classics, Section V, Courses H100, H101, H102, H103, H111, H112, H113, H201, H202, 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)

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, (Bark)

108. Medieval Antisemitism—An inquiry into the causes of antisemitism in the period in which intense anti-Jewish feeling first developed and many of the characteristic beliefs of modern antisemitism were formulated. Considerable use will be made of sociological theories about ethnic prejudice.
   5 units, spring, (Langmuir), to be given in 1966–67

   5 units, autumn, (Spitz)
110. **Age of the Reformation**—Europe in early modern times with special emphasis on the Protestant Reformation and Catholic reform.
   5 units, winter, (Spitz)

114. **Directed Reading in Medieval History.**
   3 to 5 units, (Bark), by arrangement

115. **Senior Research in Medieval History.**
   1 to 5 units, (Bark), by arrangement

116. **Directed Reading in Renaissance-Reformation History.**
   3 to 5 units, (Spitz), by arrangement

117. **Senior Research in Renaissance-Reformation History.**
   1 to 5 units, (Spitz), by arrangement

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**D. Modern Europe**

120. **Russia**—Founding of first Russian state to collapse of Russian Empire, 1917.
   5 units, autumn, (_______)

121. **The Russian Revolution**—Revolutionary era from fall of Tsarist government to present-day Soviet Russia. Prerequisite: 31, 32, or 120.
   5 units, winter, (_______)

122. **Soviet Foreign Policy**—Foreign policy in the West, Near, Middle, and Far East, 1917 to present.
   3 units, spring, (_______)

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)

126. **History of the Balkan Peoples Since 1914.**
   5 units, spring, (Vucinich)

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. **Europe, 1789–1815.**
   3 to 4 units, winter, (Dawson)

132. **Modern France**—Foundations of Third Republic to present.
   3 to 4 units, autumn, (Wright)

134. **Natural Law Rationalism**—Origins, application to intellectual problems of the seventeenth and eighteenth centuries, decline.
   4 units, autumn, (Harris)

135. **European Diplomacy Since 1815.**
   4 to 5 units, spring, (Craig)

138. **Directed Reading in Modern European History.**
   3 to 5 units, (Craig, Dawson, Harris, Vucinich, Wright), by arrangement

139. **Senior Research in Modern European History.**
   1 to 5 units, (Craig, Dawson, Harris, Vucinich, Wright), by arrangement

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**E. The British Commonwealth and Empire**

140. **England to 1460.**
   5 units, autumn, (Langmuir), to be given in 1966–67

141. **Yorkist and Tudor England.**
   4 to 5 units, winter, (Seaver)

142. **Stuart England.**
   4 to 5 units, spring, (Seaver)

143. **Britain, 1714–1867**—Emphasis on domestic political, economic and social hist-
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tory, but foreign and imperial affairs will be included as they influenced the country’s
general development.

4 to 5 units, winter, (Lyman), to be given in 1966-67

144. Britain Since 1867—See description of 143 (above).
4 to 5 units, winter, (Lyman)

145. Directed Reading in British History.
3 to 5 units, (Lyman, Seaver)

146. Senior Research in British History.
1 to 5 units, (Lyman, Seaver)

F. The United States

150. The Colonial Period.
3 units, autumn, (———)

151. The Revolution, Confederation, and Constitution.
5 units, winter, (———)

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, (———)

154. American Diplomatic History to 1898.
4 to 5 units, autumn, (Bailey)

155. American Diplomatic History since 1898.
4 to 5 units, winter, (Bailey)

158. The Great West in American History—Exploration, settlement, and his-
torical influence of the Trans-Mississippi West.
4 units, spring, (Fehrenbacher), to be given in 1966-67

159. History of California—From Spanish period to present, emphasis upon twen-
tieth century.
4 units, spring, (Fehrenbacher)

160. The South in American History to 1861—Factors of regional distinctiveness;
the staple crop economy; the plantation system and its social structure; slavery;
economic conditions of the Old South; the South as a minority; Southern political
reactions and the development of the sectional crisis.
5 units, autumn, (Potter)

161. The South in American History since Reconstruction—Factors of re-
gional 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)

163. A Political History of the American People, 1854-1914—Transformation
of American politics during sectional rivalry, Civil War, and industrial growth; gov-
ernment, the economy, and reform; urban culture, minorities, and a middle-class
consensus.
4 units, winter, (Pease)

164. A Political History of the American People Since 1914—Political process
and economic power during prosperity, depression, and two wars; accompanying
transformation in American culture.
4 units, spring, (Pease)

166. American Intellectual History: Nineteenth Century—Changing climates
of opinion in thought, expression in United States during nineteenth century.
4 to 5 units, autumn, (Knoles)

167. American Intellectual History: Twentieth Century—American thought,
expression during twentieth century; influences acting upon intellectual, cultural de-
velopment.
4 to 5 units, winter, (Knoles)
174. Directed Reading in United States History.
   3 to 5 units, (Bailey, Fehrenbacher, Knoles, Pease, Potter), by arrangement

175. Senior Research in United States History.
   1 to 5 units, (Bailey, Fehrenbacher, Knoles, 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.
   4 units, autumn, (Johnson)

177. Modern Latin America—Political, social, economic institutions in leading republics since independence.
   4 units, winter, (Johnson)

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)

179. Historical Evolution of Mexico—Economic, social development since 1850 and Mexican foreign relations, especially with United States in twentieth century.
   3 units, spring, (Johnson), to be given in 1966-67

180. Nineteenth Century Brazil, 1808-1914—Survey of neo-colonial Brazil from independence and the Imperial era through the First Republic to World War I.
   3 units, autumn, (Wirth)

181. Contemporary Brazil, 1914-1965—Politics and society in transition from agrarian to industrial bases, the rise of nationalism, and Brazil’s role in the hemisphere and international organizations.
   3 units, winter, (Wirth)

184. Directed Reading in Latin American History.
   3 to 5 units, (Johnson, Wirth), by arrangement

185. Senior Research in Latin American History.
   1 to 5 units, (Johnson, Wirth), by arrangement

H. MIDDLE EAST

186. Ottoman Empire—Origin, development, and decline of the Ottoman Empire. An appraisal of Ottoman institutions and civilizations. International diplomacy and the emergence of the so-called Eastern Question.
   5 units, autumn, (Vucinich), to be given in 1966-67

   3 units, spring, (Rents), to be given in 1967-68

188. History of the Islamic World Since 1803—Advance and retreat of European colonialism in Islamic territories, development of modern Islamic territories, development of modern Islamic states, and recent adjustments in Islamic society.
   3 units, spring, (Rents), to be given in 1966-67

I. EAST ASIA

190. Institutional History of China—Topical analysis of key institutions.
   3 units, winter, (Van Slyke)

   3 units, winter, (Van Slyke), alternate years, to be given in 1966-67
192. Modern China—1800 to the present, emphasis on rebellions, reforms, revolutions, and resistance to changes.  
3 units, spring, (Van Slyke)

193. Communist China—Origin and rise of the Chinese Communist party; internal developments and foreign policy of China under the Communists.  
4 to 5 units, winter, (Buss)

194a. Japan, 1600–1868—Development of institutions and thought; early relations with the West; the Meiji Restoration and the beginnings of modernization. Emphasis on latter half of the period.  
4 to 5 units, autumn, (Smith)

194b. Japan Since 1868—Japan's development as a modern nation; industrialization; urbanization; political and constitutional development; relations with the West; World War II; the Occupation; post-occupation Japan.  
4 to 5 units, winter, (Smith)

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)

196. United States and the Far East—Genesis, growth of American interests, policies in Far East, emphasis on immediate background of contemporary period.  
4 to 5 units, summer, (Buss), to be given in 1966–67

197. History of Southeast Asia.  
4 to 5 units, spring, (Buss)

198. Directed Reading in Far Eastern History.  
3 to 5 units, (Buss, Smith, Van Slyke), by arrangement

199. Senior Research in Far Eastern History.  
1 to 5 units, (Buss, Van Slyke), by arrangement

IV. GRADUATE COURSES

Courses numbered 200–299 are intended primarily for first-year graduate students, but more advanced graduate students may be admitted by permission of the instructor.

205. Graduate Seminar in Medieval History.  
5 units, spring, (Bark)

210. Graduate Seminar in Early Modern Europe.  
5 units, winter, (Spits)

5 units, autumn, (Harris)

5 units, spring, (Harris)

220. Graduate Seminar in Russian History.  
5 units, spring, (———)

5 units, winter, (Vucimich)

228. Graduate Seminar in Modern Germany.  
5 units, autumn, (Craig)

5 units, spring, (Dawson)

235. Graduate Seminar: Twentieth Century Europe.  
5 units, spring, (Wright)

240. Graduate Seminar in Medieval English History.  
3 to 5 units, winter, (Langmuir), to be given in 1966–67

5 units, autumn, (Scaver)
243. Graduate Seminar in Modern British History.
   5 units, autumn, (Lyman)
250. Graduate Seminar in American Colonial History.
   5 units, spring, (———)
252. Graduate Seminar in Nineteenth Century United States History.
   5 units, winter, (Fehrenbacher)
253. Graduate Seminar in Twentieth Century United States History.
   5 units, spring, (Pease)
255. Graduate Seminar in American Diplomatic History.
   5 units, autumn, (Bailey)
258. Graduate Seminar in American Intellectual History.
   5 units, autumn, (Knoles)
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 American History.
   5 units, autumn, (Johnson)
282. Graduate Seminar in Latin American History.
   5 units, winter, (Wirth)
290. Graduate Seminar in the History of China.
   5 units, autumn, (Van Slyke)
292. Graduate Seminar in the History of Japan.
   5 units, spring, (Smith)
   5 units, winter, (Buss)

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 or winter, (Staff)
301. American Historiography—Main currents in historical research and writing relevant to United States from earliest days.
   5 units, spring, (Bailey)
302. The Teaching of History—Methods of teaching history at the college level.
   1 unit, autumn, winter, or spring, (Staff), by arrangement
308. Graduate Colloquium: Topics in Medieval History.
   5 units, winter, (Langmuir), to be given in 1966-67
310. Graduate Colloquium: The Fall of the Roman Empire.
   5 units, autumn, (Bark), to be given in 1966-67
314. Directed Reading in Medieval History.
   Units by arrangement, (Bark)
315. Graduate Research in Medieval History.
   Units by arrangement, (Bark)
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)
319. Graduate Colloquium: Humanism and the Reformation.
   5 units, autumn, (Spitz)
  5 units, spring, (Seaver)

322. Graduate Colloquium: Europe, 1685–1789.
  5 units, winter, (Dawson)

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)

329. Graduate Colloquium: Problems in Nineteenth Century European History.
  5 units, winter, (Harris)

335. Graduate Colloquium: Europe 1890–1950.
  5 units, autumn, (Wright)

338. Directed Reading in Modern European History.
  Units by arrangement, (Craig, Harris, Vucinich, Wright)

339. Graduate Research in Modern European History.
  Units by arrangement, (Craig, Harris, Vucinich, Wright)

340. Graduate Colloquium: Topics in Modern British History.
  5 units, spring, (Lyman), to be given in 1966–67

345. Directed Reading in British History.
  Units by arrangement, (Lyman)

346. Graduate Research in British History.
  Units by arrangement, (Lyman)

358. Graduate Colloquium: American Intellectual History.
  5 units, spring, (Knoles)

360. Graduate Colloquium: American Politics from Jackson to Lincoln.
  5 units, autumn, (Fehrenbacher)

  5 units, autumn, (Pease)

374. Directed Reading in United States History.
  Units by arrangement, (Bailey, Fehrenbacher, Knoles, Pease, Potter)

375. Graduate Research in United States History.
  Units by arrangement, (Bailey, Fehrenbacher, Knoles, Pease, Potter)

380. Graduate Colloquium in Latin American History.
  5 units, autumn, (Johnson)

382. Graduate Colloquium: Latin American Historians.
  5 units, spring, (Wirth)

384. Directed Reading in Latin American History.
  Units by arrangement, (Johnson, Wirth)

385. Graduate Research in Latin American History.
  Units by arrangement, (Johnson)

390. Graduate Colloquium: Topics in Chinese History.
  5 units, winter, (——)

395. Graduate Colloquium in Japanese History.
  5 units, winter, (Smith)

398. Directed Reading in Far Eastern History.
  Units by arrangement, (Buss, Smith, Van Slyke)

399. Graduate Research in Far Eastern History.
  Units by arrangement, (Buss, Smith, Van Slyke)
HUMANITIES (SPECIAL PROGRAMS)

Executive Head: John W. Dodds
Director: Lawrence V. Ryan (Graduate Program in Humanities)
Professors: Robert McAfee Brown (Religion), Paul Harold Kocher (English and Humanities), Philip H. Rhinelander (Philosophy and Humanities)
Associate Professors: William A. Clebsch (Religion), Edwin M. Good (Religion and Hebrew), Jeffery Smith (Humanities and Philosophy)

Special Programs in Humanities include:
1. Undergraduate Honors Program in Humanities.
2. Graduate Program in Humanities.
3. Curriculum in Religion.

UNDERGRADUATE HONORS PROGRAM

Committee in Charge: John W. Dodds (Chairman), Alfred Appel, Philip Dawson, Edwin M. Good, George Knoles, Lucio P. Ruotolo, Jeffery Smith

Purpose of the Program
The Honors Program aims to develop a greater sense of the relatedness of various fields, and to increase the student's awareness of basic values—intellectual, aesthetic, social, and ethical. The Committee in charge, composed of representatives of several departments in the Humanities, will help each student to plan a balanced and integrated program.

Admission to the Program
A University average of at least B is required for admission to the program and for graduation with "Honors in Humanities."
Freshmen and sophomores interested in the program should consult with the chairman of the Honors Committee (Room 51M). If possible this should be done before the end of the freshman year, especially in the case of students going to overseas campuses, as scheduling adjustments may be necessary.
The program is open to majors in any field, and is normally taken in addition to a departmental major. However, in certain exceptional cases (for example, when the student is taking a pre-medical curriculum) the student may enroll as a Humanities major.

Requirements of the Program
1. World Literature—Humanities 61, 62, 63—15 units, sophomore year.
2. Humanities Seminars—12 units, junior year.
3. Senior Colloquia in Humanities—2 units autumn and 2 units spring, senior year.
4. Senior Essay—A critical essay usually centered in the departmental field, but not confined to it (2 units spring, junior year; 5 units autumn and 5 units winter, senior year). A grade of at least B is required on the essay for graduation with "Honors in Humanities."

Each student should plan a program that will give him a substantial background for his prospective senior essay. This is especially important for students majoring in the social, biological or physical sciences.
COURSES, FIRST AND SECOND YEAR

21, 22. **World Personalities**—A study of the lives of selected individuals of world significance, such as Socrates, St. Francis, Leonardo da Vinci, Van Gogh, Madame Curie, Gandhi, Churchill and Hitler. Each series will include representatives of several cultures, occupations and personality structures. Each student will write a term paper on a personality of his own choosing, preferably related to his field and special interests.

21. **World Personalities I.**
   4 units, winter, (Smith), MWF 1:15

22. **World Personalities II.**
   4 units, winter, (Smith), MWF 1:15, to be given in 1966-67

#61, 62, 63. **World Literature and the History of Ideas**—An introduction to fundamental ideas of the past; lectures, discussions, reading of selected masterpieces of literature. The course is conceived of as a unity; it is strongly recommended that students take all three quarters in sequence. Students in the Undergraduate Honors Program will be enrolled in special two-hour discussion sections and will receive five units for each course.

#61. **Classic Literature**—Homer, Greek dramatists, Plato, Aristotle, Lucretius, Vergil, Gospels of Mark and John.
   4 units (5 units for Honors students), autumn, (Otis, Staff), TWTh 11 and one hour by arrangement (two hours for Honors students)

#62. **Medieval and Renaissance Literature**—Augustine, medieval epics, Aquinas, Dante, Marlowe, Thomas More, Cervantes, Erasmus, Calvin, Montaigne, Spenser, Molière, others.
   4 units (5 units for Honors students), winter, (Rebholz, Staff), TWTh 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, (Smith, Staff), TWTh 11 and one hour by arrangement (two hours for Honors students)

THIRD AND FOURTH YEAR

175. **Individual Work**—For students with definite objectives not met by current course offerings.
   2 to 4 units, each quarter, (Staff), by arrangement

176. **Individual Study: Sequoia.**
   1 to 2 units, autumn, winter, spring, (Appel), by arrangement

191, 192, 193. **Interdepartmental Seminars on the Nature of the Humanities**—These seminars are concerned with the nature of the humanities. In the first quarter emphasis is placed on principles and methods of humanistic study. The second quarter is concerned with the arts, both verbal and nonverbal, and with aesthetic principles involved in the study of them as part of the humanities. The third quarter focuses on philosophy and history and on problems relating to their humanistic interpretation.

In each quarter the broad subject is treated through specific works, which will vary from section to section, and from year to year. Each student presents a class report, which, following discussion, is developed into a term essay.

191. **Seminar in Humanities.**
   4 units, autumn, (Friedlander, Mueller-Vollmer, Smith), by arrangement

192. **Seminar in Humanities.**
   4 units, winter, (Appel, Harris, Katz, Rhinelander), by arrangement

193. **Seminar in Humanities.**
   4 units, spring, (Mothershead, Pease, Rhinelander), 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, (Clebsch, Hastings, Tuttle), by arrangement*

*spring, (Watkins, ———, ———), by arrangement*

200. **Senior Essay**—An essay of about 15,000 words.

*12 units, (Staff), by arrangement*

See also Senior Colloquia.

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**GRADUATE PROGRAM**

*Committee in Charge: John W. Dodds (Chairman), Raymond D. Giraud, John D. Goheen, David Harris, Paul H. Kocher, Brooks Otis, Philip H. Rhinelander, Lawrence V. Ryan (Director), Friedrich W. Strothmann*

The Graduate Program in Humanities supplements the doctoral programs of certain departments (Classics, English, French and Italian, History, Modern European Languages, Philosophy, Speech and Drama), with an interdepartmental program devoted to the study of the Western tradition as a whole. The degree offered is a joint Ph.D., awarded in “History and Humanities,” “Philosophy and Humanities,” “English and Humanities,” etc.

Because the Graduate Program in Humanities is designed as a supplement to, and not as a substitute for, departmental specialization, its courses may be taken only by students who have been accepted for graduate work by one of the seven cooperating departments and whose applications have been approved by the Committee in Charge. Students entering the program should expect to take it in its entirety and should consult with the Director and their major advisers about its articulation with their departmental studies.

**Requirements**

1. For entering the Program. Candidates may apply to the Director for entrance to the Program upon qualifying for graduate study in one of the participating departments.

2. Within the Program:

   a) Continued work in the candidate's major field in accordance with departmental requirements. For these requirements the prospective student should consult the departmental listings.

   b) Participation in one course for each of six quarters in the "Western Traditions" series—reading, interpretation, and discussion of significant writers. This Western Traditions course is divided, according to the Stanford quarter system, as follows: The Classical and Patristic Periods (1st and 2d quarters); The Medieval Period (3d quarter); The Renaissance (4th quarter); The Eighteenth and Nineteenth Centuries (5th quarter); The Modern Period (6th quarter).

   c) Participation in 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 1964–65 were: Conceptions of Man during the Renaissance and in Modern Thought (2d quarter); The Functions of a University and the Meaning of Education (3d quarter).
d) Submission of a Ph.D. dissertation acceptable to both the Humanities Com-
mittee and the major department, as well as to the University Committee
on the Graduate Division.

e) The passing of a reading examination in two foreign languages, one ancient
and one modern. (Certain departments require a third language.) One of
these examinations must be passed during the first two quarters of the can-
didate's second year of work beyond the A.B. degree.

f) The passing of a comprehensive written examination in Humanities and the
University oral examination.

FELLOWSHIPS

The Program awards a number of fellowships which are available to properly
qualified students. Detailed information concerning these may be obtained by writing
to the Director of the Program.

GRADUATE COURSES

301, 302, 303, 304, 305, 306. The Western Traditions.

301. The Classic Period: Greece.
   4 units, autumn, (Rhinelander), MTWTh 9

302. The Roman and Patristic Periods.
   4 units, winter, (Clebsch, Otis), MTWTh 9

303. The Middle Ages.
   4 units, spring, (Calin), MTWTh 9

304. The Renaissance.
   4 units, autumn, (Kocher, Ryan), MTWTh 9, alternate years, to be given in
   1966-67

305. The Eighteenth and Nineteenth Centuries.
   4 units, winter, (Giraud), MTWTh 9, alternate years, to be given in 1966-67

306. The Modern Period.
   4 units, spring, (Mueller-Vollmer), MTWTh 9, alternate years, to be given in
   1966-67

351, 353. Basic Humanistic Problems.

351. Basic Humanistic Problems.
   4 units, winter, (Kocher), MW 2:15-4:05

353. The Functions of a University and the Meaning of Education.
   4 units, spring, (Rhinelander), TTh 2:15-4:05

RELIGIOUS STUDIES

Committee in Charge: John W. Dodds (Chairman), Robert McAfee Brown, William
A. Clebsch, Edwin M. Good, Robert M. Minto, Brooks Otis, Philip H. Rhine-
lander, 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 docu-
ments, in its history and doctrine, in its relation to contemporary life and to alterna-
tive world-views. Certain of the offerings are listed in the General Studies Bulletin
to which reference should be made.

COURSES

R101. The Ancient Cultures of the Near East—Beginnings of civilization in
Mesopotamia. Sumerian, Babylonian, Assyrian, Canaanite, Hittite cultures and re-
ligions.
   4 units, spring, (Good), TWTThF 1:15

and the Messianic idea. Old Testament in Judaism and Christianity.
   4 units, autumn, (Good), TWTThF 9
4 units, winter, (Good), TWTh F 9

#R104. History of Classical Christian Thought—An introduction to the theological history of Christianity in ancient and medieval times; representative theologians and the relation of their thought to classical, Byzantine, and medieval culture.
4 units, autumn, (Clebsch), MTWTh 10

#R105. History of European Christian Thought—An introduction to the theological history of Christianity in the Europe of the renaissance, reformation, and enlightenment; representative theologians and the relation of their thought to imperial and national European culture.
4 units, winter, (Clebsch), MTWTh 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, autumn, (Brown), TWTh F 9, to be given in 1966-67

#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), MTWTh 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), TWTh F 10, to be given in 1966-67

R120. American Religious Thought—Leading religious thinkers of the colonial and national periods; their relation to historical, intellectual, and literary movements in America.
4 units, spring, (Clebsch), MW 2:15-4:05

#R150. Christian Classics—One or two major works will be studied in their religious and historical setting and for their permanent significance.
2 units, winter, (———), TTh 1:15, to be given in 1966-67

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), TWTh F 1, to be given in 1966-67

4 units, spring, (Good), MW 2-4, to be given in 1966-67

# 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. Registration limited.
4 units, spring, (Brown), MTWTh 9

R186. Theologies of History—A historical study of various theological interpretations of history and culture in the classical, medieval, and modern periods.
4 units, autumn, (Clebsch), MW 2:15-4:05

4 units, spring, (Clebsch), MTWTh 10

R188. English Religious Thought—Leading religious thinkers representing such movements as Reformation, Puritanism, rationalism, pietism, romanticism; their relation to historical, intellectual, and literary developments in England.
4 units, winter, (Clebsch), MW 2:15-4:05, to be given in 1966-67
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). Prerequisite: permission of instructor.

4 units, winter, (Brown, Staff), MW 2:15–4:05

R195. The Ecumenical Movement—An examination of the development of ecumenical concern in the twentieth century in both Protestantism and Roman Catholicism. Particular attention will be given to the World Council of Churches, the Second Vatican Council, and the writings of ecumenical theologians. Prerequisite: permission of instructor.

4 units, winter, (Brown), MTWTh 11

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.

LATIN AMERICAN STUDIES

Committee in Charge: The Committee on Latin American Studies, a subcommittee of the Committee on International Studies

Chairman: A. Kimball Romney

Master of Arts

1. Candidacy. The Master of Arts degree is the sole degree in Latin American studies offered by the University. Candidates must have completed an equivalent of the training represented by an A.B. or B.S. degree and must demonstrate a working knowledge of Spanish or Portuguese.

The University does not offer a Ph.D. in Latin American Studies but a qualified candidate may be assisted in designing a cross-disciplinary doctoral program focused on that area. For further information, see the section “Graduate Division Special Programs” in this Bulletin.

2. Requirements.

a) Language (Spanish or Portuguese)—Proficiency in translation from English, into English, free composition, aural comprehension, and oral skill, a level of achievement corresponding to Spanish 113 or Portuguese 113.

b) Courses—45 units of graduate work including:
1) Nine units in an interdisciplinary core seminar, three units per quarter.
2) Eighteen units in a single discipline.
3) Eighteen units divided among no less than two nor more than three participating disciplines.

Participating disciplines are Anthropology, Economics, Geography, History, Modern European Languages, Political Science, Sociology. Relevant courses may be found under the listing for those departments.

The student's program should be designed in consultation with a member of the Latin American Studies Committee. If Modern European Languages is his base dis-
c) Thesis—In lieu of the thesis requirement, each student will be expected to prepare for the core seminar a research paper that reflects a thorough understanding of social science methodology, ability to use reference materials in Spanish or Portuguese, and the ability to use these skills in a scholarly and creative manner.

Inquiries concerning this program should be directed to the Chairman, Committee on Latin American Studies, Bolivar House, Stanford, California.

LINGUISTICS

Committee in Charge:

Chairman: Clara N. Bush
Professors: Robert W. Ackerman, Joseph H. Greenberg, Alphonse Juilland, Robert L. Politzer, C. H. van Schooneveld
Associate Professors: Dorothy A. Huntington, Ruth H. Weir

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 a written 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).

Minor in Linguistics for the Degree of Doctor of Philosophy

The requirements of the Ph.D. minor in Linguistics are roughly equivalent to those of the A.M. major in Linguistics, above. Programs of courses are to be established in accordance with the student’s interest, in consultation with a committee adviser. A substantial term paper is required instead of a thesis.
Doctor of Philosophy

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 reading knowledge of French and German, and of one other research language, to be established by Committee examination or certification.

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) Examinations.
   1) Successful passing of a written Committee examination on:
      (a) The principles of general linguistics (descriptive, comparative, and historical).
      (b) The methods and techniques of the main linguistic disciplines (phonology, morphology, syntax, lexicology, dialectology, typology, etc.).
      (c) One related discipline (e.g., Anthropological Linguistics, or Mathematical Linguistics, or Psycholinguistics, or Sociolinguistics, or Statistical Linguistics, etc.).
      (d) 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.).
   2) Successful passing of an oral examination which will normally consist of a defense of the dissertation in the pre-final form.

d) Dissertation. An original dissertation of such substance and scope as would justify publication.

COURSES

Courses recognized toward the A.M. and Ph.D. degrees in Linguistics are those listed below, and those approved by the Committee.

L200. Historical Linguistics—Introduction to the principles and methods of historical linguistics; the development of modern schools and trends of historical linguistics in the nineteenth and twentieth centuries.

3 units, spring, (———), M 4:15–6:05
L301. Seminar in Structural Linguistics—Lectures, readings, and reports on the principles, methods, and techniques of the structural approach to language.

3 units, autumn, (Staff), by arrangement

L302. Seminar in Structural Linguistics—Lectures, readings, and reports on the principles, methods, and techniques of the structural approach to language.

3 units, winter, (Staff), by arrangement

L303. Seminar in Structural Linguistics—Lectures, readings, and reports on the principles, methods, and techniques of the structural approach to language.

3 units, spring, (Staff), by arrangement

General Courses—A101, Science of Language. (See French and Italian.)

Anthropology—160, Anthropological Linguistics; 167, Language and Culture; 261, Linguistic Field Methods; 262, Phonetics and Phonemics; 263, Morphology and Syntax.

Asian Languages—J291, History of the Japanese Language.

Communication—211, Theory of Communication I; 212, Theory of Communication II.

English—102, Introduction to the English Language; 208, Introduction to Modern Linguistics; 209, Principles of Standard English; 310, Old English; 312, Middle English; 316, Seminar in Elizabethan Language.

French—Fr204, Etudes de style; Fr205, Modern French; TF288, Methods of Teaching French; Fr310, Grammaire historique francaise; Fr311, Old French Texts. (See French and Italian.)

German—G185, History of the German Language; G190, German Applied Linguistics; G205, Modern German; G221, Gothic and Historical German Grammar; G223, Old Norse; G225, Old Saxon; G227, Old High German; G228, Middle High German; G229, Advanced Middle High German. (See Modern European Languages.)

Romance Linguistics and Philology—L180, An Introduction to General Linguistics; L203, Vulgar Latin; L204, Introduction to Romance Linguistics; L250, Seminar in Romance Linguistics; L270, Topics in Structural Linguistics. (See French and Italian or Modern European Languages.)

Philosophy—157a, Introduction to Logic; 157b, Intermediate Logic; 181, Philosophy of Language; 202, Theory of Meaning.

Slavic—SL201, Synchronic Phonology, Morphology, and Syntax of Russian I; SL202, Synchronic Phonology, Morphology, and Syntax of Russian II; SL203, Synchronic Phonology, Morphology, and Syntax of Russian III; SL204, Synchronic Phonology, Morphology, and Syntax of Russian IV; SL211, Old Church Slavonic I; SL212, Old Church Slavonic II; SL214, Old Church Slavonic Literature; SL221, Diachrony of East Slavic and Readings in Old Russian I; SL222, Diachrony of East Slavic and Readings in Old Russian II; SL226, Diachrony and Synchrony of South Slavic; SL227, Diachrony and Synchrony of Western Slavic; SL228, Divergence of Slavic Languages; SL250, Graduate Seminar in Linguistics. (See Modern European Languages.)

Spanish—Sp190, Spanish Applied Linguistics; Sp205, Modern Spanish; Sp260, History of the Spanish Language; Sp261, Old Spanish; Sp263, Historical Spanish Linguistics I; Sp264, Historical Spanish Linguistics II; Sp266, Hispanic Dialectology; Sp299, Individual Work. (See Modern European Languages.)

Speech and Drama—1, Characteristics of Spoken Language.

Teacher Training—T200, Seminar in the Use of a Language Laboratory; T201, 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
Associate Professors: Paul Walter Berg, Solomon Feferman, Newton Seymour Hawley, Karel deLeeuw, Donald S. Ornstein, Robert Osserman, Dana S. Scott. Visiting: Shoro Araki
Assistant Professors: Mary Virginia Sunseri. Visiting: Bohumil Cenkl, Walter Strauss
Instructors: Stephen B. Agard, Rodolfo V. De Sapio, Lesley M. Sibner, Robert J. Sibner

OFFERINGS AND FACILITIES

The introductory courses consist of four alternative sequences in analytic geometry and calculus (10, 11, 21, 22, 23, 44, 45, 46, or 41, 42, 43, 44, 45, 46, or 41, 52, 53, 54, 55, or 41, 62, 63, 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 will be made by the Department after consideration of the student’s performance on the Advanced Placement Examination in Mathematics of the College Entrance Examination Board. 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, 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), Introduction to Topology (159), or of Differential Geometry (217a) may be substituted for this course]; one quarter of Introduction to Functions of a Complex Variable (106).

3. Nine units of courses in mathematics numbered above 100 in addition to those listed in “2.” The average grade point ratio in these courses and the courses listed under “2” above must be not less than 2.00.

4. French 23, German 23, or Russian 52; Physics 51, 52, 53, 54, 55, 56, 57.

Master of Science

The University’s basic requirements for the Master’s degree (residence, thesis, etc.) are discussed in the section “Degrees” in this Bulletin. The following are Departmental requirements:

   Candidates must complete an approved course program which will ordinarily consist of a minimum of 45 units, at least 36 of which will be in this department. The Master’s Thesis is optional: If a thesis is presented, the candidate’s program must contain 15 units of 200-level courses (in addition to the thesis). If no thesis is to be presented, the candidate’s program must include 24 units of courses numbered 200 or above. The candidate must have a B average over all course work taken in Mathematics, a B average in the 200 level courses considered separately, and must achieve a satisfactory score in the Department’s comprehensive examination. Certain exceptions to the 45 unit requirement above are possible. In particular, a student will be recommended for the M.S. degree upon completion of an approved program of 36 units of 200 level Mathematics courses with grades of B or better.

   For the degree of Master of Science in Computer Science, see Computer Science Department material in this Bulletin.

Doctor of Philosophy

The University’s basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section “Degrees” in this Bulletin. The following are Departmental requirements:

   In order that a student be admitted to candidacy for the Ph.D. degree, he must have successfully completed 45 units of graduate courses (i.e., courses numbered 200 and above). These courses should include Mathematics 205a, b, c, 206a, b, c, 210a, b,
Beyond the requirements for candidacy, the student must complete a course of study of at least 30 units approved by the Graduate Study Committee of the Department of Mathematics. This program must either display sufficient breadth in mathematics outside the student's field of specialization, or fulfill the requirements for a minor in another department. In addition, the student must pass his second language examination and the University oral examination, and submit an acceptable dissertation. A student must receive a grade of B or better in a course in order that it satisfy a requirement for the Ph.D. degree.

A candidate for the Ph.D. degree in Mathematics may specialize in computer science and submit his dissertation in this area. He must satisfy the usual requirements for the degree as established by the Mathematics Department. Since he must also be expert in certain areas of computer science he should confer early with the Computer Science Department in planning his program. In view of the necessary work in computer science, consideration will be given to a reduction in the variety of other mathematics courses required for the degree.

For the degree of Doctor of Philosophy in Computer Science, see the Computer Science Department material in this Bulletin.

For further information concerning degree programs, requirements for a Ph.D. minor in mathematics, fellowships, and assistantships, inquire of the Department secretary.

Teachers' Credentials

The requirements for a teaching major in Mathematics for the Standard Teaching Credential (Secondary) are the B.S. degree with major in Mathematics (see above) or, if the candidate has a Bachelor's degree with a major in another subject, the following: Courses 10, 11, 21, 22, 23, 44 (or 41, 42, 43, 44, or 41, 52, 53, 54) together with 21 units selected from courses numbered 100 or above, and in addition, 15 units selected from courses numbered 100 or above or in courses in other departments requiring extensive application of mathematics. Thirty-six quarter units must be in upper division or graduate standing, 9 of these must be at the graduate level. Candidates for the General Secondary Credential may count courses 45 and 46 as equivalent to "courses numbered 100 or higher" for the purpose of meeting requirements listed in this paragraph. The requirements for a teaching minor in Mathematics are Courses 10, 11, 21, 22, 23, 44 (or 41, 42, 43, 44, or 41, 52, 53, 54) together with 12 units as follows: 9 units in mathematics courses numbered 100 or higher; 3 units either in mathematics courses numbered 100 or higher or in courses requiring extensive application of mathematics given in other departments. In order to receive the recommendation of the Department for a teaching major or a teaching minor, the candidate is expected to have an average grade of B in these required courses. If work in mathematics has been taken at another institution, it is expected that at least one course numbered 100 or above will be taken in the Department. Attention is called to Courses 114a, 120, 142, 152a, 157, and CS136 as particularly appropriate to these programs.

Master of Arts in Teaching (Mathematics)

In cooperation with the School of Education, the Department offers a program leading to a degree, Master of Arts in Teaching (Mathematics). This degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish to further strengthen their academic preparation. Detailed requirements are outlined in this Bulletin under "School of Education, the Master of Arts in Teaching."
COURSES

B. Algebra and Trigonometry—Fundamental laws; linear and quadratic equations; inequalities; logarithms; binomial theorem; trigonometric functions, identities, and equations; solution of right and oblique triangles; complex numbers; De Moivre's theorem.

4 units, autumn, winter, (———), MTWThF 10 or 2:15

#1. Elementary Mathematical Analysis I—Structure of the real number system; logic of algebra; fundamental concepts of geometry and trigonometry. No credit allowed if taken after courses numbered 10 or higher.

3 units, winter, (Bacon), MWF 8

#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, spring, (Bacon), MWF 8

#10. Analytic Geometry and Calculus—Distance, slope, equations of lines, functions and graphs, derivative of a function, velocity and rates, properties of limits, polynomials and their derivatives, rational functions, rules for differentiation, implicit relations, chain rule for derivatives, differentials, continuity, related rates, curve tracing, maxima and minima with applications, Rolle's Theorem, Mean Value Theorem. Continuation in the course depends upon the student's passing a qualifying examination given during the first week of the course and covering algebra and trigonometry. Prerequisites: algebra and trigonometry.

3 units, autumn, (———), MWF 8, 10, or 2:15
winter, (———), MWF 10, 12, or 2:15

#11. Analytic Geometry and Calculus—Continuation of 10. Curves and equations, tangents and normals, Newton's method for finding roots, circle, parabola, ellipse, hyperbola, translation and rotation of coordinate axes, invariants, conics, indefinite integral, differentiation of sines and cosines, area under a curve, definite integral and the fundamental theorem of calculus, trapezoid rule. Prerequisite: 10.

3 units, winter, (———), MWF 8, 10, or 2:15
spring, (———), MWF 10, 12, or 2:15

#21. Analytic Geometry and Calculus—Continuation of 11. Area between two curves, volumes, length of arc, surface of revolution, average value of a function, moments and center of mass, theorems of Pappus, hydrostatic pressure, work, trigonometric functions, inverse trigonometric functions, the logarithmic and exponential functions. Prerequisite: 11.

3 units, autumn, (———), MWF 8 or 3:15
spring, (———), MWF 10, 12, or 2:15


3 units, autumn, (———), MWF 9, 11, or 1:15
winter, (———), MWF 8 or 3:15

#23. Analytic Geometry and Calculus—Continuation of 22. Polar coordinates, angle between tangent and radius vector, areas, parametric equations, vector components, differentiation of vectors, curvature, tangential and normal acceleration, space coordinates, vectors, scalar product, planes and lines in space, space curves, cylinders, quadric surfaces, partial derivatives, tangent plane, chain rule for partial derivatives. Prerequisite: 22.

3 units, winter, (———), MWF 9, 11, or 1:15
spring, (———), MWF 8 or 3:15
#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
spring, (——), MWF 9 or 1:15

#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, (Sunseri), MTWThF 8; (Bacon), MTWThF 9; (Sunseri), MTWThF 10
winter, (——), MTWThF 12

#42. Analytic Geometry and Calculus—Continuation of 41.

5 units, winter, (——), MTWThF 8, 9, or 10

#43. Analytic Geometry and Calculus—Continuation of 42. Improper integrals, Simpson's Rule, determinants, simultaneous equations, hyperbolic functions, inverse hyperbolic functions, polar coordinates, polar curves, angle between radius vector and tangent line, areas, parametric equations, vector components, differentiation of vectors, tangential and normal acceleration, space coordinates, vectors, scalar product, planes and lines in space, space curves, cylinders and quadric surfaces, functions of several variables, partial derivatives, tangent plane, chain rule for partial derivatives, differential equations of first order (homogeneous, linear), special second order differential equations, l'Hospital's rule. Prerequisite: 42.

5 units, autumn, (——), MTWThF 8, 9, or 10

#44. Advanced Calculus I—Infinite series, convergence tests, parallel topics on improper integrals. Uniform convergence. Power series. Prerequisite: 23 or 43 or concurrent registration in 23 or 43 and consent of instructor.

3 units, autumn, (——), MWF 9, 11, or 1:15
winter, (——), MWF 12
spring, (——), MWF 9 or 11

#45. Advanced Calculus II—Vectors in the plane and space, linear dependence, inner product, vector product. Geometry of lines and planes. Vector functions of one variable, curves and motion. Functions of several variables, gradient, partial derivatives, differentials, extreme values, line integrals, two dimensional integrals. Prerequisite: 44 or concurrent registration in 44 and consent of instructor.

3 units, winter, (——), MWF 9, 11, or 1:15

#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 1:15

#52. Honors Calculus—Honors version of 42, with greater emphasis on the fundamental concepts and rigorous development of the calculus and more extensive discussion of its applications. Prerequisites: 41 or equivalent, and consent of instructor.

5 units, winter, (——), MTWThF 9

#53. Honors Calculus—Continuation of 52.

5 units, spring, (——), MTWThF 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 44 or consent of the instructor is required for the courses listed below:

106. Introduction to Theory of Functions of a Complex Variable—Complex numbers, analytic functions, Cauchy–Riemann equations, complex integration, Cauchy formula; elementary conformal mappings. Prerequisite: 45.
3 units, autumn, (———), MWF 11; (———), MWF 2:15
spring, (———), MWF 8
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

113. Linear Algebra and Matrix Theory—The study of the algebraic properties of matrices and their interpretation in geometric terms. The relationship between the algebraic and geometric points of view and matters that are fundamental to the study and solution of linear equations are dealt with. Topics include: linear equations; vector spaces, linear dependence, bases and coordinate systems; linear transformations and matrices; similarity and eigenvalues reduction of quadratic forms.
3 units, autumn, (———), MWF 9; (———), MWF 1:15
winter, (———), MWF 10; (———), MWF 1:15
summer, (———)

113h. Linear Algebra and Matrix Theory (Honors).
3 units, autumn, (———), MWF 9

114. Linear Algebra and Matrix Theory—Continuation of 113. A deeper study of certain of the topics indicated as well as additional topics chosen among the following: invariant subspaces, canonical forms of matrices, minimal polynomials and elementary divisors; vector spaces over arbitrary fields; inner products; Hermitian and unitary matrices; multilinear algebra.
3 units, winter, (———), MWF 9
spring, (———), MWF 10

114h. Linear Algebra and Matrix Theory (Honors).
3 units, winter, (———), MWF 9

115. Fundamental Concepts of Analysis—Rigorous treatment of real numbers, limits, function, continuity, differentiability, integral, infinite series, other infinite processes. Especially recommended for students who intend to take graduate work in mathematics.
3 units, autumn, (———), MWF 11; (———), MWF 2:15
winter, (———), MWF 11; (———), MWF 2:15

3 units, winter, (———), MWF 11
spring, (———), MWF 11

3 units, spring, (———), MWF 11

120. Modern Algebra—Integral domains, fields, polynomials, divisibility theory. groups. Prerequisite: 114a.
3 units, winter, (———), MWF 1:15
spring, (———), MWF 1:15
121. Modern Algebra—Continuation of 120.
3 units, spring, (———), MWF 1:15

123. Theory of Probability—This is an introductory course to the theory of probability and some of its applications. The basic concepts of probability, random variables and their distribution functions are treated in the modern manner. The method of characteristic functions will be developed. Classical limit theorems for sequences of independent random variables are discussed in some detail. Some special types of stochastic processes will be covered as well as various examples of combinatorial problems.
3 units, winter, (McGregor), MWF 11

124. Theory of Probability—Continuation of 123.
3 units, spring, (McGregor), MWF 11

130. Ordinary Differential Equations—Special equations, exact equations, linear equations; series solutions, numerical solution; Laplace transform and operational methods. Courses 130, 131, 132 form a sequence.
3 units, autumn, (———), MWF 8, 11, or 2:15
winter, (———), MWF 10
summer, (———)

130h. Ordinary Differential Equations (Honors).
3 units, autumn, (Latta), MWF 11

3 units, winter, (———), MWF 8, 11, or 2:15
spring, (———), MWF 10

131h. Partial Differential Equations (Honors).
3 units, winter, (Latta), MWF 11

3 units, spring, (———), MWF 8, 11, or 2:15

136. Introduction to Algorithmic Processes—(Enroll in Computer Science 136.)

137. Numerical Analysis—(Enroll in Computer Science 137.)

138. Numerical Analysis—(Enroll in Computer Science 138.)

142. Higher Geometry—Homogeneous and projective coordinates with applications; projective correspondence in forms of one dimension; involution; projective correspondence in forms of two dimensions; collineations, their classification; correlation, polarity; projective, affine, metric properties of conics.
3 units, autumn, (Bacon), MWF 8

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, (———), MWF 2:15

3 units, winter, (———), MWF 2:15

157. Non-Euclidean Geometry—Hyperbolic, elliptic plane geometry, trigonometry
3 units, autumn, (Bacon), MWF 8, alternate years, to be given in 1966–67

159. Introduction to Topology—This course will cover some of the basic properties of metric and topological spaces; compactness, connectedness, and continuity. Special attention will be paid to the Euclidean spaces; and the fixed-point and degree of mapping theorems will be developed. Enrollment is limited to undergraduates.
3 units, autumn, (Royden), MWF 8
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, (Feferman), MWF 11
160b. Symbolic Logic—Continuation of 160a. (Enroll in Philosophy 160b.)
3 units, spring, (Feferman), MWF 11

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, (Scott), TTh 11:00-12:15

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, winter, (Scott), MWF 10

195. Undergraduate Colloquium—Based on reading and discussion of topics in history and philosophy of mathematics. Prerequisite: consent of instructor.
3 units, autumn, (Hawley), T 2:15-4:15

199. Undergraduate Honors.
(Staff), by arrangement

Courses Intended Primarily for Graduate Students

205a. 3 units, autumn, (Chung), MWF 11
205b. 3 units, winter, (Chung), MWF 11
205c. 3 units, spring, (Chung), 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.
206a. 3 units, autumn, ( ), MWF 10
206b. 3 units, winter, ( ), MWF 10
206c. 3 units, spring, ( ), MWF 10

210a, b, c. Modern 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.
210a. 3 units, autumn, (Feferman), MWF 1:15
210b. 3 units, winter, (Feferman), MWF 1:15
210c. 3 units, spring, (Feferman), MWF 1:15

212. Proseminar—The emphasis is on the solution of problems of non-routine type. This course serves as an introduction to independent study and research, and is 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

3 units, autumn, (Hawley), MWF 3:15

217b, c. Differential Geometry—Differentiable manifolds, tensor bundles, tensor fields, connections, holonomy groups, geodesics, curvatures, Riemannian manifolds, differential forms and deRham's theorem.
217b. 3 units, winter, (Kodaira), MWF 3:15
217c. 3 units, spring, (Kodaira), MWF 3:15
Mathematics

220a, b, c. Methods of Mathematical Physics — Theory and construction of fundamental solutions (Green's functions) for ordinary and partial differential equations; reformulation of boundary value problems in terms of integral equations with Green's function kernels; variational procedures and asymptotic integration.

220a. 3 units, autumn, (Latta), MW 2:15
220b. 3 units, winter, (Latta), MW 2:15
220c. 3 units, spring, (Latta), MW 2:15

221a. Calculus of Variations — Euler-Lagrange equations, sufficient conditions; applications to eigenvalue problems, geometry, mechanics; direct methods, Dirichlet's principle.

3 units, spring, (———), MWF 1:15

230a, b. Advanced Probability — Basic concepts; distribution functions and their Fourier transforms; weak and strong convergence theorems; random walk problems; martingales.

230a. 3 units, winter, (Chung), MW 3:15-4:30
230b. 3 units, spring, (Chung), MW 3:15-4:30

232. Topics in Stochastic Processes — Topics from general Markoff processes, martingale theory, some discussion of ergodic theory.

3 units, spring, (Karlin), MWF 9

237a, b, c. Advanced Numerical Analysis — (Enroll in Computer Science 237 a, b, c.)

246a, b. Complex Manifolds — Definition and examples of complex manifolds, vector bundles, sheaves, Hermitian and Kähler metrics, cohomology with coefficients in sheaves, differential geometric method, Hodge manifolds, deformation of compact complex manifolds.

246a. 3 units, autumn, (Kodaira), MWF 1:15
246b. 3 units, winter, (Kodaira), MWF 1:15

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 1966-67

253a, b. Total Positivity and Applications to Analysis — Classifications of totally positive kernels, Polya frequency functions, Tchebycheff systems, connections with Sturm-Liouville eigenvalue problems and integral equations. Some applications in probability theory will also be given. Prerequisites: 205 and 206.

253a. 3 units, autumn, (Karlin), MWF 9
253b. 3 units, winter, (Karlin), MWF 9

254a, b. Ordinary Differential Equations — Fundamental existence theorems, stability and asymptotic behavior of nonlinear systems, Poincaré-Bendixson theorem, linear systems and Sturm-Liouville eigenvalue problems; selected topics from equations in the complex domain; Fuchsian theory, Hamiltonian systems, optimal control problems, singular perturbations, existence of periodic solutions and orbital stability.

254a. 3 units, winter, (Gilbarg), TTh 11:00-12:15
254b. 3 units, spring, (Gilbarg), TTh 11:00-12:15


256a. 3 units, autumn, (Phillips), TTh 1:15-2:30
256b. 3 units, winter, (Phillips), TTh 1:15-2:30
256c. 3 units, spring, (Phillips), TTh 1:15-2:30
259. **Scattering Theory**—The dynamic theory of scattering as applied to the Schrödinger wave equation and the acoustic wave equation. Prerequisite: 261.

2 units, autumn, (Phillips), M 2:15-4:15


- 261a. 3 units, autumn, (deLeeuw), TTh 9:30-10:45
- 261b. 3 units, winter, (deLeeuw), TTh 9:30-10:45
- 261c. 3 units, spring, (deLeeuw), 9:30-10:45

263. **Representations of Lie Groups and Lie Algebras.**

3 units, spring, (Samelson), MWF 10

278. **Celestial Mechanics**—The two body problem and orbital determination, perturbation theory, the three body problem.

3 units, spring, (Hawley), MWF 4:15

279a, b. **Mathematical Genetics**—Mathematical models in population genetics, ecology, population growth and epidemiology. The first part of the course will deal mainly with deterministic models in population genetics. (Same as Genetics 308.) Prerequisite: consent of instructors.

- 279a. 3 units, autumn, (Bodmer, Karlin, McGregor), by arrangement
- 279b. 3 units, winter, (Bodmer, Karlin, McGregor), by arrangement


- 281a. 3 units, autumn, (------), MWF 9
- 281b. 3 units, winter, (------), MWF 9
- 281c. 3 units, spring, (------), MWF 9

283a, b, c. **Selected Topics in Topology**—Topics from: fiber spaces and fiber bundles, characteristic classes, cohomology operations, sheaves, homology of groups. Prerequisite: 281 or equivalent.

- 283a. 3 units, autumn, (------), MWF 10
- 283b. 3 units, winter, (------), MWF 10

291a, b, c. **Set Theory**—Axiomatic set theory; cardinal and ordinal numbers; alternative axiomatizations, questions of consistency and independence. (Enroll in Philosophy 291a, b, c.) Prerequisite: 161 or consent of instructor.

- 291a. 3 units, autumn, (Levy), MWF 11
- 291b. 3 units, winter, (Levy), MWF 11
- 291c. 3 units, spring, (Levy), MWF 11

292a, b, c. **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. (Enroll in Philosophy 292a, b, c.) Prerequisite: 160b or consent of instructor.

- 292a. 3 units, autumn, (Ehrenfeucht), TTh 2:15-3:30
- 292b. 3 units, winter, (Ehrenfeucht), TTh 2:15-3:30
- 292c. 3 units, spring, (Ehrenfeucht), TTh 2:15-3:30

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.

*To be given in 1966–67*
360. Advanced Reading and Research.
   Any quarter, (Staff), by arrangement

   By arrangement

381. Seminar in Analysis.
   By arrangement

385. Seminar in Abstract Analysis.
   By arrangement

386. Seminar in Geometry and Topology.
   By arrangement

387. Seminar in Function Theory.
   By arrangement

   By arrangement

389. Seminar in Mathematical Biology.
   By arrangement

391. Seminar in Foundations of Mathematics.
   By arrangement

MILITARY SCIENCE

Executive Head: David Y. Nanney (Colonel, Artillery)
Professor: David Y. Nanney (Colonel, Artillery)
Assistant Professors: John W. Begiebing (Captain, Armor), William C. Hammill
                     (Captain, Infantry), Terry A. Taylor (Captain, Signal Corps)

GENERAL

The Department of Military Science offers a course of instruction and training
which combined with a baccalaureate degree, qualifies a student for a reserve com-
mmission in the United States Army. A student must fulfill the enrollment require-
ments listed in this section of the Bulletin in order to take Military Science courses.

OBJECTIVE

The objective of the Army ROTC program is to produce junior officers who by
their education, training and inherent qualities are suitable for continued develop-
ment. The aim is to provide a basic military education and in conjunction with other
University disciplines to develop individual character and attributes essential to
an officer. The Army ROTC training is designed to develop and perfect the qualities
of leadership required in both military and civilian life and to give the student an
opportunity to reinforce his knowledge with actual practice in the techniques of
leadership. In this respect, then, the ROTC is a training ground for tomorrow's
leaders in the armed forces as well as in private enterprise and government.

PROGRAM OF STUDY

The program consists of a two-year basic course, a two-year advanced course
and a six-week summer camp. The program includes 25 credit units, which are
military in nature and are taught by officers of the United States Army. An addi-
tional 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 Com-
munication, Science Comprehension, General Psychology, or Political Development
and Political Institutions. Normally, courses must be taken in numerical sequence.
During the summer session courses are given by special arrangement.
CURRICULUM

The curriculum embraces general military science subjects common to all branches of the Army, such as psychology and techniques of leadership, United States Army and national security, United States role in world affairs, military history, teaching principles, basic tactics, map reading, command and staff problems and procedures. For the first year the course consists of one 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. 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, nor of an age that will preclude their appointment in the Army by the 28th birthday. Normally a student must have at least 12 quarters (exclusive of summer work) remaining at time of enrollment. Specific exceptions may be made to meet unusual situations in the latter case. Primary criterion is that every enrolled cadet has the potential of becoming an effective Army officer. Classification tests are given periodically to test the progress of cadets, but principal reliance for selection and retention in the program is placed on the judgment of the Professor of Military Science and his assistants. Interested candidates desiring further information should communicate with the Professor of Military Science.

REGULAR ARMY COMMISSIONS

Cadets who possess outstanding qualities of leadership, high moral character, and excellent academic standing may be designated Distinguished Military Graduates by the Professor of Military Science with the concurrence of the President of the University. Such graduates are eligible to apply for a commission in the Regular Army. Selection for appointment is made by Headquarters, Department of the Army, from a consolidated order of merit list of applicants. Those selected may apply later for graduate education at selected civilian colleges and universities at government expense while receiving full pay.

EMOLUMENTS, UNIFORMS AND TEXTS

Scholarship AROTC cadets will be chosen in nation-wide competition beginning with the school year 1965–66. In addition to payment for tuition, books, and fees for four years, each scholarship cadet draws retainer pay of $50 per month. Students not on scholarship pursuing the last two years of the course will receive retainer pay of not less than $40 or more than $50 per month. Uniforms and texts are supplied without cost.
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, (Staff), M 8, 9, 10, 1:15, 2:15, or 3:15, or T 10, or 11

   1 unit, winter, (Staff), M 8, 9, 10, 1:15, 2:15, or 3:15, or T 10, or 11

   1 unit, spring, (Staff), M 8, 9, 10, 1:15, 2:15, or 3:15, or T 10, or 11

SECOND-YEAR COURSES

   2 units, autumn, (Taylor), MW 10, TTh 10, or TTh 2:15

   2 units, winter, (Taylor), MW 10, TTh 10, or TTh 2:15

   2 units, spring, (Taylor), MW 10, TTh 10, or TTh 2:15

THIRD-YEAR COURSES

131. Leadership and Counterinsurgency—Basic problems in small unit leadership. Basic principles of counterinsurgency.
   2 units, autumn, (Hammill), TTh 8, TTh 9, or TTh 1:15

   3 units, winter, (Hammill), TWTh 8, TWTh 9, or TWTh 1:15

133. Small Unit Tactics and Communications—Principles of offensive and defensive combat. Communications systems, procedures, and security.
   3 units, spring, (Hammill), TWTh 8, TWTh 9, or TWTh 1:15
FOURTH-YEAR COURSES

   3 units, winter, (Begiebing), TWTh 8, TWTh 9, or TWTh 1:15

   3 units, winter, (Begiebing), TWTh 8, TWTh 9, or TWTh 1:15

   2 units, spring, (Begiebing), TTh 8, TTh 9, or 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, spring, (Staff), by arrangement

MODERN EUROPEAN LANGUAGES

Emeriti: Bayard Quincy Morgan, Jack A. Posin, Juan B. Rael, Kurt F. Reinhardt (Professors); Sarra Kliachko, Grace Knopp, Elisabeth Stenbock-Fermor (Assistant Professors)

Executive Head: F. W. Strothmann
Associate Executive Heads: Aurelio Macedonio Espinosa, Jr., Cornelis H. van Schooneveld, Gertrude L. Schuelke
Assistant Professors: A. Peter Foulkes, William J. Lillyman, Lawrence L. Stalberger. Acting: Gisela Luther, Edward L. Nordby
Instructors: Raúl A. Inostroza, Gisela Nordby, Luis S. Ponce de León, Laura T. Tarquinio. Acting: Edwin A. Hopkins
Lecturers: Rudolph Morgan, Nicholas S. Pashin, Eugenie Skarginsky

The Department accepts candidates for the degree of Bachelor of Arts, Master of Arts, and Doctor of Philosophy, and for certification as high school and junior college teachers. Special consideration is given to the needs of those who intend to make teaching their profession.

PROGRAMS OF STUDY

Bachelor of Arts

The degree of Bachelor of Arts may be taken in German, Russian, or Spanish. Candidates must have completed the first- and second-year courses in reading,
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:

For German majors: G100, G110, G111, G112, G113, G131, G132, G133, and G185; certain seniors majoring in German who have completed the basic courses of the junior year may wish to devote one or two quarters of their last year exclusively to reading. They may, with the permission of their adviser, be relieved of certain elective course requirements, enrolling instead for 12 to 15 units of Individual Work;

For Russian majors: R100, R110, R111, R112, R113, R191, R192, 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, Sp151, Sp152, Sp186, Sp187, Sp188, Sp189. (Only one course of the series Sp121-126 may be used to satisfy major requirements.)

In addition to the 35 units mentioned above, students not enrolled in the Honors Program in Humanities (for a description see “Humanities—Special Programs” in this Bulletin) are to select with the help of their adviser a minimum of three general courses (9 units) in support of their major program.

Teaching Credentials

For information concerning the requirements for teaching credentials, consult the “School of Education” section of this Bulletin and the Credential Secretary, School of Education.

Master of Arts in Teaching

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

Graduate Program in Humanities

The Department of Modern European Languages participates in the Graduate Program in Humanities leading to a joint Ph.D. degree. For a description of that program, and fellowships offered in connection with it, see the section “Humanities (Special Programs)” in this Bulletin.

Intensive Language Work in European Study Centers

Each student accepted by the Committee on General Studies for work at a Stanford center in Germany or Austria will complete twelve units of Intensive German during the six months of his residence abroad. The intensive work is oriented to the development of the student's individual ability to understand, speak, write, and read German. All German courses taken at a study center, regardless of the level at which the work is completed, bear the designation G80, with the successive levels, the lowest 2 and the highest 6, indicated as second digit.

Master of Arts: German

To be accepted as a candidate for the degree of Master of Arts, a student needs to establish that he has completed creditably either an A.B. degree with a major in German or an equivalent of this work. A working knowledge of Latin is also desirable. Stanford University requires a minimum residence of three full quarters before
any degree can be granted. A student with graduate work taken at another university, in this country or abroad, is advised that this work will not reduce the three-quarter requirement; however, if he continues his studies, it will shorten the time needed for completion of the Ph.D. degree.

The Departmental requirements for the completion of the Master of Arts degree are:

1. 35 units of graduate work in the major field, normally the following courses:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) G190. Phonemics and Morphology ..................... 2</td>
</tr>
<tr>
<td>b) G201 and G202. Advanced Composition .................. 4</td>
</tr>
<tr>
<td>c) G205. Modern German Grammar ............................ 3</td>
</tr>
<tr>
<td>d) G228. Middle High German ............................... 4</td>
</tr>
<tr>
<td>e) G289. Proseminar .................................. 3</td>
</tr>
<tr>
<td>f) G290 or G291. One seminar ............................ 3</td>
</tr>
<tr>
<td>g) Two advanced courses in literature (one of them numbered 200 or higher) ........................................ 6</td>
</tr>
<tr>
<td>h) G281 and G283. German Thought ........................ 6</td>
</tr>
<tr>
<td>i) G299. Thesis work ................................. 4</td>
</tr>
</tbody>
</table>

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

2. 7-9 units of electives. These may be taken in or out of the Department; the choice depends on the student's individual needs ................. 7-9

   Total ................................................................ 42-44

3. Completion of a Master's thesis showing that the candidate can write and do independent work.

Doctor of Philosophy: German

Students should read carefully the University regulations governing the conferring of this degree as described in the section "Degrees" in this Bulletin.

The Master of Arts degree is a prerequisite for admission to the program. Exceptions are made only for those students who have completed a substantial equivalent at a foreign university.

Near-native proficiency in German is expected of all candidates, irrespective of their field of specialization. Early during the first year at Stanford, all graduate students will be given the MLA Foreign Language Proficiency Test for Teachers and Advanced Students to give them an indication of their achievement in listening-comprehension, speaking, reading, and writing. If judged desirable by the Department, graduate students will be given an opportunity to enroll for half a year in a Stanford-approved program at a German University.

Departmental Requirements:

1. A working knowledge of Latin and a reading knowledge of one modern language other than English or German.

2. Course Work. In addition to the course work listed under the requirements for the Master of Arts degree, the student is expected to complete the following program:

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>a) At least three graduate seminars beyond the Master of Arts requirement ........................................... 9</td>
</tr>
<tr>
<td>b) 4 units chosen from the following courses: Gothic, Old Norse, Old High German and Old Saxon, or Advanced Middle High German ... 4</td>
</tr>
</tbody>
</table>
c) At least one course from each of the five groups listed under G231 to G275. These courses may be taken in any sequence

d) 15 units of electives. These may be taken either in additional courses in German literature and philology (numbered 200 or higher), or they may be used for a unified complementary program such as comparative literature, taken outside of the Department in courses numbered 100 or higher

3. Students may take a formal minor instead of requirement "2d" above. The requirements for such a minor are determined by the departments concerned.

4. 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.

5. A Departmental as well as a University oral examination is required.

6. Teaching experience is required of all candidates as a condition to receiving the Ph.D. degree. Teaching assistantships are available to help candidates fulfill this requirement, which may be waived only for those students who have had teaching experience in other institutions. All prospective teachers are required to enroll in G200.

Master of Arts: Russian

No student is accepted for candidacy for the degree of Master of Arts unless he has completed the equivalent of the training represented by the requirements for the A.B. degree. Students intending to work toward the Ph.D. degree are required to pass the reading examination in either French or German during their first year of graduate studies.

Requirements:

1. 30 units of graduate work to be distributed approximately as follows:

   a) R191 and R192. Advanced composition .................................. 4
   b) Graduate seminar .......................................................... 2-4
   c) Philology or general linguistics ........................................ 8
   d) Three graduate courses in the history of Russian literature.... 9-12
   e) Thesis .................................................................................. 3

2. 13 to 18 units of electives chosen with the approval of the student's adviser to bring the total to 44 units.

Doctor of Philosophy: Slavics

Candidates are not obliged to present a minor but they are urged to offer one. A minor in a second language is strongly recommended. If it is in French, German, or Spanish, it should be equivalent to the course requirements for the degree of Master of Arts.

Candidacy—Candidates should read carefully the general regulations governing the conferring of this degree, as described in the section "Degrees" in this Bulletin. For specific Departmental requirements and recommendations, the student should consult with his adviser. No student is accepted as a candidate until he has completed the equivalent of the training represented by the requirements for the Master of Arts degree as described above.
General Requirements—All candidates, regardless of their field of specialization, are expected to fulfill these requirements:

1. Have a working knowledge of Latin and a reading knowledge of French and German. Knowledge of the modern languages must be demonstrated by passing an examination.
2. Write a thesis that embodies such results of research as would merit publication.
3. Pass an oral examination along the following lines:
   a) The principles of general and descriptive linguistics and the outlines of the history of the Russian language in its relationship to the development of the other Slavic languages.
   b) The history of Russian literature including its relationship to the development of other Slavic literatures.
   c) The essentials of the political and cultural history of the Slavic world.
4. Prove, by examination, that they can write and speak Russian correctly.
5. In addition to a reading knowledge of French and German, have a reading knowledge of two Slavic languages other than Russian.
6. Satisfactory teaching experience in this Department. This experience will be acquired by participating, under supervision, in the teaching of language classes.

Specialisation—Candidates in Slavic Languages and Literatures specialize either in linguistics or literature. Candidates who specialize in linguistics must complete the amount of literary study required of candidates for the Master of Arts degree (i.e., three graduate courses in the history of literature, and one graduate seminar dealing with a literary problem). Candidates in literature must complete a minimum of 12 units in philology and linguistics.

Course Work—Candidates for the Ph.D. degree should arrange their course work in such a way as to fulfill all requirements for their major and minor within nine quarters after receiving the A.B. degree. This can be done by enrolling for a minimum of 12 units per quarter. Candidates who enroll for less must expect a corresponding delay.

Master of Arts: Spanish

To be accepted as a candidate for the degree of Master of Arts, a student needs to establish that he has completed creditably either an A.B. degree with a major in Spanish or an equivalent of this work. A working knowledge of Latin is also desirable. Stanford University requires a minimum residence of three full quarters before any degree can be granted. A student with graduate work taken at another university, in this country or abroad, is advised that this work will not reduce the three-quarter requirement; it will, however, if he continues his studies, shorten the time needed for completion of the Ph.D. degree.

Course Requirements:

1. A working knowledge of Latin.
2. 30 units of graduate-level work, to be distributed approximately as follows:

<table>
<thead>
<tr>
<th>Units</th>
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<tbody>
<tr>
<td>a) Sp202 and Sp203. Advanced composition and grammar</td>
</tr>
<tr>
<td>b) Sp250 or Sp251</td>
</tr>
<tr>
<td>c) L180, Sp190, Sp205 and Sp260 or Sp261</td>
</tr>
<tr>
<td>d) Two graduate courses in the history of Spanish and Spanish American literature</td>
</tr>
<tr>
<td>e) Thesis</td>
</tr>
</tbody>
</table>
3. Advanced or graduate courses dealing with Spain or Hispanic America other than in the fields of language and literature .................................................. 8

4. Electives in Spanish or related fields, chosen with the approval of the student's adviser, to bring the total to 44 units.

**Doctor of Philosophy: Spanish**

Students should read carefully the University regulations governing the conferring of this degree as described in the section “Degrees” in this Bulletin.

No student is accepted for candidacy unless he has completed the equivalent of the requirements for the Master of Arts degree in Spanish, as described above.

Requirements—All candidates for the Ph.D. degree in Spanish must fulfill the following requirements:

1. Have a working knowledge of Latin and a reading knowledge of French and Portuguese (or Italian). This knowledge must be demonstrated by passing a Departmental examination (preferably by the end of the first year of graduate work).

2. Pass a preliminary examination in the history of Spanish and Spanish American literature and in the essentials of the political and cultural history of the Hispanic world. This examination should normally be taken shortly after completion of the work for the A.M. degree.

3. Pass the final Departmental oral and written examinations, and the University oral examination, along the following lines:

   a) The principles of general and descriptive linguistics.
   b) The history of the Spanish language, and the outlines of the history of the other Romance languages.
   c) The history of Spanish and of Spanish American literature.
   d) The political and cultural history of the Hispanic world, with specialization in approved areas.

4. Write a dissertation that embodies such results of research as would merit publication.

5. Satisfactory teaching experience in the Department. Teaching assistantships are available to enable candidates to fulfill this requirement, which will be waived only in the case of students who have teaching experience in other institutions. All prospective teachers are required to enroll in Sp200.

**Specialization**—Candidates for the Ph.D. degree in Spanish specialize in one of the following fields: Spanish literature; Spanish American literature; philology and linguistics. In addition to specializing in one of these fields, all candidates must complete a substantial amount of work (normally, at least three advanced or graduate courses) in each of the other fields.

**Minor:**

1. Candidates are not obliged to present a minor, but they are urged to offer one. A minor in a second language is strongly recommended. The course requirements for such a minor are determined by the departments concerned.

2. Candidates who do not elect a formal minor and are not enrolled in the Graduate Humanities Program are required to take a substantial amount of work in a related minor field. If the minor field selected is French, German, or Russian, the amount of work completed should total not less than 18 units, or equivalent, of advanced work (including Fr113, G113, or R113).

**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

A101. Europe as Seen Through Travel Literature—From the Ancients to Napoleon.
3 units, autumn, (Hilton), MWF 11

A102. Europe as Seen Through Travel Literature—From Napoleon to World War I.
3 units, winter, (Hilton), MWF 11

A103. Europe as Seen Through Travel Literature—From World War I to the present.
3 units, spring, (Hilton), MWF 11

Hitherto neglected, travel literature has come to be recognized as an invaluable means of perceiving the physical and spiritual development of the regions of the world. The vision of one society by a perceptive observer from another culture has produced a unique literary and historical form, the wealth of which is only now becoming apparent. In particular, our vision of countries of Europe is immensely enriched by this forgotten literature. The courses A101, A102, and A103 are of special interest for the Stanford students who plan to attend one of the European centers, or indeed who have already done so.

#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, summer, (Reinhardt), to be given in 1966-67

#A185. The Existential Quest in the Continental Novel—Reading and discussion of works by Dostoevsky, Gide, Rilke, Kafka, Musil, Broch, Malraux, and others.
3 units, spring, (Sokel), MWF 10

A199. Individual Work—Thirty-six hours of reading per unit, weekly conference with instructor.
1 to 3 units, any quarter, (Staff), by arrangement

AG. German

#AG75. Goethe's Faust—Lectures in English, reading of Faust in translation. Not open to freshmen.
3 units, (Lohner), alternate years, to be given in 1966-67

AG103. German Literature—The roots of the contemporary crises of philosophy. Given only at Stanford in Germany.
2 units, summer, winter, (Freudenberg)

AG104. German Literature—Contemporary German philosophy. Given only at Stanford in Germany.
2 units, autumn, spring, (Freudenberg)

#AG146. Kafka—A discussion of his works.
3 units, winter, (Sokel), MWF 10

#AG156. Brecht—Representative works in English translation.
3 units, (Boeningger), to be given in 1966-67

#AG181. Nietzsche—His major works considered in relation to contemporary thought and literature.
3 units, (Sokel), to be given in 1966-67

#AG183. Thomas Mann—Major works in both fiction and essay in English translation.
3 units, autumn, (Boeningger), MWF 9

AP. and AR. Polish and Russian

AP150. Introduction to Polish Civilization and Culture.
2 units, spring, (Stahlberger), TTh 10
AR151. Fedor Dostoevsky.
4 units, autumn, (Stenbock-Fermor), MWF 10

AR153. Leo Tolstoy—Chief works of fiction in English translation. Open to all students except freshmen.
4 units, winter, (Stahlberger), MWF 9

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, spring, (Posin), MTWThF 11

AS. SPANISH

#AS75. Don Quixote in Translation—Reading, interpretation of Don Quixote.
3 units, winter, (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 1966–67

#AS151. The Modern and Contemporary Spanish Novel in Translation—Analysis, discussion of representative works.
3 units, spring, (Schevill), MWF 2

AS152. Lorca and Other Contemporary Spanish Dramatists in Translation—Modern trends, tensions as reflected in significant Spanish dramatists of present day.
3 units, autumn, (Schevill), alternate years, to be given in 1966–67

AS171. The Civilization of Spain.
3 units, autumn, (Hilton), TTh 8

AS172. The Civilization of Spanish America.
3 units, winter, (Hilton), TTh 8

AS173. The Civilization of Portugal and Brazil.
3 units, spring, (Hilton), TTh 8

These courses, given in English, provide, with convenient regional subdivisions, a general picture of Spain, Portugal, and Latin America (geography, history, social organization, culture).

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, spring, (Staff)

#G2. First-Year German—Continuation of G1.
4 units, autumn, winter, spring, (Staff)

#G3. First-Year German—Continuation of G2.
4 units, autumn, winter, spring, (Staff)

G5. Intensive First-Year German—Equivalent to G1, 2, and 3 combined. Enrollment limited.
12 units, summer, (Staff), MTWThF 8:00–9:30, 10:30–12:00 and W 2:15–4:05

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, winter, (Staff), MTWTh 8
summer, (Staff), MTWThF 8 or 9
#G22. Second-Year Reading—Prerequisite: G3.
3 units, autumn, winter, spring, (Staff)

#G23. Second-Year Reading—Continuation of G22.
3 units, autumn, winter, spring, (Staff)

G24. Second-Year Composition and Conversation—Prerequisite: G3 or equivalent.
3 units, autumn, winter, (Staff)

3 units, winter, spring, (Staff)

#G52. Second-Year German—Emphasizes speaking, writing in addition to reading. Students with a grade of A or B in G3 (or equivalent) may apply for admission. Students electing this course may not take G22 and G24. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 8,9, or 1:15

#G53. Second-Year German—Continuation of G52. Students electing this course may not take G23 and G25. Enrollment limited to 15. Prerequisite: G52 (or G22 plus G24).
5 units, winter, (Staff), MTWThF 8 or 1:15

#G54. Second-Year German—Continuation of G53. Satisfies General Studies Requirement under C. Prerequisite: G53 (or G23 plus G25).
5 units, spring, (Staff), MTWThF 8 or 1:15

#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—Enrollment only by special permission of Department. Thirty-six hours of reading per unit, weekly conference with instructor. May be repeated for credit. Prerequisite: G23 or G53.
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, and lectures. Discussion and oral presentation of assigned topics. Course may be taken twice for credit. Prerequisite: G54 or equivalent.
3 units, autumn, (Luther), MWF 2:15
spring, (Luther), MWF 9

G110. German Pronunciation—Prerequisite: G22.
3 units, winter, (Luther), MWF 9; (Hopkins), MWF 2:15

G111. Third-Year German Composition—Prerequisite: G54 or equivalent.
2 units, autumn, (Luther), TTh 9; (———), TTh 2:15

G112. Third-Year German Composition—Continuation of G111.
2 units, winter, (Luther), TTh 9; (Nordby), TTh 2:15

G113. Third-Year German Composition—Continuation of G112.
2 units, spring, (Luther), TTh 9

#G120. German Cultural Readings—Training in careful reading of books with a significant cultural content. Prerequisite: G23.
4 units, spring, (———), MTWThF 12

#G121. German Newspapers—This course is especially designed for students who want to keep their German alive. Current newspapers from East and West Germany will be read and discussed. This course may be repeated once.
2 units, spring, (Nordby), TTh 11

#G131. Masterworks of German Literature—The Classical Period. Prerequisite: G23 or G53.
4 units, autumn, (Lillyman), MTWTh 10

#G132. Masterworks of German Literature—Romanticism and Poetic Realism. Prerequisite: G23 or G53.
4 units, winter, (———), MTWTh 10
# G133. Masterworks of German Literature—From Naturalism to the Present. Prerequisite: G23 or G53.
4 units, spring, (Boeninger), MTWTh 10

# G141. Deutsche Lyrik—This course will change content every year and may therefore be repeated once. In autumn of 1965-66, it will focus on the lyric poetry of Goethe. Prerequisite: G23 or G53.
3 units, winter, (Lillyman), MWF 11

# G143. Deutsche Dramen—This course will change content every year and may therefore be repeated once. In winter of 1965-66, the plays of Büchner and Grabbe will be studied. Prerequisite: G23 or G53.
3 units, winter, (Lillyman), MWF 11

# G145. Deutsche Novellen—This course will change content every year and may therefore be repeated once. In the spring of 1965-66, romantic Märchen will be read and discussed in German. Prerequisite: G23 or G53.
3 units, spring, (Lillyman), MWF 1:15

ADVANCED AND GRADUATE

# G180. Die Dramen Kleists, Grillparzers und Hebbels.
3 units, autumn, (Foulkes), MWF 1:15

# G181. Thomas Mann.
3 units, (Sokel), alternate years, to be given in 1966-67

# G182. Brecht und das moderne Drama.
3 units, winter, (Boeninger), MWF 9

# G183. Hölderlin und Rilke.
3 units, (Lohner), to be given in 1966-67

# G184. Goethe's Faust.
3 units, (Lohner), alternate years, to be given in 1966-67

# G185. History of the German Language.
3 units, winter, (Schuelke), MWF 1:15

# G186. Heine und das Junge Deutschland.
3 units, spring, (Foulkes), MWF 11

# G187. Die Literatur der Deutschen Demokratischen Republik—A discussion of the German literature published under the Communistic regime of East Germany.
3 units, (Boeninger), alternate years, to be given in 1966-67

# G189. Kafka und Musil—Eine kritische Interpretation ihrer dichterischen Welt.
3 units, (Sokel), alternate years, to be given in 1966-67

# G190. German Applied Linguistics—Phonology and Morphology. (Same as Education 287.)
2 units, winter, (Politzer), T 2:15-4:05

# G199. Individual Work—Open only to German majors and to students who are working on special projects. May be repeated for credit.
1 to 15 units, each quarter, (Staff), by arrangement

GRADUATE COURSES IN GERMANIC STUDIES

# G200. Methods of Teaching German—(Same as Education 291.)
3 units, spring, (Lohnes), MWF 11

# G201. Advanced Composition and Grammar—Prerequisite: qualifying examination.
2 units, autumn, (Boeninger), TTh 11

# G202. Advanced Composition and Grammar—Continuation of G201.
2 units, winter, (Boeninger), TTh 9

# G205. Modern German—The syntax of modern German.
3 units, autumn, (Strothmann), MWF 11
G221. Gothic and Historical Germanic Grammar — Development of Germanic languages; reading of selected texts from the Gothic Bible.
   4 units, autumn, (Schuelke), MTWTh 10

G222. Old Norse.
   4 units, (Schuelke), to be given in 1966-67

G224. Old Icelandic Sagas.
   4 units, (Schuelke), to be given in 1966-67

G225. Old Saxon.
   2 units, winter, (Schuelke), WTh 10

G227. Old High German.
   2 units, winter, (Schuelke), MT 10

G228. Middle High German.
   4 units, spring, (Schuelke), MTWTh 10

G229. Advanced Middle High German.
   4 units, spring, (Schuelke), MTWTh 2:15

G231. Das mittelhochdeutsche Epos — Prerequisite: G228.
   3 units, winter, (Strothmann), MWF 11

G233. Die mittelhochdeutsche Lyrik — Prerequisite: G228.
   3 units, (Schuelke), to be given in 1967-68

G235. Die Mystik des Mittelalters — Prerequisite: G228.
   3 units, (Strothmann), to be given in 1966-67

G241. Lyrik und Drama des Barock.
   3 units, (Lohner), to be given in 1966-67

   3 units, (Lohner), to be given in 1966-67

G244. Die Mystik des Barock.
   3 units, autumn, (Lohner), MWF 2:15

G245. Lessing, Wieland und die Aufklärung.
   3 units, (Mueller-Vollmer), to be given in 1967-68

G252. Herder und der Sturm und Drang.
   3 units, (Sokel), to be given in 1967-68

   3 units, spring, (Lohner), MWF 3:15

G256. Der späte Goethe.
   3 units, (Lohner), to be given in 1966-67

G261. Die Romantik.
   3 units, (Mueller-Vollmer), to be given in 1967-68

   3 units, (Lillyman), to be given in 1966-67

   3 units, (Sokel), to be given in 1967-68

   3 units, winter, (Lohner), MTTh 2:15

   3 units, spring, (Sokel), MWF 1:15

   3 units, (Sokel), to be given in 1966-67

G281. Von der Aufklärung zur Romantik: Deutsche Geistesgeschichte I.
   3 units, autumn, (———), MWF 3:15

G283. Von Hegel bis Nietzsche: Deutsche Geistesgeschichte II.
   3 units, spring, (Sokel), MWF 2:15

   3 units, (Mueller-Vollmer), to be given in 1966-67

   3 units, autumn, (Lillyman), T 2:15-4:05

G290. Seminar — Subject to be announced in Time Schedule.
   3 units, autumn, (Lohner), W 4:15-6:05
   winter, (Lohner), M 4:15-6:05
   spring, (Lohner), W 4:15-6:05
G291. Seminar—Subject to be announced in Time Schedule.
3 units, winter, (Sokel), W 2:15–4:05
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 pho-
nemics, morphology, linguistic geography, and related areas.
2 units, autumn, (Weir), TTh 10

P. PORTUGUESE COURSES

[Under the direction of Ronald Hilton]
P11. Elementary Portuguese—Intensive course primarily for students specializing
in Hispanic American literature, civilization. Cannot be taken to fulfill General
Studies language requirements. Prerequisite: knowledge of Spanish or French.
4 units, autumn, (——), MTWTh 12
4 units, winter, (——), MTWTh 12
4 units, spring, (——), MTWTh 12
P99. Individual Reading—Thirty-six hours of reading per unit, weekly conference
with instructor. May be repeated for credit. Prerequisite: P13.
1 to 3 units, each quarter, (Hilton), by arrangement

R. RUSSIAN AND SL. SLAVIC COURSES

FIRST- AND SECOND-YEAR

[Under the direction of Edward L. Nordby]

#R1. First-Year Russian.
5 units, autumn, (Staff)
#R2. First-Year Russian—Continuation of R1.
5 units, winter (Staff)
#R3. First-Year Russian—Continuation of R2.
5 units, 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 2:15–4:05
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 (Skarginsky), MTWTh 8
12 units, summer, (Staff), MTWThF 8:00–9:30, 10:30–12:00, and W 2:15–4:05
#R52. Second-Year Russian—Emphasizes speaking and writing, in addition to
reading.
3 to 5 units, autumn, (Staff), MTWThF 1:15
#R53. Second-Year Russian—Continuation of R52. Satisfies General Studies re-
quirement under C. Prerequisite: R52.
3 to 5 units, winter, (Staff), MTWThF 1:15
#R54. Second-Year Russian—Continuation of R53. Enrollment limited to 15.
Prerequisite: R53.
5 units, spring, (Staff), MTWThF 1:15
R99. Individual Reading—Enrollment only by special permission of Department. Not required for majors in Russian. Thirty-six hours of reading per unit; weekly conference with instructor. May be repeated for credit. Prerequisite: R52.
1 to 2 units, each quarter, (Staff), by arrangement

SL15. Elementary Polish.
4 units, spring, (________), MTWThF 1:15

Third- and Fourth-Year

R100. Third-Year Russian Conversation—Course may be repeated for credit. Prerequisite: R54 or equivalent.
3 units, winter, (Skarginsky), MWF 10
spring, (Pashin), MWF 10

R110. Russian Pronunciation—Prerequisite: R54 or equivalent.
2 units, autumn, (Pashin), TTh 10

R111. Third-Year Russian Composition—Prerequisite: R54 or equivalent.
3 units, autumn, (Pashin), MWF 9

R112. Third-Year Russian Composition—Continuation of R111.
2 units, winter, (Pashin), TTh 10

R113. Third-Year Russian Composition—Continuation of R112.
2 units, spring, (Pashin), TTh 9

#R131. The Russian Short Story—Prerequisite: R54.
4 units, autumn, (Pashin), MWF 11

#R132. The Russian Novel—Prerequisite: R54.
4 units, winter, (Pashin), MWF 11

#R133. The Russian Drama—Prerequisite: R54.
4 units, spring, (Pashin), MWF 11

#R131. The Russian Short Story—Prerequisite: R54.
4 units, autumn, (Pashin), MWF 11

#R181. Russian Literature from the Eleventh to the Seventeenth Century.
4 units, autumn, (Stahlberger), MTWTh 11

#R182. Russian Literature of the Eighteenth and Nineteenth Centuries.
4 units, winter, (Stenbock-Fermor), MTWTh 11

#R183. Russian Literature of the Twentieth Century.
4 units, spring, (Stahlberger), MTWTh 11

R191. Russian Literary Criticism—Reading, discussion and writing. For graduating majors.
2 units, autumn, (Pashin), TTh 9

R192. Russian Literary Criticism—Reading, discussion and writing. Continuation of R191.
2 units, winter, (Pashin), TTh 9

R199. Individual Work—Thirty-six hours of reading per unit; weekly conferences with instructor. May be repeated for credit. Open only to majors in Russian.
1 to 3 units, each quarter, (Staff), by arrangement

Graduate Courses in Slavic Studies

SL201. Synchronic Phonology, Morphology, and Syntax of Russian I.
3 units, autumn, (van Schooneveld), alternate years, to be given in 1966–67

SL202. Synchronic Phonology, Morphology, and Syntax of Russian II.
3 units, winter, (van Schooneveld), alternate years, to be given in 1966–67

SL203. Synchronic Phonology, Morphology, and Syntax of Russian III.
2 units, autumn, (van Schooneveld), TTh 2:15

SL204. Synchronic Phonology, Morphology, and Syntax of Russian IV.
3 units, winter, (van Schooneveld), MWF 2:15

SL211. Old Church Slavonic I.
3 units, autumn, (van Schooneveld), MWF 2:15

SL212. Old Church Slavonic II.
3 units, winter, (van Schooneveld), MWF 3:15

SL214. Old Church Slavonic Literature.
2 units, winter, (Stahlberger), TTh 10
SL221. *Diachrony of East Slavic and Readings in Old Russian I.*
3 units, autumn, (van Schooneveld), alternate years, to be given in 1966-67

SL222. *Diachrony of East Slavic and Readings in Old Russian II.*
3 units, winter, (van Schooneveld), alternate years, to be given in 1966-67

SL226. *Diachrony and Synchrony of South Slavic.*
2 units, spring, (van Schooneveld), alternate years, to be given in 1966-67

SL227. *Diachrony and Synchrony of Western Slavic.*
2 units, winter, (van Schooneveld), TTh 2:15

SL228. *Divergence of Slavic Languages.*
2 units, autumn, (van Schooneveld), TTh 3:15

SL231. *The Early History and Culture of the Slavs.*
2 units, autumn, (Stahlberger), alternate years, to be given in 1966-67

SL250. *Graduate Seminar in Linguistics* — Subject to be announced in *Time Schedule.*
3 units, autumn, winter, (van Schooneveld), MWF 3:15

2 units, autumn, (———), alternate years, to be given in 1966-67

2 units, winter, (———), alternate years, to be given in 1966-67

SL271. *Russian Literature of the Seventeenth and Eighteenth Centuries.*
2 units, autumn, (———), alternate years, to be given in 1966-67

2 units, autumn, (Stenbock-Fermor), MW 10

3 units, autumn, (———), every three years, to be given in 1966-67

SL277. *Gogol.*
3 units, winter, (———), every three years, to be given in 1967-68

SL278. *Tolstoy.*
3 units, spring, (Stenbock-Fermor), MWF 10

SL279. *Dostoevsky.*
3 units, winter, (Stenbock-Fermor), MWF 10

SL281. *Comparative Slavic Mediaeval Literature.*
2 units, autumn, (Stahlberger), TTh 10

2 units, winter, (Stahlberger), TTh 3:15

2 units, spring, (———), every third year, to be given in 1967-68

SL299. *Individual Work* — Exclusively for graduate students in Slavic working on thesis or engaged in special work.
1 to 12 units, any quarter, (Staff), by arrangement

SL300. *Graduate Seminar in Literature* — Subject to be announced in *Time Schedule.*
4 units, autumn, (———), MW 4:15-6:05

**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, winter, (Staff)

#Sp2. *First-Year Spanish—Continuation of Sp1.*
4 units, autumn, winter, spring, (Staff)
#Sp3. First-Year Spanish—Continuation of Sp2.
4 units, autumn, winter, 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 8:00–9:30, 10:30–12:00, and W 2:15–4:05

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 1:15

#Sp22. Second-Year Reading—Aims primarily at reading ability. Prerequisite: Sp3.
3 units, autumn, winter, spring, (Staff)

#Sp23. Second-Year Reading—Continuation of Sp22. Reading material assigned will vary from section to section.
3 units, autumn, winter, spring, (Staff)

#Sp23a. Second-Year Reading—The historical development of Latin America. Reading of Américo Castro's *Iberoamérica* and training in the understanding of talks in Spanish. An alternative to Sp23. Prerequisite: Sp22 (or equivalent) with a grade of B or better. Taken in conjunction with Sp25 is the equivalent of Sp53.
3 to 4 units, winter, (Staff), MWF 8

Sp24. Second-Year Grammar and Composition—Students taking Sp52 may not take this course. Prerequisite: Sp3.
3 units, autumn, winter, (Staff)

2 units, winter, spring, (Staff)

Sp27. Second-Year Conversation—Students taking Sp53 may not take this course. Prerequisite: Sp3.
2 units, winter, (Staff)

Sp28. Second-Year Conversation—Students taking Sp54 may not take this course. Prerequisites: Sp24 and Sp27.
2 units, spring, (Staff)

#Sp52. Second-Year Spanish—Emphasizes speaking, writing in addition to reading. Students with a grade of A or B in Sp3 (or equivalent) may apply for admission. Students electing this course may not take Sp22 and Sp24. Enrollment limited to 15.
5 units, autumn, (Staff), MTWThF 9 or 1:15

#Sp53. Second-Year Spanish—Continuation of Sp52. Students electing this course may not take Sp23, Sp23a, Sp25, and Sp27. Enrollment limited to 15. Prerequisite: Sp52 (or Sp22 plus Sp24).
5 units, winter, (Staff), MTWThF 9

5 units, spring, (Staff), MTWThF 9

Sp99. Individual Reading—Enrollment only by special permission of Department. Thirty-six hours of reading per unit, weekly conference with instructor. Prerequisite: Sp23 or Sp53.
1 to 2 units, any quarter, (Staff), by arrangement

THIRD- AND FOURTH-YEAR

Sp100. Advanced Spanish Conversation—May be repeated for credit. Prerequisite: Sp28 or equivalent.
3 units, winter, (Ponce de León), MWF 3:15
MODERN EUROPEAN LANGUAGES

Sp10. Spanish Pronunciation—Prerequisite: Sp22.
   3 units, autumn, (Inostroza), TTh 11 and one hour by arrangement

Sp11. Third-Year Spanish Grammar and Composition—Prerequisite: Sp53 or equivalent (Sp23 or Sp23a plus Sp25).
   3 units, autumn, (Staff), MWF 9 or 11

Sp12. Third-Year Spanish Composition—Prerequisite: Sp11 or equivalent.
   2 units, winter, (Staff), TTh 8 or 9

Sp13. Third-Year Spanish Composition—Continuation of Sp12.
   2 units, spring, (Staff), TTh 8 or 9

#Sp121. Hispanic American Cultural Readings—The life of Simón Bolívar. Reading of Campos Menéndez, Se llamaba Bolívar, and training in the understanding of talks in Spanish. Prerequisite: Sp23 (Sp23a is recommended) or equivalent.
   4 units, spring, (Hilton), MTWTh 9

#Sp125. Spanish Cultural Readings—Training in careful reading of books with significant cultural content. Prerequisite: Sp23 or Sp53 or equivalent.
   4 units, autumn, (Espinosa), MTWTh 1:15

#Sp126. Cervantes—Reading and interpretation of selected passages from Don Quijote and the Novelas ejemplares. Prerequisite: Sp23 or equivalent.
   4 units, winter, (———), MTWTh 11

#Sp131. Masterworks of Spanish Literature I—From its origins to end of fifteenth century. Prerequisite: Sp23 or equivalent.
   3 to 4 units, winter, (Espinosa), MWF 10

#Sp132. Masterworks of Spanish Literature II—Sixteenth and seventeenth centuries. Prerequisite: Sp23 or equivalent.
   3 to 4 units, spring, (Espinosa), MWF 10

#Sp133. Masterworks of Spanish Literature III—From 1700 to 1898. Prerequisite: Sp23 or equivalent.
   3 to 4 units, winter, (Espinosa), alternate years, to be given in 1966–67

#Sp134. Modern and Contemporary Spanish Literature I—The Generation of 1898. Prerequisite: Sp23 or equivalent.
   3 to 4 units, autumn, (Schevill), alternate years, to be given in 1966–67

#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, spring, (———), alternate years, to be given in 1966–67

#Sp143. The Spanish Romantic Drama.
   3 to 4 units, winter, (———), alternate years, to be given in 1966–67

#Sp151. Masterworks of Spanish-American Literature I—Prerequisite: Sp23 or equivalent.
   3 to 4 units, spring, (———), MWTh 1:15

#Sp152. Masterworks of Spanish-American Literature II—Prerequisite: Sp23 or equivalent.
   3 to 4 units, spring, (———), alternate years, to be given in 1966–67

ADVANCED AND GRADUATE

#Sp180. Lope de Vega, Tirso y Calderón—Estudio e interpretación de cuatro o cinco comedias representativas.
   3 to 4 units, spring, (Espinosa), alternate years, to be given in 1966–67
#Sp182. Teatro español contemporáneo.
3 to 4 units, spring, (Schevill), MWF 4:15

Sp184. Spanish Speech and Drama—Reading and rehearsing of Spanish plays. May be repeated for credit. Prerequisites: Sp100 and Sp112 or permission of instructor.
3 to 4 units, winter, (Schevill, Ponce de León), TTh 4:15-6:05

Sp185. Spanish Dramatics—Staging of a Spanish play. Prerequisite: Sp184 or permission of the instructor.
2 units, spring, (Schevill, Ponce de León), by arrangement

#Sp186. Literatura hispanoamericana I—Epoca colonial. Open only to graduate and advanced undergraduate students.
3 to 4 units, autumn, (——), alternate years, to be given in 1966-67

#Sp187. Literatura hispanoamericana II—Romanticismo. Open only to graduate and advanced undergraduate students.
3 to 4 units, winter, (——), alternate years, to be given in 1966-67

#Sp188. Literatura hispanoamericana III—Modernismo. Open only to graduate and advanced undergraduate students.
3 to 4 units, autumn, (——), MWFTh 2:15

#Sp189. Literatura hispanoamericana IV—Siglo veinte. Open only to graduate and advanced undergraduate students.
3 to 4 units, winter, (——), MWFTh 2:15

Sp190. Spanish Applied Linguistics—Phonology and Morphology. (Same as Education 283.)
2 units, winter, (Weir), TTh 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, any quarter, (Staff), by arrangement

Graduate Courses in Spanish and Spanish Literature

Sp200. Methods of Teaching Spanish—(Same as Education 292.)
2 units, winter, (Morgan), TTh 3:15

2 units, autumn, (Schevill), W 7:15-9:05 p.m.

3 units, winter, (Schevill), MWF 4:15

2 units, spring, (Schevill), W 7:15-9:05 p.m.

Sp205. Modern Spanish—The syntax of modern Spanish.
3 units, autumn, (Espinosa), MWF 10

Sp211. Historia de la literatura española I—From the origins to 1500.
4 units, winter, (Espinosa), MTWTh 11

Sp212. Historia de la literatura española II—Sixteenth and seventeenth centuries.
4 units, winter, (Espinosa), alternate years, to be given in 1966-67

Sp213. Historia de la literatura española III—Desde 1700 hasta 1850.
4 units, autumn, (Espinosa), alternate years, to be given in 1966-67

4 units, autumn, (Schevill), TTh 4:15-6:05

4 units, winter, (Schevill), alternate years, to be given in 1966-67

Sp217. Teatro español del Siglo de Oro.
4 units, spring, (——), TTh 4:15-6:05

Sp218. Renaissance Prose and Mysticism.
3 units, autumn, (——), alternate years, to be given in 1966-67
MODERN EUROPEAN LANGUAGES

Sp220. Cervantes.
   4 units, winter, (Espinosa), alternate years, to be given in 1966-67

Sp223. La novela española moderna.
   3 to 4 units, winter, (________), MWF 2

Sp224. La novela hispanoamericana.
   3 units, autumn, (________), MWF 2

   3 to 4 units, (________), alternate years, to be given in 1966-67

Sp228. La poesía española contemporánea.
   3 to 4 units, spring, (________), alternate years, to be given in 1966-67

Sp230. Hispanic Folklore.
   3 units, (Espinosa), every third year, to be given in 1967-68

Sp232. The Spanish Epic Tradition.
   3 units, (Espinosa), every third year, to be given in 1966-67

Sp240. Spanish Versification.
   2 units, winter, (Espinosa), every third year, to be given in 1966-67

Sp249. Proseminar: Problems and Methods of Research in Hispanic American Literatures.
   3 units, autumn, (________), T 4:15-6:05

Sp250. Graduate Seminar in Spanish Literature—Subject announced in Time Schedule.
   3 to 4 units, autumn, (________), W 4:15-6:05
   winter, (________), T 2:15-4:05

   3 to 4 units, winter, (________), W 7:15-9:05 p.m.
   spring, (________), T 7:15-9:05 p.m.

   3 units, spring, (Espinosa), MWF 2

Sp261. Old Spanish—Elements of phonology, morphology; reading of Old Spanish texts.
   3 units, (Espinosa), alternate years, to be given in 1966-67

Sp263. Historical Spanish Linguistics I—Prerequisite: Sp260 or 261.
   3 units, spring, (Weir), alternate years, to be given in 1966-67

Sp264. Historical Spanish Linguistics II.
   3 units, spring, (Weir), MWF W

Sp266. Hispanic Dialectology.
   3 units, (Espinosa), every third year, to be given in 1966-67

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.

T. TEACHER TRAINING COURSES
[Under the direction of Rudolph Morgan]

T200. Use of the Language Laboratory—(Same as Education 295.)
   2 units, autumn, (Morgan), T 7:15-9:05 p.m.
   summer, (Morgan), TTh 9 or by arrangement

T201. Seminar in the Development of Laboratory Techniques—(Same as Education 297.)
   2 units, summer, (________), TTh 1:15 and one hour by arrangement

TS152. 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
TS153. Spanish for Elementary Teachers—Continuation of TS152.
   6 units, summer, (Staff), MTWThF 9 and MWF 1
TS199. Individual Work—Exclusively for graduate students in Spanish in the Master of Arts in Teaching Program. May be repeated for credit.
   1 to 4 units, summer, (Staff), by arrangement
See also Senior Colloquia.

MUSIC

Executive Head: William Loran Crosten
Professors: Putnam Calder Aldrich, William Loran Crosten, Wolfgang Erasmus Kuhn, Herbert Boswell Nanney, Leonard Gilbert Ratner, Sándor Salgo, Harold Carl Schmidt
Associate Professor: Leland Clayton Smith
Assistant Professor: George Louis Houle. Acting: Arthur Page Barnes (Director of Bands)
Music Librarian: Edward Eugene Colby
Director of Men's Glee Club: Robert Rightor MacKinnon
Lecturers: Adolph Bailer, Earle Blew (Piano), Charles R. Bubb (Brass Instruments), Marjorie Chauvel (Harp), Raymond Herbert Duste (Oboe), Philip Fath (Clarinet), Lloyd Gowen (Flute), Bonnie Hampton (Violoncello), Hazel Miloradovitch (Viola da Gamba), Ivan Burdette Rasmussen (Voice)

OFFERINGS AND FACILITIES

The Department’s aims are to promote understanding and enjoyment of music in the University at large and to provide specialized training for those who plan careers in music as teachers, composers, performers, or research scholars.

Practice facilities are available in the Dinkelspiel Auditorium Building, which also includes a well-equipped modern theater for concert and operatic productions. In addition to practice pianos and a practice organ, rare instruments from the Harry R. Lange Historical Collection may be used by qualified students.

The Departmental library contains a comprehensive collection of complete editions, scores, books, and records. 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:

1. Theory of Music: 21, 22, 26, 27, 121, 122
2. Music History: 100, 101, 102, 103, 104
3. Musical Performance:
   a) All students are required to demonstrate a minimum proficiency in piano which will include sight-reading as well as playing two prepared pieces on
the order of an easier Chopin Prelude or a Clementi Sonatina. This requirement should be fulfilled as early as possible and not later than the beginning of the junior year.

b) Ensemble: At least six quarters of work elected from courses 160, 161, 162, 163, 165, 166, and 171.

c) Six quarters of individual vocal or instrumental study, excluding Music 12. (In exceptional cases, students who can demonstrate on entrance a high degree of proficiency in solo performance may petition for exemption from this requirement.) Assignments to particular teachers will be made on the basis of auditions.

4. Musical Repertory. Supplementing the detailed study of individual compositions in the music history and theory courses, the student is expected on his own to develop a wide aural acquaintance with the music of the major composers. This acquaintance will be checked by a series of identification examinations which should be passed normally before the beginning of the senior year.

5. Listening and Reading Skills. The student’s ability to hear music accurately and to perform it at sight will be checked by two examinations, the first to be taken upon completing Music 22, the second to be taken in the first quarter of the senior year. A laboratory for the development of these skills will be offered.

Music majors will be expected to maintain a grade point average of at least 2.00 in music classes excluding performance activities.

Undergraduate minor—A program of 26–28 units of required work is offered as follows:

1. Music Literature: Music 1 and any two other courses in music history or literature given by the Department.
3. Musical Performance: At least three consecutive quarters of (a) ensemble and (b) vocal or instrumental study. The latter is available to music minors in the form of small-group instruction, for which no extra fee is charged.

(Note—The music minor may not enroll for vocal or instrumental instruction until he has completed Music 21, or unless he takes it concurrently.)

Senior Honors Program in Music—This program is designed as a 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 12 units will be planned to extend over the senior year. This work may be centered on composition, musical research or musical performance.

An Honors Program in Humanities is offered for undergraduate majors in this Department who wish to supplement their Departmental major by a related and carefully guided program of studies. See Humanities (Special Programs) for a description of the Honors Program.
## Sample Schedule for Four-Year A.B. Program with Major in Music

### First Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 1, 2, 3.</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Language 1, 2, 3. (if completed, substitute Western Civ.)</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Music 21, 22, 26. Elements of Music and Counterpoint</td>
<td></td>
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<td>4</td>
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<tr>
<td>Ensemble (Music 160, 161, 62, 163, 165, 166 or 171)</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Music 172. (Individual Vocal or Instrumental Instruction)</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Group activities</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Electives (optional)</td>
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<td>14</td>
<td>14–17</td>
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</table>

*Students who have not completed the language requirement and who do not wish to enroll for 18 units of credit may postpone Music 172.*

### Second Year

<table>
<thead>
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<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language 22, 23. (if not completed)</td>
<td></td>
<td>3</td>
<td>3</td>
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<tr>
<td>History 1, 2, 3. Western Civ.</td>
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<tr>
<td>Music 100, 101, 102. History and Literature</td>
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<tr>
<td>Music 27, 121, 122. Countertop and Advanced Harmony</td>
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<tr>
<td>Ensemble</td>
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<td>1</td>
</tr>
<tr>
<td>Music 172.*</td>
<td></td>
<td>2*</td>
<td>2*</td>
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<tr>
<td>Group activities</td>
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<tr>
<td><strong>Total</strong></td>
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<td>15–18</td>
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### Third Year

<table>
<thead>
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<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science 1, 2, 3. (Biology or Physical Sciences)</td>
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<td>Social Science</td>
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<tr>
<td>Music 103, 104. History and Literature</td>
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<tr>
<td>Elective in Music History or Literature (optional)</td>
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<td>4–5</td>
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<tr>
<td>Additional A.B. requirement (i.e., language reading or Phil. 3)</td>
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<td>4–5</td>
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<tr>
<td>Ensemble (optional)</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172. (optional)</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>15</td>
<td>14–15</td>
<td>15</td>
</tr>
</tbody>
</table>

### Fourth Year

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional science</td>
<td></td>
<td>3–5</td>
<td>3–5</td>
<td>—</td>
</tr>
<tr>
<td>Senior Colloquia</td>
<td></td>
<td>2</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>Senior Honors Program in Music or Electives in music (optional)</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Electives in Humanities</td>
<td></td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Ensemble (optional)</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 172. (optional)</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>15–17</td>
<td>15–17</td>
<td>14</td>
</tr>
</tbody>
</table>
Students planning to work for the General Secondary Credential in Music should add the following courses to their A.B. program in place of electives or optional courses:

**Third Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music 83.</td>
<td>Voice Class</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Music 84, 85, 86.</td>
<td>Instrumental Classes</td>
<td>1</td>
<td>(1)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Fourth Year**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Autumn</th>
<th>Winter</th>
<th>Spring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music 84, 85, 86.</td>
<td>Instrumental Classes</td>
<td>(1)</td>
<td>1</td>
<td>(1)</td>
</tr>
<tr>
<td>Music 127.</td>
<td>Orchestration</td>
<td>3</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Music 130a, b.</td>
<td>Orchestral Conducting</td>
<td>—</td>
<td>3</td>
<td>(3)</td>
</tr>
<tr>
<td>Music 131a, b.</td>
<td>Choral Conducting (may be taken in third year)</td>
<td>3</td>
<td>(3)</td>
<td>—</td>
</tr>
</tbody>
</table>

**Teachers' Credentials**

Students in the Department may work for the Standard Teaching Credential (Secondary) with a teaching major in music.

The program for this credential extends over a summer quarter of full-time academic work at the University, plus a year divided between half-time study at the University and a half-time teaching internship in a public high school near Stanford.

**Admission**

Students are admitted to this program only at the beginning of the summer quarter each year, upon the recommendation of the Music Department and the Secondary Education Committee. Applicants must have completed the Stanford A.B. degree in music, or its equivalent, plus the following courses:

<table>
<thead>
<tr>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music 127. Orchestration</td>
</tr>
<tr>
<td>Music 130, 131. Conducting</td>
</tr>
<tr>
<td>Piano: sufficient to pass piano proficiency test</td>
</tr>
<tr>
<td>Music 83. Voice Class</td>
</tr>
<tr>
<td>Music 84, 85, 86. Instrumental classes</td>
</tr>
<tr>
<td>Proficiency examinations must be taken in piano, voice, and conducting.</td>
</tr>
</tbody>
</table>

**GRADUATE DEGREES IN MUSIC**

The following statements apply to all the graduate degrees described below, unless otherwise indicated.

Applicants for admission to graduate study should possess a well-rounded general education as well as sound basic training in the theory, history, and performance of music. An entrance test will be given each applicant to measure his competence in the handling of musical materials, in analysis, and in verbal expression. Prior to his initial registration, each student will be given a comprehensive placement examination in the history and literature of music and in general musicianship (listening and reading skills). At the same time, the student should be prepared to demonstrate a moderate proficiency in piano.

None of Stanford's required undergraduate courses in music may be credited toward an advanced degree. Likewise, courses required for a particular Master of Arts concentration may not be credited toward the same concentration at the doctoral level.

Only work that receives a grade of A, B, or plus will be recognized as fulfilling the advanced degree requirements in music.

**Master of Arts**

The University's basic requirements for the Master's degree (residence, admission to candidacy, etc.) are discussed in the section "Degrees" in this Bulletin. Al-
though the A.B. is the normal antecedent to the A.M. degree, persons holding the Bachelor of Music degree may be admitted to Stanford subject to the possibility that they may be asked to do extra work in humanistic fields outside music.

Foreign language requirement—All students are required on entrance to demonstrate a reading knowledge and a comprehension of the principal musical terms in either French, German, or Italian.

Study program—Students may concentrate in musical research, composition, music education, performance practice, or conducting. To be recommended for the A.M. degree, a candidate must complete a program of 40 units based on the graduate courses offered by the Department and must pass a comprehensive examination. The study program will include: (a) Music 200, 226 or 229, and 240; (b) seminars or special studies in the chosen field of concentration; (c) musical performance (individual or ensemble), three quarters; (d) Master of Arts Project. (Depending on the concentration, this will be an investigative essay, a composition, or a demonstration of performance supported by a written commentary. In any case, the A.M. Project should be completed during the last quarter of residence.)

Doctor of Education

In cooperation with the School of Education the Department offers work leading to the Doctor of Education degree with a concentration in music education. Students in this program normally will take about one-third of their work in Education and two-thirds in Music. General regulations covering this degree are discussed in the Manual on Advanced Graduate Degrees in Education, which may be obtained from the School of Education. The work in music education may center on curriculum studies, principles and methods of teaching, or supervision and administration of music.

Doctor of Musical Arts

The purpose of the Doctor of Musical Arts program is to offer advanced training in the practice and pedagogy of music. Students may concentrate in composition, conducting, music education, or performance practice—the latter being taken to cover the study of modes of performance from medieval to modern times. Each concentration, however, will be given breadth through collateral studies in other branches of music and in relevant fields outside music. In all cases the work is planned especially with regard to possible careers in college or university teaching.

Enrollment is limited and, except in the field of music education, preference will be given to applicants who are not over thirty years of age.

Admission—The normal preparation for this program is the completion of the Stanford Master's degree or its equivalent in the student's field of concentration. In addition to completing the entrance test, an applicant will be asked to submit evidence of accomplishment in his particular field of concentration. Applicants in music education must have had at least two years of successful teaching experience.

Residence—If there are no deficiencies to be made up, this program may be completed in a minimum of two years of full-time study following the Master's degree. The work must be done entirely in residence at Stanford and must include at least three consecutive quarters of full-time study.

Study Program—Each candidate must complete a minimum of 72 units of work beyond the Master's degree. It must be emphasized, however, that the degree will be awarded on the basis of demonstrated proficiency rather than on the accumulation of units. The student's program of work will normally include:

(1) tutorial study in his field of concentration, (2) doctoral seminar in musical analysis, (3) studies in the history, theory, or performance of music as appear necessary on the basis of the placement and advisory examinations, (4) seminar in the
teaching of music in college, (5) electives, (6) final project or thesis, (7) public lecture-demonstration.

*Tutorial study*—Individual work under the guidance of the student’s major professor.

Concentrators in conducting or performance practice will make an extensive study of repertoire, leading to four demonstrations of their ability to perform music from different style periods. Each demonstration is to be supported by a written report containing stylistic analysis of the music in question, discussion of the special performance problems that are involved, and detailed proposals for the solution of those problems.

Concentrators in music education will do extensive reading and research in both the philosophy and practice of their field, each candidate ultimately focusing on a special branch according to his particular interest. The students in this area will also complete a minor of at least 12 units in either composition or performance practice.

Concentrators in composition will be expected to produce a number of original works demonstrating their ability to compose in a variety of forms and for the common media of vocal and instrumental music. In so far as possible, the works submitted will be presented in public performance prepared by the composer.

*Final project or thesis*—(1) Composition: an extended work for chorus, orchestra, chamber ensemble, or a combination of voices and instruments. (2) Music education: a thesis based on independent research in the candidate’s field of specialization. (3) Conducting or performance practice: possibilities open to the candidate include (a) preparing a modern performing edition of an early score; (b) writing an extended critical or historical essay on a selected problem or phase of performance practice.

*Public lecture-demonstration*—This is to be given during the last quarter of residence. It should be about one hour in length, dealing with some aspect(s) of the candidate’s final work.

*Foreign language requirements*—All students are required on entrance to demonstrate (a) a reading knowledge of one foreign language chosen from French, German, or Italian, and (b) a knowledge of the common musical terms in all three of the above languages. Concentrators in conducting and performance practice are further required to demonstrate reading ability in a second language chosen from the three listed above. This proficiency must be certified by the end of the first year of doctoral study.

*Departmental examinations*—(1) An advisory examination to be taken toward the end of the student’s first year in residence, to determine whether he will be recommended to continue work for the degree. (2) A final qualifying examination to be taken not later than the quarter preceding that in which the candidate expects to receive his degree.

*Teaching assistantships*—It is the policy of the department to appoint each doctoral candidate to a teaching assistantship for at least one quarter.

**Doctor of Philosophy**

A limited number of students with superior qualifications are accepted by the Department for work toward the Ph.D. degree in music.

General University regulations regarding this degree are discussed in the section “Degrees” in this *Bulletin*.

*Admission*—The normal preparation for this program is the completion of the Stanford Master’s degree, or its equivalent in musical research.

*Residence*—The candidate must spend at least three consecutive quarters beyond the Master’s degree as a registered student at Stanford, and must devote at least one full quarter in residence to work on his dissertation.
Basic requirements—In addition to his doctoral dissertation, each candidate must complete a minimum of 60 units of study beyond the Master's degree. The program will normally include work under the following headings:

(1) musical notation, (2) history of music theory, (3) performance practice, (4) historical studies in musical style and aesthetics, (5) electives.

Specialization—As soon as feasible the candidate will select the field of study in which he proposes to do independent research leading ultimately to the writing of a dissertation.

Foreign language requirements—A reading knowledge of French and German plus any other language necessary to research in the candidate's field of specialization. The examination in one language must be taken prior to the student's first registration. The second language must be certified by the end of the first year of doctoral study.

Departmental examinations—(1) An advisory examination will be given toward the end of the student's first year of doctoral study, to explore the strengths and weaknesses of his preparation; (2) a qualifying examination will be taken upon completion of the formal course requirements for the degree. This will 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 repertories. Prerequisite: 1 or equivalent.
3 units, autumn, (Salgo)

#3. Opera—Opera as a musico-dramatic form; examples from Mozart to present. Prerequisite: 1 or equivalent.
3 units, winter, (Crosten)

#7. Concerto—Selected concertos, seventeenth century to present. Prerequisite: 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 these to musical form. Written exercises in various textures, ear-training, analysis, elementary vocal and instrumental scoring, keyboard drill. Lectures and laboratory sections. Open to all students desiring basic technical knowledge of music. No prerequisite for Music 21 except ability to read music.

21. 4 units, autumn, (Nanney); winter, (Houle)
22. 4 units, winter, (Nanney); spring, (Houle)

4 units, spring, (Aldrich)

27. Counterpoint—Eighteenth century style. Prerequisite: 22.
4 units, autumn, (Ratner)

121, 122. Advanced Harmony—Harmonic materials of nineteenth and early twentieth centuries. Prerequisites: 22, either 26 or 27, and satisfactory completion of first listening and reading test.
121. 4 units, winter, (Ratner)
122. 4 units, 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)

222. Seminar in Composition—May be repeated for credit.
4 units, any quarter, (Smith)

224, 225. Solfège and Score Reading.
  224. 4 units, winter, (Barnes)
  225. 4 units, spring, (Barnes)

3 units, autumn, (Ratner)

227. Advanced Orchestration—Prerequisite: 127.
3 units, winter, (Smith)

229. Tonality and Structure—Graduate review 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, (Aldrich, Houle)

4 units, winter, (Aldrich, Houle)

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)

143. Chamber Music of the Classic Period—Prerequisite: 102.
4 units, (Ratner)

150. Studies in Opera.
4 units, (Crosten)

4 units, (Schmidt)

4 units, (Nanney)

155. Keyboard Music to 1700.
4 units, (Aldrich, Nanney)

199. Individual Work—For advanced undergraduates who wish to do work in fields not covered by regular curriculum. Projects for study must be specific and must be submitted for faculty approval before registration in the course. Credit not to exceed 4 units per quarter.
Any quarter, (Staff), by arrangement

240. Seminar in Music History and Analysis—May be repeated for total of 8 units.
4 units, autumn, winter, (Aldrich, Ratner)
12. **Introductory Piano**—Class for music majors.
   1 unit, autumn, winter, spring, (Blew)

72. **Group Instruction**—For music majors and minors.
   1 unit, autumn, winter, spring, (Staff)

72a. **Piano Class** (Blew).

72b. **Voice Class** (Rasmussen).

72c. **Recorder Class** (Houle).

72d. **Viola da Gamba Class** (Miloradovitch).

172, 272. **Individual Vocal and Instrumental Instruction**—Restricted to music majors.
   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 Nauney in charge
   Harpsichord: Professor Aldrich in charge

172b, 272b. **Voice**.
   Mr. Rasmussen in charge

172c, 272c. **Stringed Instruments** (violin, viola, violoncello, viola da
   gamba, contrabass, harp).
   Professor Salgo in charge

172d, 272d. **Wind Instruments** (flute, recorder, oboe, clarinet, bassoon,
   trumpet, horn, trombone).
   Professor Houle in charge

*Note*—A special fee of $40 per quarter is charged for enrollment in any branch of
172 or 272.

130a, b. **Orchestral Conducting**—Prerequisite: 127.
   130a. 3 units, autumn, (Salgo)
   130b. 3 units, spring, (Salgo)

131a, b. **Choral Conducting**.
   131a. 3 units, autumn, (Schmidt), to be given in 1966–67
   131b. 3 units, winter, (Schmidt), to be given in 1966–67

169. **Performance Practice**.
   169a. **Renaissance and Early Baroque**.
       4 units, autumn, (Houlc)
   169b. **Eighteenth Century**.
       4 units, winter, (Houlc)
   169c. **Medieval Music**.
       4 units, spring, (Houlc)

230a, b. **Advanced Orchestral Conducting**.
   230a. 4 units, autumn, (Salgo)
   230b. 4 units, spring, (Salgo)

231a, b. **Advanced Choral Conducting**.
   231a. 4 units, autumn, (Schmidt)
   231b. 4 units, winter, (Schmidt)

269a, b. **Seminar in Performance Practice of Early Music**—Prerequisite: 169a, b,
   or equivalent.
   269a. 4 units, autumn, (Aldrich)
   269b. 4 units, 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 admission 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 7:15 p.m.

161. University Bands.
   161a. Concert Band.
      1 unit, autumn, (Barnes), T 7:15 p.m.
      winter, (Barnes), MWF 4:15-5:30 p.m.
      spring, (Barnes), MWF 4:15-5:30 p.m.

   161b. Studio Band.
      1 unit, autumn, winter, spring, (Barnes), by arrangement

   161c. Marching Band.
      1 unit, autumn, (Barnes), MWF 4:15-5:30 p.m.

162. University Chorus.
   1 unit, autumn, winter, spring, (Schmidt), M 4:00-5:30 and W 7:00-8:30 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 and Th 7:00-8:30 p.m. and Sunday 10-12 a.m.

   1 unit, autumn, winter, spring, (Schmidt), (I) MTh 12; (II) TF 12

166. Chamber Orchestra—Open to advanced players who have had orchestral experience.
   1 unit, autumn, winter, spring, (Salgo), TF 12

   1 unit, autumn, winter, spring, (MacKinnon), T 7:15-8:45 and Th 4:15-5:45 p.m.

   1 unit, autumn, winter, spring, (Barnes)

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

84, 85, 86. Instrumental Classes for Secondary Credential Candidates.
   84a. Strings.
      1 unit, autumn, (Kuhn)

   84b. Strings—Continuation of 84a.
      1 unit, winter, (Kuhn)

   85a. Woodwinds.
      1 unit, winter, (Barnes)

   85b. Woodwinds—Continuation of 85a.
      1 unit, spring, (Barnes)

   86a. Brass and Percussion.
      1 unit, winter, (Barnes)

   86b. Brass and Percussion—Continuation of 86a.
      1 unit, spring, (Barnes)

280. Seminar in Music Education.
   4 units, any quarter, (Kuhn)

281. Administration and Supervision of Public School Music.
   4 units, spring, (Kuhn)
265a, b, c, d. Curriculum and Instruction in Secondary School Music—(Same as Education 265a, b, c, d.)

265a. 3 units, summer, (Kuhn)
265b. 1 unit, autumn, (Kuhn)
265c. 1 unit, winter, (Barnes)
265d. 1 unit, spring, (Kuhn)

380. The Teaching of Music in College.
4 units, spring, (Kuhn, Staff)

GRADUATE RESEARCH AND SPECIAL STUDIES

200. Music Bibliography—Use of bibliographical materials in graduate study; introduction to methods of research.
3 units, winter, (Colby)

251. Seminar in Choral Repertory.
4 units, autumn, (Schmidt)

299. Master of Arts Project.
4 units, any quarter, (Staff)

300a. Seminar in Musical Notation.
4 units, autumn, (Aldrich)

300b. Seminar in Musical Notation—Continuation of 300a.
4 units, winter, (Aldrich)

300c. Seminar in Musical Notation—Continuation of 300b.
4 units, spring, (Aldrich)

301a. Doctoral Seminar in Musical Analysis.
4 units, autumn, (Ratner)

301b. Doctoral Seminar in Musical Analysis—Continuation of 301a.
4 units, winter, (Crostien)

301c. Doctoral Seminar in Musical Analysis—Continuation of 301b.
4 units, spring, (Smith)

302. Doctoral Research in Musicology.
3 units, (Aldrich, Ratner), by arrangement

321. Readings in Music Theory.
3 units, (Aldrich, Ratner)

Any quarter, (Aldrich, Crosten, Ratner), by arrangement

390. Tutorial—For Doctor of Musical Arts candidates.
4 units, any quarter, (Staff)

399. Doctor of Musical Arts Project.
Any quarter, (Staff), by arrangement

NAVAL SCIENCE

Executive Head: Carroll W. Brigham (Captain, USN), Commanding Officer
Executive Officer: Douglas J. Jackson (Commander, USN)
Professor: Carroll W. Brigham (Captain, USN)
Associate Professor: Douglas J. Jackson (Commander, USN)
Assistant Professors: Robert L. Milbrad (Major, USMC), Phillip A. Livengood (Lieutenant, USN), Patrick H. Sullivan (Lieutenant, USN)

OFFERINGS AND FACILITIES

The Naval Science Department affords the opportunity for selected male students to receive instruction in essential Naval subjects which, in conjunction with a
baccalaureate degree earned through undergraduate work in fields of their own choice, will qualify them for a commission in the United States Naval Service.

The Regular NROTC Midshipman is chosen in nation-wide competition and attends the University under Navy sponsorship. In addition to payment for tuition, books, and fees, he draws retainer pay of $50 per month. 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 $40 per month. Applicants for the Contract NROTC program should communicate directly with the Professor of Naval Science, Stanford University.

Upon successful completion of the required courses in Naval Science, together with the University requirements for a baccalaureate degree, NROTC students are appointed Ensigns and serve on active duty with the Fleet as commissioned officers. Qualified students who so desire may pursue Marine Corps professional studies during the last two years of attendance. Upon completion they may be appointed Second Lieutenants.

Regular Midshipmen must complete three summer cruises with Fleet units. Contract students must complete one such cruise, normally between their junior and senior years.

**Requirements for Commissioning**

1. All NROTC students must complete the entire sequence of Naval Science courses offered.
2. Regular NROTC Midshipmen must satisfactorily complete one year of college physics, including laboratory, by the end of their second year. Contract students should complete this requirement if their schedule permits.
3. Regular NROTC Midshipmen must satisfactorily complete one year of college mathematics by the end of their second year. Contract students must complete mathematics through trigonometry (in secondary school or college) prior to the end of their second year.
4. All NROTC students must satisfactorily complete Psychology I 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: Engineering 31, Chemistry 173, or Physics 170, are exempt from Naval Science 411 and 412.

**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. Prerequisite: consent of instructor for enrollment of non-NROTC students.

111. **Naval Orientation**—Mission, ideals, standards, traditions and customs of the Naval Service. Introduction to seamanship, naval warfare, and naval leadership. 
3 units, autumn, (Livengood), MWF 8 or 12; lab. Th 8 or 12

112. **Evolution of Sea Power I**—Develops understanding of significant principles of sea power. These are examined in terms of the influence of sea power on historical development throughout the world.
3 units, winter, (Livengood), MWF 8 or 12; lab. Th 8 or 12
113. Evolution of Sea Power II—Continuation of 112.  
3 units, spring, (Livcngood), MWF 8 or 12; lab. Th 8 or 12

211. Naval Weapons I—Develops understanding of naval weapons and weapons systems and their application to maintain control of the sea. Stress is placed on basic scientific principles underlying determination of weapons systems requirements, design, and employment, rather than study of specific weapons systems.  
3 units, autumn, (Staff), MWF 8 or 2:15; lab. Th 8 or 2:15

212. Naval Weapons II—Continuation of 211. Jet and rocket propulsion, aerodynamics, inertial guidance systems, principles of nuclear physics.  
3 units, spring, (Staff), MWF 8 or 2:15; lab. Th 8 or 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.)

3 units, autumn, (Sullivan), MWF 10 or 12; lab. Th 10 or 12

3 units, winter, (Sullivan), MWF 10 or 12; lab. Th 10 or 12

3 units, spring, (Sullivan), MWF 10 or 12; lab. Th 10 or 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, (Milbrad), MWF 10 or 2:15; lab. Th 10 or 2:15

312M. Evolution of the Art of War II—Continuation of 311M.  
3 units, winter, (Milbrad), MWF 10 or 2:15; lab. Th 10 or 2:15

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, (Milbrad), MWF 10 or 2:15; lab. Th 10 or 2:15

411. Naval Engineering—Application of thermodynamics to design, installation and operation of naval propulsion plants. Introduction to principles of nuclear reactors, problems of radiation shielding and instrumentation. Principles of stability, experimental determination of righting moment, metacentric height, list and trim.  
3 units, autumn, (Staff), MWF 11 or 1:15; lab. Th 11 or 1:15

412. Naval Engineering and Introduction to Naval Leadership—Continuation of 411. Stress on preparation of Midshipmen for immediate assumption of command responsibilities upon graduation and commissioning.  
3 units, winter, (Staff), MWF 11 or 1:15; lab. Th 11 or 1:15

412E. Introduction to Naval Leadership—Stress on preparation of Midshipmen for immediate assumption of command responsibilities upon graduation and commissioning. (Open to Engineering majors only.)  
1 unit, 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 or 1:15; lab. Th 11 or 1:15

411M. Amphibious Warfare I—Historical development of amphibious warfare. Current doctrine.  
3 units, autumn, (Milbrad), MWF 11 or 1:15; lab. Th 11 or 1:15
NAVAL SCIENCE

412M. Amphibious Warfare II—Continuation of 411M.
3 units, winter, (Milbrad), MWF 11 or 1:15; lab. Th 11 or 1:15

3 units, spring, (Milbrad), MWF 11 or 1:15; lab. Th 11 or 1:15

Naval Science Laboratory—Two hours a week of Naval Science Laboratory required of all NROTC students. Monday session held on Drill Field at 3:15 p.m. Thursday session practical work conducted in regular classroom.

PHILOSOPHY

Acting Executive Head: Donald H. Davidson
Director: Philip H. Rhinelander (Tutorial Program)
Associate Professors: David S. Nivison, Jeffery Smith
Assistant Professor: Visiting: Dagfinn Follesdal (spring quarter)
Instructors: Kenneth Mills, Gregory O'Hair, Warren Quinn

LOGIC DIVISION

Director: Dana S. Scott
Professor: Georg Kreisel
Associate Professors: Solomon Feferman, Dana S. Scott. Visiting: Azriel Levy
Assistant Professor: Visiting: Andrzej Ehrerfeucht

OFFERINGS AND FACILITIES

Courses in philosophy give the student a knowledge of major philosophical ideas as they have developed historically and in terms of their contemporary analysis. The historical courses listed below emphasize change and development of philosophical ideas over a period of time, whether in the form of a widespread movement or the intellectual history of an individual philosopher. Other courses, such as those in systematic philosophy (cf. the listing which follows), or, in some instances, in the single work of a philosopher, emphasize the analysis, clarification, and elaboration of ideas. In recognition of the fact that philosophy gains significance as it draws from and contributes to other fields of human interest and knowledge, the programs of all philosophy majors will be planned to include courses outside the Department.

The Tanner Memorial Library of Philosophy, situated in the philosophy building, contains an excellent working library and ideal conditions for study.

The Philosophy Colloquium, to which guest speakers are invited, meets once a month during the academic year. The Hume Society, the undergraduate and graduate philosophical group, holds frequent meetings at which student speakers or their guests discuss philosophical issues.

A number of scholarships for undergraduate majors in Philosophy are available. In addition to general university scholarships, undergraduate majors in the Department may apply for tuition scholarships available from the Crossett fund.

PROGRAMS OF STUDY

Bachelor of Arts

The following Departmental requirements are in addition to the University's basic requirements for the Bachelor's degree:

The major program shall consist of 48 units within the Department, including, in the case of qualified and interested students, 9–24 units of tutorial work as de-
scribed 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 1965-66 all students accepted for Senior Tutorial automatically became 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 their Departmental adviser as early as possible.

Applicants for admission to graduate standing in the Department of Philosophy should apply to the Director of Admissions. Applicants are 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 his Departmental adviser.

Preliminary Examinations

1. All first-year graduate students will take a three-hour written examination during the winter quarter of their first year of graduate study at Stanford. It is expected that this examination will ordinarily be given in the first two weeks in February. A student is required to pass this examination in order to continue as a second-year student in the Department.
2. All Ph.D. candidates shall take written preliminary examinations during the winter quarter of their second year of graduate study at Stanford. These examinations cover the following fields: logic and philosophy of science; epistemology and metaphysics; ethics and value theory; history of philosophy. Each examination will last three hours. The examinations must be passed as a group. It is expected that a student must pass these examinations in order to continue as a graduate student. In special circumstances a student may be permitted to take these examinations a second time. The second-year examinations will ordinarily be set in the middle of February. If they so desire, first-year students may ask the Department for the option of taking the second-year examinations.
Language Requirements—Candidates for the Ph.D. must demonstrate a reading knowledge of French and German. When it is relevant to a proposed dissertation topic, the department will give permission to substitute other modern languages, or ancient languages, for one or both of the required languages.

Dissertation—Upon passing the preliminary examinations the candidate will submit a brief written statement of his dissertation topic to the Department, and a committee will be appointed to direct the research for and writing of the dissertation. Departmental approval of the dissertation topic is required for formal admission to candidacy for the doctoral degree.

The dissertation must be submitted to the committee in substantially final form at least four weeks before the University deadline in the quarter during which the candidate expects to receive his degree.

Immediately after passing the preliminary examinations, the candidate will file a formal application for candidacy as prescribed by the University. Dissertations must be completed and approved within five years from the date of that application. A candidate taking more than five years will be required to reinstate his candidacy by repassing the preliminary examinations.

Oral Examination—The University oral examination is taken after completion of the dissertation. The oral examination is to be considered primarily as a defense of the dissertation, but it may range over related topics as well.

Graduate Fellowships and Assistantships

A number of fellowships, including those provided by the Weiss and Locke funds which are reserved for students of philosophy, are available to graduate students.

In addition, the department has six teaching assistantships which may be held separately or combined with additional scholarship funds. Teaching assistants are expected to devote about half their time to their teaching duties. There are sections taught by teaching assistants in Philosophy 2, 3, 5, 6a and 6b.

Application forms for fellowships and teaching assistantships may be secured by writing the Office of Financial Aids; applicants for teaching assistantships should in addition address a specific request to the Director of Graduate Studies in Philosophy. In general, teaching assistantships are not offered to first-year graduate students. Students who do not intend to become candidates for the doctor’s degree are ineligible for graduate fellowships and teaching assistantships.

Graduate Program in Humanities

The Department of Philosophy also participates in the Graduate Program in Humanities leading to the joint Ph.D. degree in Philosophy and Humanities. For a description of that program, and fellowships offered in connection with it, see the section “Humanities (Special Programs).”

Graduate Program in Logic and Foundations of Mathematics

This program is intended to lead to a doctorate in mathematics, in philosophy, or, in some exceptional cases, in a field of study especially designed for the individual student. Candidates for the Doctor’s degree must meet the requirements of the department concerned. For further information concerning this program, students should write Professor Dana Scott, Director, Division of Logic.

At the beginning graduate level there are courses in Intermediate Logic (160a, b), Introduction to Set Theory (161), and Theory of Automata (162), designed in such a manner as to permit the entering graduate student either to start his logical studies from 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 1965–66 according as student interest and preparation warrant. The purpose of the Seminars is to prepare the student for creative research; they will be flexibly arranged to suit the students' interest and to aid their selection of Ph.D. topics.

Aside from these courses, which are all concerned directly with logic and the foundations of mathematics, there are related courses in the philosophy of language, decision theory, and the application of the axiomatic method to the empirical sciences. Directed reading courses can also be arranged for individual students.

**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 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.

5 units, winter, (Davidson), MTWTh 1:15 and Th or F section

**#3. Introduction to Logic**—An introduction to the methods and principles of formal logic. Exploration of modern techniques of deduction. Applications to philosophy and the exact sciences. This course is not a General Studies Humanities course.

5 units, autumn, (Scott), MTWTh 1:15 and Th or F section

spring, (---), MTWTh 1:15 and Th or F section

summer, (---), MTWThF 11 and Th or F section

**#4. Introduction to Chinese Philosophy**—Examination of selected problems in Chinese political thought, ethics, metaphysics, and art criticism. Comparison with similar problems in Western philosophy.

4 units, spring, (Nivison), MTWTh 2:15

**#5. Introduction to Philosophy**—Principal problems with which philosophy deals. Emphasis on conflicts in points of view which result from attempts to deal with these problems, and on practical consequences of various solutions offered. Prerequisite: sophomore standing (third quarter freshmen with good records may be admitted). (Graduate students taking this course will receive credit for 4 units only.)

5 units, autumn, (Mothershead), MTWThF 10

summer, (---), MTWThF 1:15 and one hour by arrangement

**#6a, b. Problems of Good and Evil**—The problem posed in the Book of Job is taken as central, and various attitudes toward this problem are considered in chronological order. In the first quarter the works covered include the Old Testament, several Greek tragedies, selections from Plato, Aristotle, the Stoics, Lucretius, New Testament, and Dante's Divine Comedy. In the second quarter, authors covered include Montaigne, Shakespeare, Leibniz, Hume, Marx, Mill, Dostoevsky, and Camus.
The course will be given as a continuous course over two quarters, but the first quarter (6a) may be taken for credit without the second. The course is open to Freshmen. 6a is prerequisite for 6b.

6a. 3 units, winter, (Rhinclander), MWF 10
6b. 3 units, spring, (Rhinclander), MWF 10

#8. Philosophy of Art—Nature and function of artistic creation and expression. Unique and common characteristics of various arts. Relation of arts to other human interests.

4 units, autumn, (Smith), MWF 9

#10. Introduction to Philosophical Analysis—An analysis of selected philosophical problems. Readings will include important historical texts as well as contemporary writers.

5 units, spring, (Gohcen), MTWTh 11 and Th or F section

#21. Sophomore Seminar in Plato—An introduction to the philosophy of Plato. Readings will include the Republic and several shorter dialogues. Enrollment limited to 15.

3 units, autumn, (Rhinclander), T 2:15-4:05, to be given in 1966-67

#22. Sophomore Seminar in Descartes—An introduction to the philosophy of Descartes. Readings will include Descartes’ Meditations. Enrollment limited to 15.

3 units, autumn, (O’Hair), W 4:15-6:05

#23. Sophomore Seminar in Locke—An introduction to the philosophy of Locke. The reading and analysis of some of the principal works of Locke will be considered. Enrollment limited to 15.

3 units, autumn, ( ), T 2:15-4:05

#24. Sophomore Seminar in Berkeley—An introduction to the philosophy of Berkeley. The reading and analysis of some of the principal works of Berkeley will be considered. Enrollment limited to 15.

3 units, winter, (Quinn), W 4:15-6:05

#25. Sophomore Seminar in Kant—Reading and discussion of the principal ethical writings of Kant with especial consideration of their relevance to contemporary ethics. Term paper. Enrollment limited to 15. Prerequisite: Philosophy 2 or 5.

3 units, winter, (Mothershead), T 2:15-4:05

#30. Sophomore Seminar on the Problems of Philosophy—An introduction to the questions philosophy has traditionally set itself to answer. Enrollment limited to 15.

3 units, autumn, (Mills), T 4:15-6:05

#31. Sophomore Seminar on Philosophical Rigor—This course will cover greatly simplified aspects of the propositional and predicate calculus and show exactly why mathematical theorems of completeness establish the equivalence between intuitive notions of validity and formal derivability, and also answer the question: what is a logical connective?

3 units, spring, (Krcisel), T 4:15-6:05

COURSES FOR ADVANCED UNDERGRADUATE AND GRADUATE STUDENTS

I. History of Philosophy from Ancient Times to the Present

100. Greek Philosophy—Characterization of historical situation in which Western science and philosophy began. Rise of critical thought. Early metaphysical speculation. Sophists and Socrates. Post-Socratic ethical schools. Philosophies of Plato, Aristotle, the Epicureans, the Stoics, and the Skeptics. Prerequisite: some general course in philosophy, such as 2, 5, 6a, or 10.

4 units, autumn, (Gohcen), MTWTh 11

of scholasticism in thirteenth century. William of Occam and the nominalist attack on scholasticism. Philosophic thought in the Renaissance. Prerequisite: 100 or equivalent.

4 units, winter, (Goheen), MTWTh 11


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 1:15 and Th or F section

II. COURSES IN THE PHILOSOPHY OF A PERIOD AND IN INDIVIDUAL PHILOSOPHERS

The following courses will be offered in 1965-66. 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, winter, (Hintikka), M 4:15-6:05

137. Seminar in the Philosophy of Plato—A study of selected dialogues. Prerequisite: 100 or equivalent.

3 units, autumn, (Goheen), MF 4:15

140. The Philosophy of St. Thomas Aquinas.  
4 units, spring, (———), MTWTh 2:15, to be given in 1966-67

144. Seminar in the Philosophy of Spinoza—A study of the basic works of Spinoza.

4 units, autumn, (Rhinelander),  THh 2:15-4:05

145. The Philosophy of David Hume—Prerequisite: 102 or equivalent.

4 units, spring, (Quinn), MTWTh 9

147. The Philosophy of Kant—A selection of representative problems in Kant's philosophy are discussed in the light of recent developments.

3 units, spring, (Hintikka), M 4:15-6:05

150. Seminar in the Philosophy of A. N. Whitehead.

3 units, winter, (Goheen), Th 2:15-4:05


3 units, autumn, (———), by arrangement, to be given in 1966-67

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 Philoso-
phy 2. Special section for graduate students.

157a. Introduction to Logic—For graduate students. Lectures same as Philosophy 3.

5 units, autumn, (Scott), MTWTh 1:15 and Th or F section

spring, (——), MTWTh 1:15 and Th or F section

summer, (——), MTWThF 11 and Th or F section


3 units, winter, (Scott), MWF 11

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, winter, (——), MWF 2:15 and one hour by arrangement

165. Philosophy of Logic—Some or all of the following topics will be discussed from a semi-formal point of view: Platonism versus nominalism, relation between logic and mathematics, epistemological implications of Gödel’s and Church’s theorems, counterfactuals, necessity and possibility, extensional and intensional contexts, synonymy, intuitionism, constructivity.

3 units, spring, (——), TTh 4:15-5:30

166. Probability and Induction—The most important approaches to induction and to probability are discussed and compared, with emphasis on the theories of inductive probability.

3 units, spring, (Hintikka), MWF 2:15

168. Philosophy of History—Nature and limits of our knowledge of the past, the categories of explanation used by historians, and the aims of historical inquiry; relation of these problems to speculation about the “meaning” of history and the structure of historical process.

4 units, spring, (Smith), MTWTh 9

170. Theory of Value—Definitions of “value”; psychological and social conditions of different values; function of value judgments; nature of standards and their role in criticism—in art, science, morals. Foundations of the normative disciplines, i.e., logic, ethics, aesthetics. Prerequisite: 2 or permission of instructor.

4 units, winter, (Quinn), 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, (——), MTWTh 9, to be given in 1966-67


4 units, spring, (Quinn), MTWTh 1:15

177. Political Philosophy—An analysis of fundamental political conceptions and problems: State, law, natural law, rights, natural rights, political obligations, and others.

4 units, autumn, (——), MTWTh 1:15, to be given in 1966-67


3 units, spring, (Follesdal), MWF 10

180. Philosophy of Religion—Critical enquiry into the nature and validity of religious experience, its unity and variety, its relation to other human interests.

4 units, spring, (Smith), MWF 9, to be given in 1966-67

181. Philosophy of Language—Nature and uses of language. Concepts of meaning, reference, truth, name, syntax, metaphor, ambiguity, vagueness, definition. Com-
Paraphrase 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 1:15

182. Metaphysics—This course will undertake to examine and clarify the traditional metaphysical distinction between particulars and universals, or substances and attributes, or subjects and predicates. Some traditional and some contemporary positions bearing on this distinction will be considered critically; for example, some theses of Aristotle, Plato, Leibniz, and Hume, in the former instance, and some theses of Frege, Wittgenstein, Russell, and Strawson in the latter instance.

4 units, autumn, (O'Hair), MTWTh 10

184. Theory of Knowledge—A survey of the central problems in the theory of knowledge emphasizing the uses of modern techniques in clarifying classical epistemological issues.

4 units, winter, (Hintikka), MTWTh 3:15

189. The Concept of Mind—This course will attempt to give an account of the concepts of action and behavior and to investigate the logical relations in which these concepts stand to those of belief, desire, sensation, and perception.

4 units, winter, (———), MTWTh 11, to be given in 1966-67

190. Selected Topics of Contemporary Philosophy—Topics will change from year to year. The central theme will be announced in the Time Schedule in any quarter in which this course is offered.

By arrangement

191. Tutorial—Junior year.

3 units, each quarter, (Mills, O'Hair, Quinn), by arrangement

192. Ideas in Literature—This course will explore ways in which philosophical ideas receive literary expression. Readings in such authors as Homer, Greek dramatists, Augustine, Dante, Montaigne, Marlowe, Shakespeare, Milton, Wordsworth, Hardy, Kafka, Eliot, Joyce.

4 units, spring, (Davidson), MTWTh 1:15, to be given in 1966-67

194. Problems in Chinese Philosophy—In 1965-66 this course will examine the problems in Taoist and Buddhist mysticism and in Confucian ethics, of the relationship between thought and action. Prerequisite: 4 or History 192, or equivalent.

4 units, autumn, (Nivison), MW 2:15-4:05

196. Tutorial—Senior year.

5 units, each quarter, (Rhinclander, 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: Rationality.

3 units, winter, (———), W 4:15-6:05

Topic: Problems in Epistemology.

3 units, spring, (O'Hair), W 4:15-6:05

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 3:15

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, autumn, (———), MWF 1:15

205. Philosophical Foundations of Quantum Mechanics—The course will center around problems in the foundations of quantum mechanics which have been con-
sidered 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 2:15 and one hour by arrangement, to be given in 1966-67

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 Statistics 206.) Prerequisite: Mathematics 63 or equivalent.

3 units, autumn, (Suppes), TTh 3:15 and one hour by arrangement, to be given in 1966-67

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 3:15 and one hour by arrangement, to be given in 1966-67


3 units, spring, (Davidson), M 8-10 p.m.

240. Individual Work for Graduates.

Each quarter, (Staff), by arrangement

242. Seminar in the Philosophy of Science.

3 units, spring, (———), T 4:15-6:05

244. Seminar in Metaphysics.


3 units, winter, (———), by arrangement, to be given in 1966-67


Each quarter, (Staff), by arrangement

299. Advanced Seminar in Recent Philosophical Literature.

Topic: Some Philosophical Problems in Logic.

3 units, spring, (Follesdal), 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, (Feferman), MWF 11

160b. Symbolic Logic—Continuation of 160a which is prerequired.

3 units, spring, (Feferman), MWF 11

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, (Scott), TTh 11:00-12:15

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, winter, (Scott), MWF 10

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, (Levy), MWF 11

291b. Set Theory—Continuation of 291a which is prerequired.

3 units, winter, (Levy), MWF 11
291c. **Set Theory**—Continuation of 291b which is prerequired.

3 units, spring, (Levy), MWF 11

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, (Ehrenfeucht), TTh 2:15-3:30

292b. **Metamathematics**—Continuation of 292a which is prerequired.

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

292c. **Metamathematics**—Continuation of 292b which is prerequired.

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

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, (——), TTh 2:00-3:15, to be given in 1966-67

293b. **Recursion Theory**—Continuation of 293a which is prerequired.

3 units, winter, (——), TTh 2:00-3:15, to be given in 1966-67

293c. **Recursion Theory**—Continuation of 293b which is prerequired.

3 units, spring, (——), TTh 2:00-3:15, to be given in 1966-67

391a. **Seminar in Foundations of Mathematics**.

Autumn, (Kreisel), by arrangement

391b. **Seminar in Foundations of Mathematics**.

Winter, (——), 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.

**PHYSICAL SCIENCES (GENERAL PROGRAM)**

*Professor:* Claudio Alvarez-Tostado

*Lecturer:* William A. Perkins

*Physical Sciences Subcommittee:* Konrad B. Krauskopf (Chairman), Claudio Alvarez-Tostado, Willis W. Harman, Leonard I. Schiff

The general program in Physical Sciences is designed to give students an acquaintance with all the principal fields of physical science without requiring specialization in any one. It provides training suitable especially for students who are preparing to teach science courses in secondary schools.

**PROGRAMS OF STUDY**

**Bachelor of Science**

The following requirements are in addition to the University's basic requirements for the Bachelor's degree:

Chemistry 1, 2, 3, Mathematics 41, 42, 43. Geology 1, 2, Physics 21, 23, 29, or equivalents.
Forty-five additional units of work in chemistry, physics, mathematics, geology, or related fields.
A reading knowledge of a modern foreign language, preferably French or German. This will normally mean the completion of a course numbered 23 in one of the modern languages.

Programs of study must be approved by an adviser appointed by the chairman of the Physical Sciences Subcommittee. The average grade for the science and mathematics courses specified above must be at least C.

Master of Science

Candidates for the degree of Master of Science in Physical Sciences (General Program) are expected to complete, in addition to the general residence and other requirements of the University for that degree, a program of study approved by an adviser assigned by the chairman of the Physical Sciences Subcommittee. A reading knowledge of French or German is required. The program of study will include (1) an acceptable thesis; (2) the satisfactory completion of at least 30 units of advanced work in physics, chemistry, mathematics, geology, or related fields; and (3) such other advanced work in the University, making a total of at least 45 units, as may be approved by the adviser.

COURSES

#1, 2, 3. Physical Science—Survey of physical sciences as an expanding field of knowledge. Lectures, demonstrations, laboratory work in astronomy, chemistry, physics, geology, to give a concept of the general field rather than emphasize its divisions. Primarily for freshmen. No credit will be given for Physical Science 3 following Geology 1.
1. 3 units, autumn, (Ripley), TTh 8 or 9; lab. by arrangement
2. 3 units, winter, (Ripley), TTh 8 or 9; lab. by arrangement
3. 3 units, spring, (Ripley), TTh 8 or 9; lab. by arrangement

#5, 6, 7. Physical Science—Survey of physical sciences as an expanding field of knowledge. Similar to Physical Science 1, 2, 3, but no laboratory work; lectures have greater emphasis on history of science.
5. 2 units, autumn, (Ripley), TTh 11
6. 3 units, winter, (Ripley), MWF 11
7. 3 units, spring, (Ripley), MWF 11

#50. Modern Astronomy—A review of current concepts and ideas regarding the nature of the solar system, galaxy, and extragalactic systems; essentially nonmathematical discussion of the basis for these concepts. Telescopic observations if possible.
3 units, 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 1966–67

Any quarter, (Staff)
Emeriti: Joseph Grant Brown, Paul Harmon Kirkpatrick, David Locke Webster
(Professors)

Executive Head: Leonard Isaac Schiff
Associate Professors: David Mark Ritson, John Dirk Walecka

OFFERINGS AND FACILITIES

The Russell H. Varian Laboratory of Physics, the adjacent Physics Lecture Hall, and the nearby W. W. Hansen Laboratories of Physics (High Energy Physics Laboratory, Microwave Laboratory, and Biophysics Laboratory) form a closely related complex housing a range of physics activities from general courses through advanced research, and including several accelerators up to 1.2 Bev in size. Separated from this group is the Stanford Linear Accelerator Center (SLAC), a very high energy physics laboratory now under construction which will contain as its principal tool a two-mile-long 45-Bev electron accelerator, which should produce its initial 20-Bev beam in 1966. 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 Library, which includes current subscriptions and back sets of important journals, together with textbooks, scholarly treatises in English, French, and German, and the collected works of the most eminent physicists. It is a center for reading and study of physics at all levels.

In addition to course work providing a sound foundation in classical and modern physics, undergraduates are offered laboratory work at several levels. Both series of introductory courses include laboratories in which students carry out individual experiments. The Intermediate and Advanced Physics Laboratories offer facilities for increasingly complex individual work, including independent investigations.

Graduate students find opportunities for research in the fields of theoretical physics, low temperature physics, electron and nuclear resonance, nuclear physics, high energy physics, coherent optical radiation, and solid state physics. The fields of microwave physics, plasma physics, ferrites, biophysics, and others of a similar nature are offered in the Applied Physics Division and in the Biophysics Laboratory. The number of graduate students admitted to the Physics Department is strictly limited. Students should complete application by January 15, 1966, 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 engineer-
ing, 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; 9 units of a sequence, to be decided with the concurrence of the Department adviser, in a science other than physics or mathematics (in the event that the chemistry background of the student is judged inadequate, the Department will require that this sequence be Chemistry 1, 2, and 3); Language, completion of French 3, German 3, or Russian 3 (or placement in more advanced courses). Another language may be substituted by petition at the discretion of the Department.

The mean grade for all courses taken in physics and chemistry must be C or higher.

Students may reach the level of the 200-series courses via a normal sequence or an accelerated sequence. Exceptionally able students with an especially good preparation in physics will find the accelerated sequence advantageous. It requires fewer courses and provides more opportunity for electives in either physics or other fields. Admission to the accelerated sequence requires A grades in 51 and 53 or permission of the Physics Department Undergraduate Study Committee.

Sample programs under the two sequences are shown below. The sequence of courses during the first two years is relatively inflexible, but considerable freedom exists during the upper-class years. The sample programs emphasize mathematics and 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.

<table>
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<tr>
<th>Normal Sequence</th>
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<tr>
<td><strong>Year</strong></td>
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<tr>
<td>Physics 51–3–5, 57, 61</td>
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<td>52, 54, 56</td>
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<td>110, 111</td>
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<td>130, 131, 132</td>
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<td>210, 211, 212</td>
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<td>200, 201, 202</td>
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<td>Math. 41–2–3–4–5</td>
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<td>130, 131, 132</td>
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<td>106, 107</td>
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<td>Hist. 1, 2, 3</td>
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<td>Engl. 1, 2, 3</td>
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<td>Ger. 1, 2, 3</td>
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<td>Chem. 1, 2, 3</td>
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<td>Soc. Sci.</td>
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<tr>
<td>Humanities</td>
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<td>Total units</td>
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</table>

Grand total of units 169†

* 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. 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.

Each student must either choose a minor subject or request a waiver of this requirement from his adviser. In the latter case, he must take nine units of graduate (200-series) courses in one of the following fields: mathematics, chemistry, or electrical engineering. Other fields may be substituted only on petition to the Physics Department Graduate Study Committee. The courses taken must be passed with a B average. No course listed by the Physics Department may be counted to fulfill the requirements necessary for the waiver of a minor.

The Physics Department strongly encourages all graduate students to engage in teaching before receiving their degrees.

(Technically 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 and Master of Arts in Teaching**

In its capacity as agent for the State Board of Education, the University grants credentials for teaching in California in junior and senior high schools and junior colleges. Applicants for these credentials should consult the Credential Secretary of the School of Education for details of the requirements in connection with the teaching of physics.

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish to further 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.

**FELLOWSHIPS AND ASSISTANTSHIPS**

Besides the University fellowships open to all graduates, there are available in the Department a few special fellowships and several assistantships involving teaching or research. Applications for fellowships, scholarships, and assistantships are made to the Financial Aids Office; they must be completed by January 15, 1966.

**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
PHYSICS

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, (Schaiohalo), 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, (Scott), 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—Vectors, particle kinematics and dynamics, work, energy, momentum, angular momentum; conservation laws; rigid bodies; oscillations; fluids. Discussions based on use of calculus. Prerequisites: Mathematics 41 or 11 and continuation in Mathematics 42, or permission of instructor.
4 units, winter, (Meyerhof), lec.; (Martin), discussions

#52. Mechanics Laboratory—Concurrent registration in Physics 51 is required.
1 unit, winter, (Schwettman)

#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.; (Oakes), discussions

#54. Electricity Laboratory—Concurrent registration in Physics 53 is required.
1 unit, spring, (Paul)

#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, (Rilson), lec.; (Dietrich), discussions

#56. Light and Heat Laboratory—Concurrent registration in Physics 55 is required.
1 unit, autumn, (Yearian)

57. Atomic Physics—Experimental basis of quantum theory; atoms, nuclei, x rays, atomic structure, radioactivity. Prerequisite: 55.
3 units, winter, (Yearian), TTh 11:00-12:15
3 units, summer, (———), MTWF 8

61. Optics and Wave Motion—Theory of wave motions from point of view of Huygens' principle, superposition; interference, diffraction phenomena. Prerequisites: 55 or admission to Accelerated Sequence, Mathematics 42, and concurrent or prior registration in 43.
3 units, spring, (Block), TTh 11:00-12:15

100, 101. Intermediate Physics Laboratory—Fundamental experiments in mechanics, heat, electricity and magnetism, optics, and atomic physics. One set of appa-
ratus for each experiment is available so that one or two students will perform a
given experiment during a particular laboratory session. Students will work one or
two weeks per experiment, completing ten to fifteen during two quarters. Prerequisites: 111 and concurrent or prior registration in 121 and 122.

100. 2 units, winter, (Prepost, Yearian), by arrangement
101. 2 units, spring, (Prepost, Bevington), 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, perturbation theory, stability of orbits, elementary mechanics of deformable solids. Prerequisites: 51 and Mathematics 130.

110. 3 units, winter, (_____), MWF II
111. 3 units, spring, (_____), MWF II

120, 121, 122. Intermediate Electricity and Magnetism—Electrostatics, dielec-
trics; magnetostatics; solutions of Laplace and Poisson equations; passive d.c., a.c.
circuits; Maxwell’s equations; propagation of electromagnetic waves; motion of charged particles in electromagnetic fields; introduction to special relativity. Prerequisite: 53. Concurrent or prior registration in Mathematics 130 and 131 with
Physics 120 and 121, respectively, is required.

120. 3 units, autumn, (Dietrich), MWF 8
121. 3 units, winter, (Dietrich), MWF 8
122. 3 units, spring, (Dietrich), MWF 8

130, 131, 132. Atomic and Nuclear Structure—Fundamental concepts of quantum mechanics and its physical basis. Elementary properties of the Schrödinger equation. Some applications to atoms, molecules, and atomic nuclei. Prerequisites: 57 or admission to Accelerated Sequence, 61, and 111. Concurrent or prior registration in Physics 120, 121, 122, or equivalent, and in Mathematics 130 and 131 is required.

130. 3 units, autumn, (_____), MWF II
131. 3 units, winter, (_____), MWF II
132. 3 units, spring, (_____), MWF II

140. Elementary Nuclear Physics—Elements of nuclear structure, systemsatics of
nuclei, radioactivity, interactions of nuclear radiations with matter, nuclear models, nuclear reactions. Prerequisites: 57 or 130 and knowledge of calculus.

3 units, autumn, (Meyerhof), TTh 11:00-12:15

170. Thermodynamics—Derivation of laws of thermodynamics from basic postu-
lates. Macroscopic properties of matter as consequences of these laws. Prerequisites: 55 or admission to Accelerated Sequence and Mathematics 130.

3 units, autumn, (Block), TTh 11:00-12:15

171. Kinetic Theory and Introduction to Statistical Mechanics —Kinetic
theory of gases; introduction to statistical concepts from Boltzmann point of view,
including quantum statistics, applications. Prerequisites: 130 and 170, or equivalent.

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

172. Physics of Solids—Introduction to the principal types of solids, with empha-
sis on their electrical and magnetic properties. Elementary treatment of electrons in
metals, energy bands, semiconductors, rectification, and ferromagnetism. Prerequi-
sites: 171, or 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 under-
graduate 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 phys-
ics, nuclear physics, solid state physics, low temperature physics, and cosmic rays,
including Zeeman effect, isotope shift, gyromagnetic ratio of the electron, β spectra,
α-particle scattering, Compton effect, π-μ decay, x rays, nuclear magnetic resonance,
lasers, Mössbauer effect, superconductivity, and others. Experiments in electronic
circuits, including amplifiers, oscillators, transmission lines, etc. Physics 200 and 201
Physics consists of a selection of fundamental experiments chosen mainly from the field of atomic and nuclear physics. Physics 202 and 203 consist of experiments chosen by the student who wishes to do more advanced work in one or more special areas. Prerequisites: for Physics 200 and 201: 100, 101, 121, and 131; for Physics 202: 201 or consent of instructor; for Physics 203: 202. (Note: Any of these courses may be taken in any of the three quarters. Furthermore, a student may take 200 alone or simultaneously with 201.)

200. 2 units, autumn, winter, spring, (Hanna, Paul, Schwettman), by arrangement
201. 2 units, autumn, winter, spring, (Hanna, Paul, Schwettman), by arrangement
202. 3 units, autumn, winter, spring, (Hanna, Paul, Schwettman), by arrangement
203. 3 units, autumn, winter, spring, (Hanna, Paul, Schwettman), by arrangement


210. 3 units, autumn, (Fetter), MWF 10
211. 3 units, winter, (Fetter), MWF 10
212. 3 units, spring, (Fetter), MWF 10

**220, 221, 222. Classical Electrodynamics**—Vector fields, statistics, boundary value problems and Green's functions. Maxwell's equations, integration of the wave equations. Special relativity, covariant formulation of electrodynamics, radiation and diffraction, relativistic particle motion, radiation reaction and electromagnetic mass. Prerequisites: 122 or equivalent, and Mathematics 132 and Physics 212 or consent of instructor.

220. 3 units, autumn, (Martin), MWF 9
221. 3 units, winter, (Martin), MWF 9
222. 3 units, spring, (Martin), MWF 9


230. 3 units, autumn, (Schiff), TTh 9-11
231. 3 units, winter, (Schiff), TTh 9-11
232. 3 units, spring, (Schiff), TTh 9-11


240. 3 units, autumn, (Bevington), MWF 11
241. 3 units, winter, (Bevington), MWF 11

**242. Introduction to High Energy Physics**—Properties of "elementary" particles; isotopic spin formalism; phenomenology of conservation laws. Discussion of key experiments from standpoint of results.

3 units, spring, (Ritson), MWF 11

**270. Statistical Mechanics**—Development of concepts, methods of classical and quantum-statistical mechanics from ensemble viewpoint; microscopic basis for thermodynamics. Prerequisite: 171. Concurrent or prior enrollment in Physics 232 and Mathematics 106 is required.

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

**290. Literature of Physics**—Intensive study of literature of any special topic. Chiefly preparation, presentation of reports upon topics studied. Prerequisites: 25 units of college physics and permission of instructor.

Any quarter, (Staff), by arrangement

330. 3 units, autumn, (Oakes), TTh 1:15-3:00
331. 3 units, winter, (Oakes), TTh 1:15-3:00
332. 3 units, spring, (Oakes), TTh 1:15-3:00


3 units, spring, (Scott), alternate years, to be given in 1965–66

336. Advanced Topics in Theoretical Physics—Discussion of selected topics of current interest in theoretical physics. Prerequisite: 330.

3 units, spring, (———), by arrangement


3 units, autumn, (Walecka), TTh 9–11

341, 342. Nuclear Theory—Theory of nuclear structure, including nuclear forces, nuclear matter, electromagnetic properties of nuclei, nuclear spectra, nuclear models, weak interactions, and nuclear reactions. Prerequisites: 222, 232, and 241.

341. 3 units, winter, (Walecka), TTh 9–11
342. 3 units, spring, (Walecka), TTh 9–11


3 units, spring, (———), alternate years, to be given in 1966–67

370, 371. Structure of Condensed Matter—Topics such as the following from solid state and low temperature physics: liquid helium 3, helium 4, superconductivity, superfluidity, long-range order in momentum space, including quantized flux and rotation and the many-body Bose and Fermi systems. The first quarter will emphasize the macroscopic properties and theories of these systems. The second quarter will emphasize microscopic theories. Prerequisites: 172 and 230.

370. 3 units, autumn, (Fairbank), TTh 9:30–10:45, alternate years, to be given in 1965–66
371. 3 units, winter, (Little), TTh 9:30–10:45, alternate years, to be given in 1965–66

390. Research—All work in experimental or theoretical problems in research, as distinguished from independent study of non-research character listed as Physics 190 and 290. 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
POLITICAL SCIENCE

Emeriti: Thomas S. Barclay, Philip W. Buck, Anthony E. Sokol, Graham H. Stuart (Professors)

Executive Head: Gabriel A. Almond


Associate Professors: Charles A. Drekmeier, Robert A. Horn.

Assistant Professors: Richard A. Brody, Richard R. Fagen (on leave), Giuseppe Mammarella (Director of Administration, Stanford in Italy), Robert A. Packenham, Hans N. Weiler, Raymond E. Wolfinger. Acting: Ole Holsti. Visiting: John E. Rue

Lecturers: Christian Bay, Irene Blumenthal, Dennis J. Doolin, Milorad M. Drachkovich, Robert M. Rosenzweig

OFFERINGS AND FACILITIES

The purpose of instruction in the Department of Political Science is (1) to offer all students courses designed to introduce them to the political aspects of society, to train them in the analysis of political problems and to equip them for the exercise of their duties as citizens, (2) to provide undergraduate majors with a program of study leading to the A.B. degree in political science as a foundation for a liberal education, (3) to prepare students for postgraduate executive management programs in government and industry, (4) to give candidates for graduate degrees training preparatory to careers in government, research, teaching, or private enterprise where a knowledge of domestic politics and foreign affairs is in demand, and (5) to prepare students for a career in the foreign service.

The University Library has excellent resources for study and research in all fields of political science. Special collections are also found in the Hoover Institution and the Library of the Law School. The West Memorial Library which is housed in the same building with the Department's offices is maintained as a working collection serving political science students. Through participation in the Inter-University Consortium for Political Research, the faculty and students of the Department of Political Science have access to an extensive pool of data on political behavior in a great variety of institutional settings as well as to the research facilities and training programs in survey research and analysis sponsored by the Consortium at the Survey Research Center of the University of Michigan. Professors Eulau and Wolfinger serve as coordinators of the program.

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 or a seminar 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.

c) At least one seminar, which may be counted toward completion of requirement (b) above.

Honors Program in Political Science

The Honors Program provides 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 made no later than the second quarter of the junior year. Applicants must have achieved a 3.00 average or better in all University work, and a 3.30 average or better in political science courses.

Honors candidates will complete all requirements for a major in political science and will also submit an honors thesis during their senior year. Honors candidates will normally take Political Science 198, Honors Seminar, unless a substitute is approved. The thesis will be awarded a maximum of 15 credits. Following his selection of a thesis topic, the honors candidate will be assigned an adviser who will supervise his thesis research and writing.

Graduation with Honors in Political Science will require (1) a 3.00 average or better in all University work; (2) a 3.30 average or better in political science; and (3) the 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

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 system. For these courses see below under Comparative Government, International Law and Relations, Political Theory, and Public Law, and under Graduate Courses. 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. Preference is given to those applying by January 15; normally applications will not be considered after April 1. Ordinarily graduate students enter the Department at the beginning of the academic year.

Except in unusual circumstances, the Department will not admit graduate students who will not be able to take a full-time program. That is, students will be expected to carry a full course load except for time devoted to teaching or research assistantships.

Ordinarily graduate applicants over the age of 40 will not be accepted.

**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. Applications from students who plan to terminate their graduate study at the Master's level are not ordinarily encouraged; preference is given to applicants who seek the Doctorate.

The faculty of the Department recommends a candidate for this degree if he has satisfactorily completed, in the judgment of the Department, at least one full academic year as a graduate student, with 45 units of work in political science of which at least 25 units must be taken in graduate seminars. By special permission, work done in related departments may be accepted in lieu of a portion of the work in political science. Normally, grades below the level of B in graduate seminars will not be considered acceptable for A.M. candidates.

During the first quarter in residence a candidate for the Master's degree should register for Political Science 401, 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. (The Master's degree may also be awarded to doctoral candidates who have completed the above requirements.)

**Master of Arts in the Teaching of Political Science**

The degree of Master of Arts in Teaching is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 25 units in political science courses and 12 units in the School of Education. Detailed requirements for the course are outlined in the section "School of Education" in this Bulletin.

**Doctor of Philosophy**

The candidate for the Ph.D. degree will prepare for and submit himself to examination in three of the following fields of political science: American politics, comparative politics, international relations, political theory, public administration, and public law.

In addition, the candidate is required to take:

1. Further specialized work within one of the three fields of political science he offers for the degree; or
2. Relevant work in a part of one of the fields of political science he does not offer for the degree; or
3. Relevant work in cognate disciplines.
The candidate will be examined upon this work. The normal expectation is that the candidate will take these examinations at the end of his second year in residence at Stanford.

The Ph.D. candidate is required to demonstrate one of the following:

1. A reading knowledge of two Western languages (e.g., French and German); or
2. A reading knowledge of one non-Western language (e.g., Arabic, Chinese, or Japanese) or of Russian; or
3. A reading knowledge of and conversational ability in one language (e.g., French, German, Spanish, Italian); or
4. A reading knowledge of one language and knowledge of statistics and/or related skills.

The skill requirement may be fulfilled as follows:

1. By successfully completing a program of at least 15 quarter units of selected courses; or
2. By successfully passing a written examination offered by the Department.

The language or skill alternatives shall be those most likely to be useful in connection with the student's program of study for the degree and his predoctoral and postdoctoral research program. (The native language of a foreign student may be accepted in fulfillment of the requirement.) The Department decides on the language or skill program proposed by the candidate.

If the candidate has not completed at least one year of previous undergraduate instruction, or 5 quarter units of previous graduate instruction, in political theory, he will take 5 quarter units of graduate instruction in political theory. Deficiencies in undergraduate preparation in political science and other social sciences should be made up at the earliest possible time after admission. The candidate is also required to take Political Science 401 in his first year of residence. Ph.D. candidates are encouraged to participate in the Departmental Research Seminar.

Not later than the end of the third week of his third quarter in residence, the candidate will submit to the Department a statement of: (a) the three fields of political science in which he is to be examined, (b) the additional work he expects to do in one of these fields, another field of political science, or in cognate disciplines, (c) his program for making up deficiencies, (d) his program for fulfilling the language and/or skill requirements, and (e) the proposed field of investigation for his dissertation. This statement will be the subject of an interview of the candidate by a faculty committee. After this interview and an evaluation of the proposed program, the faculty decides whether the candidate will be permitted to proceed toward the Ph.D. degree in the Department. Upon approval, a date for the Departmental and University examinations will be set in the light of the candidate's total program.

After the candidate has completed his preparation in all his fields, and after he has fulfilled the language and/or skill requirements, he takes the written Departmental examinations. These examinations are scheduled in the autumn and spring quarters. Upon successful completion of the written examinations the candidate proceeds to the University oral examination.

Doctoral candidates who apply for the A.M. degree will be awarded that degree upon completion of the requirements outlined in the description of the Master of Arts program.

For more detailed information, see "Requirements and Procedures for Candidates for the Degree of Doctor of Philosophy in the Department of Political Science," which is available in the Departmental office.

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 Gradu-
ate Student Adviser. They are then interviewed, prior to admission, by a committee of the faculty. The same committee determines the required preparation in the two fields, but no candidate shall take less than 10 units, including at least one graduate seminar in each field. Candidates will be examined in their fields in the general oral examination.

Teacher's Recommendation—For the recommendation for the Stanford Junior College Teacher's Credential with political science as a major, the applicant should have completed, in a manner satisfactory to the Department, at least 40 units in political science, including courses 10 and 20. For a minor, the applicant should have completed 24 units, including course 10.

ASSISTANTSHIPS, SCHOLARSHIPS, AND PRIZES

The Department has teaching assistantships in Political Science 1, 10, and 150 and graduate assistantships in connection with its other courses. These customarily are granted to applicants only after they have been at Stanford for at least one quarter.

A number of scholarships and fellowships are also available. Graduate students, specializing in comparative politics, may apply for fellowships under the National Defense Education Act. The attention of undergraduate students is called to the annual Edwin A. Cottrell Memorial Prize for the best student in Political Science 1, the Arnaud B. Leavelle Memorial Prize for the best student in Political Science 150, the Lindsay Peters, Jr., Memorial Prize for the year's outstanding student in Political Science 10.

I. INTRODUCTORY COURSES

#1. Major Issues of American Public Policy—Alternative public policies in selected areas, including control of monopoly, labor relations, civil rights, social welfare, foreign policy. Political process; influence of cultural, economic, political factors on determination of public policy. Prerequisites: History 1 and 2.

5 units, autumn, (Marshall), MTWThF 10
winter, (Marshall), MTWThF 11
spring, (——), 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, (——), MTWThF 9
winter, (Shapira), MTWThF 11
spring, (Horn), MTWThF 11

20. Contemporary Governments Abroad—Survey of governmental institutions and political processes in England, France, the Soviet Union, Germany, Japan.

4 to 5 units, autumn, (Packenham), MTWThF 8
winter, (Packenham), MTWThF 8
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 the instructor. May be taken for a maximum of three quarters.

1 unit, autumn, winter, spring, (Watkins), by arrangement

II. ADVANCED COURSES AND UNDERGRADUATE SEMINARS

Advanced undergraduate courses are open to undergraduates who have the necessary prerequisites and also graduates where advisable. Undergraduate seminars are open, with consent of the instructor, to juniors and seniors and to graduates where
advisable. Enrollments will be limited. Some graduate seminars also may be open with consent of instructor to seniors.

ADMINISTRATION

106. Public Administration—Relation of policy to administration, planning, principles of organization, problems of supervision and personal motivation, public relations, decision-making, the budget, administrative responsibility. Prerequisite: 1 or 10. 5 units, autumn, (———), MTWThF 10

104. Local Government Laboratory—Field course in municipal affairs offered in cooperation with Coro Foundation (San Francisco). 2 units, spring, (———), T 2:00-4:30

Seminars

107. Seminar in Government and Natural Resources—Political, economic, administrative factors affecting public policy for river basin development, soil conservation, management of public domain, related problems. Pressure groups, legislative bodies, administrative agencies in the decision-making process. Prerequisite: 100. Economics 1 is desirable. 5 units, winter, (Marshall), M 2:15-4:05

108. Seminar in Administrative Responsibility—Conflicting loyalties, accountabilities of administrative officials in decision-making processes; responsibility to public at large, pressure groups, chief executive, legislature, profession. Case study method used. Prerequisite: 100. 5 units, autumn, (Marshall), M 2:15-4:05

109. Directed Reading in Administration—Advanced individual study in public administration. Prerequisite: 100. Any quarter, (Staff), by arrangement

110. Administrative Behavior—Environment of administrative action; political, social, psychological factors in management; problem of incentives. Prerequisite: 100. 5 units, spring, (Walker), MTWThF 11

For graduate courses in Administration, see Part III.

COMPARATIVE GOVERNMENT

112. Government and Politics in Asia—Survey of governmental institutions and the political process in Asian countries. Desirable prerequisites: 20 or previous study of the area. 4 to 5 units, autumn, (Ike), MTWThF 1:15

113. Governments of Latin America. 4 to 5 units, spring, (Packenham)

114. Government and Politics in Japan—Governmental institutions and the political process in prewar and postwar Japan; the influence of tradition and social change; the impact of the occupation. Desirable prerequisite: 20 or 112. 4 to 5 units, winter, (Steiner), MTWThF 11

115. Government and Politics in China—Governmental institutions and the political process in China since 1949. Desirable prerequisite: 20 or 112. 4 to 5 units, spring, (Ike), MTWThF 1:15

116. Politics in the Soviet Union—An analysis of the composition, rules of behavior, functions, styles and structures of the Soviet decision-making organs. 4 to 5 units, spring, (Blumenthal, Triska), to be given in 1966-67

117. Government and Politics of Africa South of the Sahara—Political conditions and government institutions in Africa south of the Sahara. 4 to 5 units, winter, (———)
Seminars

  5 units, autumn, (Ike), T 2:15-4:05

122. Seminar in Comparative Government: Patterns of Politics in Non-Western Countries.
  5 units, winter, (Ike), T 2:15-4:05

123. Seminar in Comparative Government: Latin America.
  5 units, spring, (Packenham)

124. Seminar in Comparative Government: Local Government—Survey of local government structures; theories of local government and politics; functions of the local community in the political system (political socialization and recruitment, communication, etc.) with emphasis on the relations between local government and democracy. Graduate students register for 224.
  5 units, spring, (Steiner), Th 4:15-6:05

125. Seminar in Comparative Government: Communist China—Graduate students register for 225.
  5 units, spring, (Doolin), M 4:15-6:05

  5 units, winter, (Blumenthal), by arrangement

126a. Seminar on Soviet Military Doctrine — Background of recent developments in Soviet military thinking in an attempt to understand the roles of communist ideology, Russian nationalism, and military technology in the development of this thought. Prerequisite: Advanced course on Soviet politics.
  5 units, autumn, (Brody), Th 2:15-4:05

  5 units, winter, (——)

  5 units, spring, (Verba), Th 2:15-4:05

129. Directed Reading in Comparative Government — Advanced individual study in comparative government. Prerequisites: 10 and 20.
  Any quarter, (Staff), by arrangement

For graduate courses in Comparative Government, see Part III.

International Law and Relations

130. Introduction to International Law—Prerequisite: third-year standing or consent of the instructor.
  5 units, spring, (Blumenthal, Triska), MWF 11

132. Principles and Problems of American Foreign Policy—The great traditions and their contemporary application; neutrality, freedom of the seas, Monroe Doctrine, Pan-Americanism, pacific settlement, international cooperation, etc.
  4 to 5 units, autumn, (Watkins), to be given in 1966-67

135. International Relations—Introductory survey of the national state system, its characteristic forms and the principal forces making for conflict and adjustment. Nationalism, imperialism, economic relations, war, diplomacy, international organization given special attention.
  4 to 5 units, spring, (Watkins), MTWThF 10

136. Soviet Union in World and Communist System Politics—Analysis of contemporary Soviet foreign policy. Testing of hypotheses concerning Soviet and communist system organization; decision making, risk-taking, diplomacy; agreements; conference behavior; Soviet-American relations; etc.
  4 to 5 units, autumn, (Triska), MWF 2:15

137. The United Nations and Its Antecedents—Development of cooperative arrangements within national state system: nineteenth century public unions, League
of Nations, United Nations; specialized agencies: their organization, procedure and work.

4 to 5 units, winter, (Watkins), MTWThF 10

139. The Modern Arab World—Introduction to the problems of the Arab successor states of the Ottoman Empire. Internal politics, the Arab League, and international relations. Not restricted to Political Science students.

4 to 5 units, autumn, (Harris), MWThF 11

Seminars

140. Introductory Seminar in International Relations—May be repeated for credit.

5 units, winter, (Watkins)


5 units, winter, (Brody), T 2:15-4:05

142. Seminar in Egyptian Nationalism and International Politics—Background and analysis of the Egyptian Revolution and reform movement of 1952. Graduate students register for 242.

5 units, spring, (Harris), W 2:15-4:05

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. Graduate students register for 243.

5 units, winter, (Harris), W 2:15-4:05

144. Seminar in American Policy Toward the Middle East—American interests and problems of policy-making in the Arab world, Turkey and Persia. Graduate students register for 244.

5 units, winter, (Harris), to be given in 1966-67

146. Seminar on De-Stalinization—Aspects and problems of the post-1953 political and economic decompression in the Soviet Union and the East-Central Europe. Graduate students register for 246.

5 units, winter, (Drachkovitch), M 4:15-6:05

147. Seminar on Soviet-Chinese Relations.

5 units, spring, (North), T 4:15-6:05

148. Introductory Seminar in International Organization—Prerequisite: 137 or equivalent.

5 units, autumn, (Watkins), to be given in 1966-67

149. Directed Reading in International Law and Relations—Advanced individual study in international law and relations.

Any quarter, (Staff), by arrangement

For graduate courses in International Law and Relations, see 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 to 5 units, autumn, (Drekmeyer), 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 to 5 units, winter, (Drekmeyer), to be given in 1966-67
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 to 5 units, spring, (Drekmeier), to be given in 1966-67

154. Political Theory of China and Japan—Leading thinkers and schools of thought from Confucius to Mao Tse-tung. Prerequisite: third-year standing or consent of the instructor.
4 to 5 units, winter, (Ike), MTWThF 1:15

155. Comparative Marxist Theory—A critical examination of the chief theories developed by Marx, Engels, Lenin, Stalin, Mao Tse-tung and various revisionists. Special emphasis on Soviet and Chinese Communist ideologies. Prerequisite: 150 or equivalent.
4 to 5 units, autumn, (North), MTWThF 2:15

157. American Political Thought: 1865 to the Present—The American political tradition since the Civil War. Special reference to the contributions of clergymen, businessmen, politicians, lawyers, economists, reformers and agitators.
4 to 5 units, winter, (Rogow), MTWThF 10

158. Theoretical Foundations of Political Sociology—The major contributions of social and political theorists to our understanding of social and psychological phenomena and their impact on political behavior, roles, institutions, and values. Critics and analysts such as Marx, Weber, Michels, Freud, and Parsons will be discussed.
4 to 5 units, spring, (Drekmeier), to be given in 1966-67

Seminars

160. Seminar in Modern European Ideologies—In a weekly two-hour session, there will first be a lecture and in the second hour a discussion of issues presented. The lectures and the readings will present representative modern spokesmen for conservatism, liberalism, Fabian socialism, and Marxist communism; and possibly also spokesmen for fascism and/or Protestant and Catholic social thought, pacifism and anarchism. Graduate students register for 260.
5 units, spring, (Bay), W 2:15-4:05

161. Seminar in Concepts of Freedom—Seminar for graduate students and seniors (juniors may be admitted on approval by the instructor), on concepts and theories of freedom, or liberty. There will be stress on the political implications of choice of definitions; kinds of commitment to freedom values will be discussed on a cognitive as well as a behavioral level; and on both levels there will be a discussion of the scope and limits for useful empirical research. Graduate students register for 261.
5 units, winter, (Bay), W 2:15-4:05

162. Seminar in Politics and Ethics—Seminar for graduate students and seniors (juniors may be admitted on approval by the instructor), on varieties of politics and ethics as systems of belief and as determinants of, rationalizations of, and consequences of behavior. General concepts of ethics and politics will be considered analytically and empirically as well as normatively, and also particular types of ethical and political thought and their interrelationships. Graduate students register for 262.
5 units, autumn, (Bay), W 2:15-4:05

169. Directed Reading in Political Theory—Advanced individual study in political theory. Prerequisite: 150.
Any quarter, (Staff), by arrangement

For graduate courses in Political Theory, see 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 1:15

172. The Constitution and Economic Justice—Changing concepts of private property rights and governmental powers over the economy in American constitutional law; Supreme Court interpretation of the contract and due process clauses versus state police powers; recent expansion of congressional currency, commerce, taxing and spending, and war powers used to regulate property and the economy. Prerequisite: third-year standing. Graduate students register for 272.

5 units, winter, (Horn), to be given in 1966-67

173. Civil Liberties in the United States—Civil liberties in contemporary American culture; theory, history underlying them. Free speech, press in era of mass communications; freedom of association for religious, political, economic groups; rights of aliens, ethnic minorities; fair trial, rights of accused persons. Prerequisite: third-year standing. Graduate students register for 273.

5 units, spring, (Horn), MTWThF 1:15

175. Aspects of the American Democratic Tradition—The content of this course will vary depending on the interests of the Stanford Lecturer in American Democracy. This lectureship enables us to bring to Stanford each year a distinguished scholar from other universities in the United States or abroad to give an undergraduate course on aspects of the American political tradition. The subjects to be covered by this program include American political ideas, political history, and public law.

5 units, winter, (Pritchett)


4 to 5 units, spring, (Blumenthal, Triska), by arrangement

Seminar

179. Directed Reading in Public Law—Advanced individual study in public law.

Each quarter by arrangement with Public Law faculty

For graduate courses in Public Law, see Part III.

POLITICS

181. 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

184. Legislative Behavior—Congressional elections, constituent relations, policy making and leadership, relations between Congress and administrative and executive agencies; the committee system, seniority and procedure; Congress as an element in the party system. Prerequisites: third-year standing and 10.

5 units, winter, (Wolfinger), MTWThF 11

Seminars

187. Introductory Seminar in Politics—Historical, social and ideological factors affecting American politics, emergent patterns in the party system; analysis of the nature of public opinion and voting behavior.

5 units, autumn, (Rosenzweig), T 2:15-4:05

188. Seminar in Political Parties—Conventions, nominations, primary elections and voting; types of party organization; money in politics; party reform and responsible parties. Prerequisites: third-year standing and 10.

5 units, spring, (Wolfinger), MF 11
   Any quarter, (Staff), by arrangement
For graduate courses in Politics, see Part III.

UNDERGRADUATE HONORS

198. Honors Seminar—Open only to honors candidates in their senior year.
   5 units, (Almond), by arrangement
199. Senior Honors Thesis.
   Each quarter, (Staff), by arrangement

III. GRADUATE COURSES

Conducted as seminars or reading and discussion groups. Courses numbered 200–299 are limited to graduates and, with the consent of the instructor, to qualified seniors. Courses numbered 300 and above are limited to graduates. All students should consult the instructor before enrolling in any graduate course.

201. Seminar in Public Administration.
   5 units, spring, (Staff)
210. Administrative Behavior—See 110.
211. Seminar in the Theories of Comparative Politics—Introduction to various systematic approaches to the study of comparative politics.
   5 units, winter, (Verba), M 7:30-9:30 p.m.
223. Seminar in Comparative Government: Latin America—See 123.
225. Seminar in Comparative Government: Communist China—See 125.
   5 units, spring, (Drachkovitch), M 4:15-6:05
229. Directed Reading in Comparative Government.
   Any quarter, (Staff), by arrangement
232. Seminar in International Relations Thought.
   5 units, winter, (Watkins), T 2:15-4:05
233R. Research Seminar in International Relations Theory: Systems Analysis.
   5 units, spring, (Brody), Th 2:15
236. Seminar in Soviet Foreign Policy.
   5 units, winter, (Triska), Th 2:15-4:05
242. Seminar in Egyptian Nationalism and International Politics—See 142.
243. Seminar on Great Powers in the Middle East in the Twentieth Century—See 143.
244. Seminar in American Policy Toward the Middle East—See 144.
246. Seminar on De-Stalinization—See 146.
247. Seminar in International Organization.
   5 units, spring, (Watkins), to be given in 1966-67
249. Directed Reading in International Law and Relations.
   Any quarter, (Staff), by arrangement
251. Seminar in Ancient, Medieval, and Early Modern Political Thought—See 151.
   5 units, spring, (Rogow)
  5 units, spring, (Rogow)

260. Seminar in Modern European Ideologies—See 160.


262. Seminar in Concepts of Freedom—See 162.

269. Directed Reading in Political Theory.
  Any quarter, (Staff), by arrangement

270. The Supreme Court and the Constitution—See 170.


  5 units, winter, (Horn), TTh 4:15-6:05

279. Directed Reading in Public Law.
  Any quarter, (Staff), by arrangement

  5 units, autumn, spring, (Eulau), MW 2:15-4:05

283. Seminar in Politics: The American Party System—The party system as a means of coordinating political decisions; bases of party organization; fragmentation, consensus and leadership in American politics. Open to advanced undergraduates with the consent of the instructor.
  5 units, autumn, (Wolfinger), T 2:15-4:05

289. Directed Reading in Politics.
  Any quarter, (Staff), by arrangement

300. Thesis.
  Each quarter, (Staff), by arrangement

302R. Research Seminar in Public Administration.
  5 units, winter, (Staff), by arrangement

311. Advanced Seminar in Political Development—Primitive and traditional systems, problems of classification, patterns of political growth.
  5 units, winter, (Almond), T 10-12

312R. Research Seminar on Comparative Politics—Problems in the politics of development.
  5 units, spring, (Verba), M 7:30-9:30 p.m.

321. Advanced Seminar on European Political Systems—Political culture, structure, and process in Britain, France, Germany, and Italy. Historical-sociological explanations of the functioning of Western European political systems.
  5 units, spring, (Almond), Th 7:30-9:30 p.m.

325. Advanced Seminar in Reform and Revolution in Twentieth Century China and Japan.
  5 units, spring, (Ike), T 2:15-4:05

331. Advanced Seminar in International Political Theory.
  5 units, winter, (North), T 4:15-6:05

333R. Research Seminar in International Politics—Student research on some aspect of international politics. Problems of data requirements and analysis, and the development and use of quantitative data will be discussed. Some data from the Studies in International Conflict and Integration will be made available for use of the seminar. Prior completion of Political Science 326 or 342 (or their equivalent) is recommended.
  5 units, spring, (Holsti), F 2:15-4:05

336R. Research Seminar in the World Communist System.
  5 units, spring, (Triska), T 2:15-4:05

360. Advanced Seminar in Power and Authority.
  5 units, spring, (Drekmeier), to be given in 1966-67
   5 units, autumn, (Rogow, Drekmeier), to be given in 1966-67

380. Advanced Seminar in the Psychodynamics of Political Behavior—The seminar will concern itself with approaches to the study of the political personality, the relationship between mental states and decision making, and the relationship between psychiatry and political science.
   5 units, winter, (Rogow)

382Ra, 382Rb. Research Seminar in American Politics: Public Opinion and Voting Behavior—Survey of current findings on attitude formation, political participation, and voting behavior; student research on numerous aspects of individual political behavior using data from the Inter-University Consortium for Political Research. This is a two-quarter course.
   382Ra. 5 units, winter, (Wolfinger), W 2:15-4:05
   382Rb. 5 units, spring, (Wolfinger), W 2:15-4:05

383Ra, 383Rb. Research Seminar in Political Behavior — The structure and function of political competition.
   383Ra. 5 units, winter, (Eulau), W 7:30-9:30 p.m.
   383Rb. 5 units, spring, (Eulau), W 7:30-9:30 p.m.

401. Departmental Seminar in 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, (Drekmeier, Almond, Staff), MW 2:15-4:05

See also Senior Colloquia.

INTERNATIONAL RELATIONS PROGRAM

Director: James T. Watkins IV

The Program in International Relations is designed to serve two purposes: (1) to provide an undergraduate major for students interested in the whole field of international relations; and (2) to provide professional preparation for students expecting to enter one of the fields of work in international relations. Professional occupations exist in governmental service, in international agencies, in business and commercial activities, in the work of foundations and charitable institutions, and in teaching.

The program leads to the degree of Bachelor of Arts, Political Science: International Relations. Candidates for the degree of Bachelor of Arts, with professional interests, are especially urged to consult promptly with the faculty advisers to whom they will be assigned.

Attention of officers in the Institute of International Relations is directed to the opportunities available in Political Science 99.

Bachelor of Arts in Political Science: International Relations

The minimum requirements for recommendation for the degree of Bachelor of Arts with Political Science: International Relations as the major subject are:

1. Registration in this major for at least one quarter, and a minimum of 25 units taken at Stanford in fulfillment of the major requirements.

2. Completion of the following requirements with a C average
   a) The required courses:
      Economics 1. Elementary Economics
      Geography 4. Economic Geography (or equivalent)
      History 31. Europe in the Nineteenth Century
      History 32. Twentieth Century Europe
      History 154. American Diplomatic History to 1898
      or
History 155. American Diplomatic History Since 1898  
Political Science 10. American Government  
Political Science 20. Foreign Governments  
Political Science 100. Public Administration  
Political Science 130. Introduction to International Law  
Political Science 137. The United Nations and Its Antecedents  
Political Science 150. Introduction to the History of Political Thought  
(each to be taken for 5 units)

b) Twenty additional units (of which ten must be in Political Science) of appropriate courses or seminars in Anthropology, Communication, Economics, Food Research, Geography, History, Modern European Languages, Political Science, or other departments in one of the following concentrations:

1) International Organization and Administration.
2) World Politics.
3) International Economic Relations.
4) Regional Studies (Western Europe, British Commonwealth, Middle East, Soviet Union and Communist System, Latin America, Asia or another Regional Group approved by the Director).

PSYCHOLOGY

Emeriti: Paul Randolph Farnsworth, Maud Merrill James, Quinn McNemar, Lois Meek Stolz (Professors)

Executive Head: Albert H. Hastorf


Associate Professors: Gordon H. Bower (on leave 1965–66), Edith Mary Dowley (Director, Stanford Nursery Schools), Leonard M. Horowitz, John D. Krumboltz, Frederick Joseph McDonald, Eleanor E. Maccoby, Walter Mischel.

Assistant Professors: J. Merrill Carlsmith, Leslie M. Cooper, Edward Joe Crothers, Jonathan L. Freedman, P. James Geiwitz, Thomas K. Landauer, John Wallace

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 a nursery school in the Escondido married students' housing area. This provides a laboratory for child observation, for training in nursery school practice, and for research.

SUMMER SESSION

The courses announced for the Summer Session are those regularly scheduled in the Department curriculum. Additional courses may be announced in the Summer Session Bulletin, to be issued in February, 1966.
PSYCHOLOGY

PROGRAMS OF STUDY

Bachelor of Arts

For the Bachelor's degree, 45 units of psychology are required, including courses 1, 60, and one laboratory course from among 103a, 103b, 103c, and 103d. The following courses in other fields allied to psychology may be counted as fulfilling up to 10 of the nonlaboratory units for the degree. A year of physics counts as 3 units toward the major requirement.

Course No.  Subject                                      Units
Anthropology 126. Cultural Dynamics                    4
Anthropology 158. Culture and Personality              4
Biology 153. The Physiological Basis of Behavior      3
Communication 70. Introduction to Survey Research     3
Statistics 27. Introduction to Probability Theory     3
Statistics 116 (Math. 123 or Econ. 270). Theory of Probability 4
Philosophy 3. Introduction to Logic                   5
Sociology 103. Introduction to Social Psychology      5
Sociology 104. Interpersonal Behavior                 5

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 include arrangements for continuous supervised research activity from the beginning of the student's junior year until the end of the winter quarter of his senior year, at which time he will submit a written report of his work as a thesis.

It is possible for a student to elect both the Psychology Honors Program and the Honors Program in Quantitative Methods in Behavioral Sciences. See the section "Behavioral Sciences (Honors Program in Quantitative Methods)" in this Bulletin.

Advanced Degrees

An applicant for admission to graduate work must file a report of his scores (aptitude and advanced psychology) on the Graduate Record Examination as part of his application. This examination may be taken at most American colleges (see your registrar for further information). Admission to both clinical and nonclinical training programs is strictly limited. Except for students who wish to concentrate in the preschool area or are also enrolled in the Medical School or the Graduate School of Business, no student will be accepted who does not plan to continue through to the doctorate. The taking of the degree of Master of Arts is optional. It is contrary to the policy of the Department to accept candidates for the major or minor who have reached the age of 40. A Stanford graduate is ordinarily not accepted for an advanced degree in the Department of Psychology unless he is also registered in the Medical School or the Graduate School of Business.

Master of Arts

For the degree of Master of Arts, at least 27 units in psychology beyond the equivalent of an undergraduate major are required as well as sufficient additional units
outside of psychology to make up a program totaling 45 or more units. In partial fulfillment of this unit requirement Psychology 151, 152, and 207 must be elected as well as two other courses from the content areas, one to be selected from 208, 209, and 210, and one to be selected from 211, 212, and 213. The student must spend half his time in research and present a thesis based on a portion of his research. Holders of halftime research assistantships do not need to register for formal research. All other students are limited to 9 units a quarter in addition to the research units they must elect.

Doctor of Philosophy

In addition to fulfilling the residence requirement for the degree, the following requirements are stipulated:

1. The course requirements mentioned above, in connection with the Master's degree, must be met by all candidates for the doctorate. These requirements should normally be met by all graduate students during their first year of graduate work. If a student already has a Master's degree in psychology from another institution, he must present evidence of his competence in these course-areas during his first year at Stanford. This may be done either by examination or by taking the courses.

2. A written examination must be taken in the area of general psychology, including history and systems. A second, more individualized examination, with topics drawn chiefly from the fields represented by courses 208-213, will be arranged by the candidate's dissertation committee.

3. Completion of a university minor, or its equivalent, satisfactory to the University Committee on the Graduate Division. Candidates for the Ph.D. degree may have the minor waived by selecting 12 units outside the Department and additional work in general psychology.

4. Demonstrated reading knowledge of a foreign language, preferably Russian, German, or French. Upon petition to the Department faculty another modern language may be substituted for one of these.

5. Passing of the University oral examination which may either be a defense of the dissertation or cover the areas of the major and the minor.

6. A dissertation satisfactory to (a) 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 firsthand knowledge of, and practical experience with, the methods of psychological investigation and study. These methods do not exist in the abstract; they are ways of behaving with the people or animals who are being studied. They are skills, and they require guided practice for their perfection. Doctoral training involves experience in the actual processes of working with people. Some areas require more intensive practice than others; for example, the diagnostic testing of emotionally disturbed children is a more difficult skill for a psychologist to learn than is the presentation of verbal learning tests to normal adults. Hence, the amount of supervised practicum experience required for doctoral training in such an area as clinical psychology is likely to be greater than that needed for the experimental psychology of human learning. Again, however, as with formal courses, there are no specific requirements; students are provided with whatever practicum opportunities they need to reach those levels of competence representative of doctoral standing. For this purpose, the Department maintains a Nursery School and an Animal Laboratory, and provides supervised practice experiences in various hospitals, clinics, community agencies, and other facilities. Continuing research programs, sponsored by members of the faculty, offer direct opportunities for experience in the fields represented by the faculty's several research interests.

For certain areas, particularly clinical psychology, the amount of supervised practice ordinarily needed by students is quite substantial. For example, a clinical psychologist who plans a career to include professional employment will require practicum work during his doctoral training because he will need to have a variety of skills. Preparation for the degree in clinical psychology, therefore, requires at least four full years. On the other hand, a student who plans an academic career, in which college teaching rather than professional clinical work would accompany his research activities, may find himself able to complete his training in less time. So far as is practicable, the Department attempts to offer remunerative work opportunities (or other stipends) in connection with supervised practicum experiences.

Each student will achieve competence in somewhat unique ways and at a somewhat unique rate. Each student and his adviser share in planning a program which will lead to the objectives discussed.

FELLOWSHIPS AND ASSISTANTSHIPS

The Dr. C. Annette Buckel Foundation, supplemented by additional support from the Board of Trustees of the University, has provided a teaching assistantship in child psychology and the University provides several fellowships and scholarships. The Thomas Welton Stanford Fellowship in Psychic Research is a postdoctoral fellowship for research in psychic phenomena, established by the Trustees, in 1913, from the "Psychic Fund" created by Thomas Welton Stanford. There are teaching assistantships in general and experimental psychology, statistics, clinical psychology, developmental psychology, and the nursery school. Several research assistantships are available in connection with special investigations. Readers are employed to assist in course examinations. Veterans Administration assistantships are available locally, and United States Public Health Service stipends and National Defense Education Act Fellowships can be assigned.
COURSES OPEN TO ALL STUDENTS

#1. General Psychology—Introduction, survey.
5 units, autumn, (Horowitz, Geiwitz), TWThF 2:15 and sections
winter, (Wallace, Pribram), MWTThF 10 and sections
spring, (Carlsmith, Landauer, Crothers), MWTThF 2:15 and sections
4 to 5 units, summer, ( ), MWTThF 9 and sections

#60. Statistical Methods.
5 units, autumn, (Cooper), MWTThF 10
winter, (Horowitz), MWTThF 11
spring, (Lawrence), MWTThF 10
4 to 5 units, summer, ( ), MWTThF 11

103a. Experimental Psychology: Higher Mental Processes—Prerequisites: 1 and 60.
4 units, spring, (Horowitz), MWF 2:15 and three hours by arrangement

103b. Experimental Psychology: Perception—Prerequisites: 1 and 60.
4 units, autumn, (Lawrence), MWF 3:15 and three hours by arrangement

103c. Experimental Psychology: Animal Learning—Prerequisites: 1 and 60.
4 units, winter, ( ), MWF 3:15 and three hours by arrangement

103d. Experimental Psychology: Social Processes—Prerequisites: 1 and 60.
4 units, spring, (Wallace), MWF 11 and three hours by arrangement

104. Special Laboratory Projects—Prerequisites: 103a, 103b, 103c, or 103d, and consent of instructor.
3 to 6 units, each quarter, (Staff), by arrangement

111. Developmental Psychology—Prerequisite: 1 or equivalent.
4 units, autumn, (Maccoby), MWF 9

112. Development in Middle Childhood—(Enroll in Education 116.) Prerequisite: 111.
4 units, winter, (P. Sears), MWF 9 and one 3-hour block by arrangement

113. Adolescent Development—Prerequisite: 1 or equivalent.
3 units, spring, ( ), MWF 1:15

114. Exceptional Children—The study of children with deviant patterns of development; includes gifted, retarded, sensory defects, emotional problems. Prerequisite: 111.
3 units, summer, ( ), MWTTh 1:15

117. Observation of Children—Enrollment limited to 16. Prerequisites: 111 or equivalent, and permission of instructor.
3 to 5 units, autumn, winter, spring, (Dowley), Th 2:15-4:05 and by arrangement

118. Nursery School Practice—Supervised experience with the nursery school child. Prerequisites: 111, 117, and permission of instructor.
3 to 5 units, autumn, winter, spring, (Dowley), T 2:15-4:05 and by arrangement

121. Social Psychology—Prerequisite: 1 or equivalent.
3 units, autumn, (Carlsmith), MWF 11

122. Industrial Psychology—Prerequisite: 1 or equivalent.
3 units, spring, (Bavelas), MWF 10

124. Cognitive Processes and Social Interaction—Prerequisite: 1 or equivalent.
3 units, spring, (Hastorf), TTh 10:30-12:00, to be given in 1966-67

131. 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, winter, (Mischel), MWF 1:15
spring, (Cooper), MWF 10

132. Personality—Prerequisite: 1 or equivalent.
4 units, winter, (Sanford), MWF 10 and by arrangement

134. Dynamic Psychology—Emphasis on psychoanalytic theories and their derivatives. Prerequisites: 131 and senior or graduate standing.
4 units, spring, (Hilgard), MWF 11
141. History of Psychology — Prerequisites: three courses in psychology and junior standing.
   3 units, winter, (Farnsworth), MWF 11

145. Psychological Foundations of Education — (Enroll in Education 215.)
   Prerequisite: 1 or equivalent.
   4 units, autumn, (Gage), MTWTh 11
   summer, (———), MTWTh 8 and by arrangement

146. Language and Thought — Prerequisite: 1 or equivalent.
   3 units, autumn, (———), MWF 1:15

148. Physiological Psychology — Prerequisites: 1 and a course in zoology or physiology.
   3 units, winter, (Pribram), MWF 8

151. Statistical Methodology — (Enroll in Statistics 151.) Prerequisite: 60 or equivalent.
   3 units, winter, (Moses), MWF 10

152. Analysis of Data — Prerequisite: 151 or permission of instructor.
   3 units, spring, (Carlsmith), MWF 10

155. Human Abilities — The nature, development, and measurement of intellectual abilities. (Same as Education 255.) Prerequisites: 1, and 60 or Education 250b.
   3 units, spring, (Cronbach), MWF 9, alternate years, to be given in 1965-66

162. Quantitative Methods in Psychology I — Prerequisites: 1 and 60 or equivalent.
   3 units, autumn, (Estes), TTh 10

163. Quantitative Methods in Psychology II — Prerequisites: 1 and 60 or equivalent.
   3 units, winter, (Atkinson), TTh 10

181. Honors Seminar (Junior) — Limited to students in the Psychology Honors Program.
   3 units, autumn, winter, spring, (Freedman), by arrangement

182. Honors Seminar (Senior) — Limited to students in the Psychology Honors Program.
   5 units, autumn, winter, spring, (Freedman), by arrangement

188. Reading and Special Work — Independent study. Prerequisite: permission of instructor.
   1 to 3 units, each quarter, (Staff), by arrangement

190. Undergraduate Seminar in the Effects of Early Experience — Primarily intended for majors in psychology. Prerequisite: permission of instructor.
   3 units, autumn, (Landauer), by arrangement

191. Undergraduate Seminar in Behavior Change — Application of social learning principles to the modification of prosocial and deviant behavior. Primarily intended for majors in psychology. Prerequisite: permission of instructor.
   3 units, spring, (Bandura), M 2:15-4:05

193. Undergraduate Seminar in Social Psychology — Primarily intended for majors in psychology. Prerequisite: permission of instructor.
   3 units, winter, (Freedman), by arrangement

194. Undergraduate Seminar in Developmental Psychology — Primarily intended for majors in psychology. Prerequisite: permission of instructor.
   3 units, spring, (Maccoby), by arrangement

195. Undergraduate Seminar in Personality — Primarily intended for majors in psychology. Prerequisite: permission of instructor.
   3 units, winter, (Geiwitz), by arrangement
196. Undergraduate Seminar in Physiological Psychology — Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, winter, ( ), by arrangement

197. Undergraduate Seminar in Learning — Primarily intended for majors in psychology. Prerequisite: permission of instructor.

3 units, autumn, ( ), by arrangement

See also Senior Colloquia.

COURSES PRIMARILY FOR GRADUATE STUDENTS

Undergraduate students may be admitted only by special permission.

207. Contemporary Viewpoints in Psychology — A survey of major issues in contemporary psychology with their historical backgrounds. Required of and limited to first-year graduate students in psychology.

2 to 3 units, autumn, (Hilgard, Hastorf), by arrangement

208. Advanced Physiological Psychology — Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, spring, ( ), by arrangement

209. Advanced Perception — Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, autumn, ( ), by arrangement

210. Advanced Learning — Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, winter, (Lawrence), MWF 3:15

211. Advanced Developmental Psychology — Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, winter, (Maccoby), by arrangement

212. Advanced Social Psychology — Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, autumn, (Festinger), Th 3:15-5:30

213. Advanced Personality — Prerequisite: graduate standing in psychology or permission of instructor.

2 to 3 units, spring, (Geiwits), by arrangement

220. Human Motivation — Limited to graduate students in psychology and related fields.

2 to 3 units, winter, (Hilgard), TTh 1:15

221. Organizational Processes and Task Performance — Prerequisite: permission of instructor.

3 units, winter, (Bavelas), W 1:15-4:05

222. Mathematical Theories of Perception — Prerequisite: permission of instructor.

3 units, spring, (Atkinson), by arrangement

224. Computer Simulation of Cognitive Processes — Introduction into computer simulation techniques and information processing models of thought processes. The research area lies at an interface between psychology and computer science and the course is expressly designed for graduate students in both fields. Some knowledge of experimental and theoretical psychology, and computer programming, is advisable but not mandatory. (Same as Computer Science 224.)

3 units, autumn, (Feigenbaum), by arrangement

248. Introduction to Test Theory — Concepts of reliability and validity; mathematical models underlying commonly used procedures for test analysis. Test scales and norms. (Enroll in Education 252.) Prerequisite: 60 or Education 216.

3 to 4 units, autumn, (Cronbach), MW 2:15-4:05, alternate years, to be given in 1965-66

249. Problems in Measurement — For prospective research workers. Survey of alternative mathematical models used in test construction and analysis covering such topics as profile analysis, measurement of gains, factor analysis, theory of personal
decisions. (Enroll in Education 353.) Prerequisites: Education 250b and 252, or equivalent.

3 to 4 units, autumn, (Cronbach), alternate years, to be given in 1966-67

251. Psychopathology—Review and analysis of research literature and theory in the area of behavior deviation. Prerequisite: permission of instructor.
3 units, autumn, (Wallace), by arrangement

252. Principles of Personality Assessment I—Theory and research on the prediction and classification of behavior. Prerequisite: permission of instructor.
3 units, winter, (Mischel), Th 9-12

253. Principles of Personality Assessment II—Representative measurement methods for the assessment of personality. Prerequisites: 252 and permission of instructor.
3 units, spring, (Mischel), Th 9-12

254. Principles of Behavioral Modification I—Application of social-learning principles to the modification of deviant behavior. Prerequisites: graduate standing and permission of instructor.
3 units, autumn, (Bandura), M 10-12

255. Principles of Behavioral Modification II—Continuation of 254. Prerequisites: graduate standing and permission of instructor.
3 units, winter, (Bandura), M 10-12

256. Intensive Psychotherapy—A discussion of general principles of exploratory psychotherapy. Prerequisite: permission of instructor.
2 units, spring, (——), by arrangement

257a. Practicum in Assessment and Modification of Behavior I—Prerequisite: permission of instructor.
3 to 5 units, autumn, (——), by arrangement

257b. Practicum in Assessment and Modification of Behavior II—Prerequisite: permission of instructor.
3 to 5 units, winter, (——), by arrangement

257c. Practicum in Assessment and Modification of Behavior III—Prerequisite: permission of instructor.
3 to 5 units, spring, (——), by arrangement

258. Child Research Practicum—Prerequisites: 117 and permission of instructor.
3 to 4 units, winter, (Dowley), TTh 1:15

260. Seminar in Neuropsychology—Prerequisite: permission of instructor.
2 to 3 units, autumn, (Pribram), by arrangement

261. Seminar in Social Psychology—Prerequisite: permission of instructor.
2 to 3 units, winter, (Carlsmith, Freedman), by arrangement
2 to 3 units, spring, (Carlsmith, Freedman), by arrangement

262. Seminar in Verbal Behavior—Prerequisite: permission of instructor.
2 to 3 units, spring, (Horowitz), T 1:15-3:05

263. Seminar in Perception—Prerequisite: permission of instructor.
2 to 3 units, winter, (——), by arrangement

264. Seminar in Learning Theory—Prerequisite: permission of instructor.
2 to 3 units, winter, (Estes), TTh 11

265a. Seminar in Mathematical Psychology I—Prerequisite: permission of instructor.
2 to 3 units, autumn, (Estes), TTh 10:00-11:30

265b. Seminar in Mathematical Psychology II—Prerequisite: permission of instructor.
2 to 3 units, winter, (Atkinson), TTh 10:00-11:30

265c. Seminar in Mathematical Psychology III—Prerequisite: permission of instructor.
2 to 3 units, spring, (——), TTh 10:00-11:30

266. Seminar in Developmental Psychology—Prerequisite: permission of instructor.
2 to 3 units, spring, (——), by arrangement
267. Seminar in Interpersonal Processes — Prerequisite: permission of instructor.
   2 to 3 units, autumn, (Hastorf), by arrangement
268. Seminar in Physiological Psychology—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Landauer), by arrangement
269. Seminar in Personality—Prerequisite: permission of instructor.
   2 to 3 units, autumn, (Wallace), by arrangement
271a. Seminar in Theoretical Problems—Prerequisite: permission of instructor.
   2 to 3 units, winter, (Festinger), Th 2:15-4:05
271b. Seminar in Theoretical Problems—Prerequisite: permission of instructor.
   2 to 3 units, spring, (Festinger), Th 2:15-4:05
272. Foundations of Mathematical Behavior Theory—Prerequisite: permission of instructors.
   2 to 3 units, spring, (Estes), 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
303. Research Seminar in Hypnosis—Primarily for graduate students doing research within hypnosis and related areas. Prerequisite: permission of instructor.
   1 to 3 units, autumn, winter, spring, (E. Hilgard, J. Hilgard, Cooper),
   F 3:15-4:30
304. Research Seminar in Neuropsychology—Prerequisite: permission of instructor.
   1 to 3 units, autumn, winter, spring, (Pribram), Th 12-2
305. Research Seminar in Mathematical Psychology—Prerequisite: permission of instructor.
   1 unit, autumn, winter, spring, (Atkinson, Estes), F 3:30-5:00
306. Research Seminar in Developmental Psychology—Prerequisite: permission of instructor.
   1 to 3 units, autumn, winter, spring, (Maccoby, Sears, Landauer), by arrangement
Counseling Techniques: The Interview—See Education 333a.
Counseling Techniques: Testing—See Education 333b.
Seminar in Educational Psychology—See Education 415.
The Biochemistry of Behavior—See Psychiatry 9.

SOCIAL SCIENCES (SPECIAL PROGRAM)

HONORS PROGRAM IN SOCIAL THOUGHT
AND INSTITUTIONS

Committee in Charge: Charles A. Drekeimer (Chairman), Richard A. Brody, Robert McAfee Brown, David Levin, Max Levin, Otis A. Pease, Robert B. Textor

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 3.00 average). It is recommended that application be made in the last quarter of the sophomore year, and that either Philosophy 5 or 10 be completed before enrollment. Any member of the committee may be consulted regarding admission. (Mr. Drekmeier's office is in the Department of Political Science.)

Requirements

It is expected that most students will be able to fulfill the conditions of an undergraduate major in one of the departments participating in the program. In some cases minor modifications of departmental requirements may be necessary. The student is required to take the interdisciplinary seminar series (Social Sciences 101, 102, 103) during his junior year—which is organized around a particular theme or concept each year. He will be asked to submit a thesis at the end of his senior year which should demonstrate his ability to synthesize and criticize materials drawn from several disciplines. A credit of from 5 to 15 units will be allowed for the thesis. The student may also be required to take a senior seminar which will offer the opportunity for the discussion of problems arising in the research projects.

Though the honors program is intended to supplement a regular departmental major, there may be areas of study which cannot be related to a department in this way. In such instances a major will be offered under the supervision of the committee and requirements for graduation will be determined by the committee in consultation with the student's advisers.

After the student's program of study has been approved by the administrative committee, he will be assigned an adviser by his department. Individual programs must also have the approval of the adviser. In most cases the committee will arrange for the appointment of a second adviser from a department appropriate to the student's interests to aid in the supervision of the projected study.

The following areas of concentration are listed as examples of programs the committee would consider acceptable. It by no means exhausts the possibilities for study within the program.

- Public opinion, propaganda, and collective behavior
- Studies in American ideas and institutions
- Problems of social planning
- Values and society
- Personality and social structure
- History of social thought
- Processes of decision-making
- Totalitarian social systems

Special Courses of Instruction

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
193. Senior Thesis and Directed Reading.
   1 to 5 units, each quarter, (———), by arrangement

SOCIIOLOGY

Emeriti: Richard Tracy LaPiere, Charles Nathan Reynolds (Professors)

Executive Head: Morris Zelditch, Jr.
Professors: Sanford M. Dornbusch, Paul Wallin
Associate Professors: Joseph Berger, Bernard P. Cohen (on leave winter and spring quarters), W. Richard Scott (on leave winter and spring quarters), Morris Zelditch, Jr.
Assistant Professors: Bo Anderson (on leave autumn quarter), Bernard Beck, James Kimberly
Visiting Professors: St. Clair Drake, J. Laurie Snell

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: Theory Construction, Advanced Social Statistics, Research Design, all normally taken in the first year of graduate work; Logic of Social Research, normally taken in the second year; and Basic Problems in Sociological Theory and Problems 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 preparations. The program consists of a minimum of 25 units in the teaching field and 12 units in the School of Education.

TEACHING ASSISTANTSHIPS AND FELLOWSHIPS

The University has a number of fellowships and scholarships available. Information about these, as well as application blanks, may be secured by writing the Office of Admissions.

In addition, the Department has annual teaching assistantships, traineeships in medical sociology, research assistantships, traineeships in mental health, and National Defense Education Fellowships for the support of its graduate students.

COURSES PRIMARILY FOR UNDERGRADUATES

#1. Introduction to Sociology — Basic concepts; theories; emphasizes group aspects of human behavior.
   5 units, autumn, (Dornbusch), MTWThF 11
   winter, (———), MTWThF 1:15
   spring, (Zelditch), MTWThF 11
   summer, (———), MTWThF 11

7. Introduction to Statistics—(Enroll in Statistics 7.)
   5 units, autumn, (Solomon), MTWThF 10
   50. American Society—Basic institutions and problems of contemporary American society.
   3 units, winter, (———), MWF 3:15

FUNDAMENTAL PROGRAM

100. Introduction to Sociological Research—The aim of this course is to provide the consumer of social research with standards by which to evaluate the findings of sociological studies. Lectures and laboratory exercises consider the problems of collecting observations, constructing theory, testing hypotheses and generalizing research results. Required of all sociology majors.
   5 units, autumn, (Cohen), MW 11; labs. T or Th 2:15-5:05

102. Basic Social Institutions—The study of how the basic institutions such as the stratification system, the polity, the family, the economy and political order affect one another in Western and non-Western societies.
   5 units, winter, (Beck), MWF 1:15

103. Introduction to Social Psychology—Review and discussion of current problems, theories, and research in social psychology; social perception, development of self-conceptions, socialization, attitude change.
   5 units, winter, (Dornbusch), MTWThF 2:15

104. Interpersonal Behavior—This course is concerned with an examination of research in such areas as power and prestige structures in small groups; communication networks and processes; deviance, conformity, and social control.
   5 units, spring, (Berger), MW 11

105. Organizational Behavior—An analysis of the structural characteristics of economic, political, educational, and other organizations and their impact on individual participants. Prerequisite: 1 or consent of instructor.
   5 units, autumn, (Scott), MWThF 9

106. Introduction to Sociological Theory—Critical analysis of some basic notions and theories used in sociological analysis, like Heider's balance theory, Homan's theory of social behavior as an exchange process and structural functional analysis.
   5 units, winter, (Anderson), MTWThF 9
OTHER COURSES OPEN TO UNDERGRADUATES AND GRADUATES

108. Class, Status, and Power—Analysis of stratification in simple and complex groups and societies. General theories of stratification are analyzed and evaluated. Emphasis is placed on conditions affecting the stability of stratification.
5 units, autumn, (Kimberly), MWF 1:15

110. Religious Institutions and Behavior—A sociological approach to organized religion, emphasizing the interaction between the church and its social setting.
5 units, spring, (Beck), MWF 1:15

115. Social Bases of Personality—Special attention to the social bases of personality development, socialization, and the causes of such forms of deviance as crime, alcoholism, and psychosis.
5 units, autumn, ( ), MTWThF 10

123. Political Institutions and Behavior—This course utilizes a framework of classic political and social theory to place in perspective empirical evidence on political processes in selected industrial societies.
5 units, spring, (Anderson), MWF 9

126. Race and Ethnic Relations—An examination of ethnic group problems and the sources of prejudice in the United States and other countries.
5 units, autumn, (Drake), MWF 2:15

129. Family Institutions and Behavior—Social structure of the family in Western and non-Western societies; family pathologies.
5 units, winter, (Zelditch), MWF 10

131. Advanced Social Psychology—An analysis of current research in social psychology including such topics as socialization, assimilation, interpersonal perception and social control. Prerequisite: 103 or consent of instructor.
5 units, spring, ( ), MWF 10

137. Advanced Organizational Behavior—An examination of organization structures, of the social processes—specialization, authority, ranking, etc.—which modify them and of the levels at which such processes operate. Prerequisite: 105 or consent of instructor.
5 units, to be given in 1966-67

145. Survey Methods—Training in the use of the questionnaire and the interview schedule for the systematic collection of data. Prerequisite: 100 or consent of instructor.
5 units, to be given in 1966-67

146. Field Methods—Training in the use of participant observation, informants’ life histories, interview material, etc., for the study of sociological problems. Prerequisite: 100 or consent of instructor.
5 units, to be given in 1966-67

147. Experiments in Social Interaction—Topics considered in this laboratory course include: formulation of an experimental problem, experimental design, problems of conducting and analyzing experiments. Discussion will be in the context of conducting an actual experiment. Prerequisite: 100 or consent of instructor.
5 units, winter, ( ), Th 2:15-5:05

149. Advanced Social Statistics—Prerequisite: 7 or consent of instructor.
5 units, winter, ( ), MWF 9

150. Sociology of Mental Health.
5 units, autumn, (Wallin), T 2:15-5:05

161. Advanced Interpersonal Behavior—A more intensive examination of topics covered in Sociology 104. Prerequisite: 104 or consent of instructor.
5 units, winter, (Kimberly), MWF 11

162. Comparative Institutional Analysis—Cross-cultural approach to the study of institutions and social systems. Special attention given to analysis of systems of ultimate values, such as religion and political messianic movements. Prerequisite: 102 or consent of instructor.
5 units, autumn, (Beck), W 2:15-5:05
165. **Advanced Social Stratification**—Analysis of stratification structures in complex social systems. Emphasis is placed on the formulation of theory relevant to problems of stability of stratification structures.
   5 units, spring, (Kimberly), Th 2:15-5:05

175. **The Evolution of Underdeveloped Societies**—A discussion of social, economic and political development of emergent countries (e.g., Ghana, Nigeria, India).
   5 units, spring, (-), MWF 10

176. **Sociological Aspects of Economic Development**—Special emphasis is given to Latin America. Prerequisite: consent of instructor.
   5 units, to be given in 1966-67

177. **Emerging African Nations**—Special attention to political and economic development of emerging nations of Africa.
   5 units, autumn, (Drake), Th 2:15-5:05

180. **Honors Seminar**—Basic readings in sociology and current faculty research.
   2 units, autumn, (Scott), by arrangement

185. **Honors Seminar**—Basic readings in sociology and current faculty research.
   2 units, winter, (Anderson), by arrangement

190. **Individual Study**.
   (Staff), by arrangement

191. **Junior Thesis**.
   2 units, spring, (Staff), by arrangement

192. **Senior Thesis**.
   3 to 10 units, (Staff), by arrangement

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**COURSES PRIMARILY FOR GRADUATES**

200a. **Graduate Proseminar**—Limited to first-year graduate students in sociology.
   2 units, autumn, (Zelditch), T 12-2

200b. **Graduate Proseminar**—Continuation of 200a.
   2 units, winter, (Zelditch), T 12-2

200c. **Graduate Proseminar**—Continuation of 200b.
   2 units, spring, (Zelditch), T 12-2

217. **Problems in Theoretical Analysis**—Prerequisite: consent of instructor.
   5 units, to be given in 1966-67

218. **Decision-Making Processes**—Prerequisites: 253 and consent of instructor.
   5 units, winter, (Berger), Th 7-10 p.m.

   5 units, winter, (Wallin), T 2:15-5:05

250. **Basic Problems in Sociological Theory**—Prerequisite: consent of instructor.
   5 units, winter, (Anderson), M 2:15-5:05

253. **Theory Construction**—Prerequisite: consent of instructor.
   5 units, autumn, (Berger), Th 7-10 p.m.

254. **Mathematical Models in Sociology**—Graph theory, stochastic processes, and difference equations applied to problems in sociology. Previous preparation equivalent to Kemeny, Snell, and Thompson, *Introduction to Finite Mathematics*, is presumed.
   5 units, spring, (Snell), MW 2:15-3:45

255. **Logic of Social Research**—Logic of scientific research, methods commonly used for collection and analysis of social data. Prerequisites: 149 and 260.
   5 units, spring, (Wallin), T 2:15-5:05

260. **Research Design**—Prerequisite: 149.
   5 units, spring, ( ), F 2:15-5:05

267. **Problems of Sociological Measurement**—Prerequisite: 149.
   5 units, to be given in 1966-67
276. Problems in the Analysis of Evaluation Processes—Prerequisite: consent of instructor.
5 units, autumn, (Zelditch), M 2:15-5:05

GRADUATE INDIVIDUAL STUDY

290. Graduate Individual Study.
(Staff), by arrangement
300. Graduate Research.
(Staff), by arrangement
309. Directed Graduate Research.
(Staff), by arrangement
(Staff), by arrangement

SPEECH and DRAMA

Emeriti: James Gordon Emerson (Professor); Helene Blattner, Elisabeth Buckingham (Associate Professors)

Executive Head: Robert Loper
Professors: Wendell Cole, Robert Loper, Norman Philbrick, H. Donald Winbigler
Associate Professor: Paul Landry. Visiting: William Sharp
Assistant Professors: Clara Bush, Arthur Hastings, Douglas A. Russell, Helen W. Schrader
Instructors: Frederick Hunt, Griffith Richards. Acting: Marianne E. Crowder
Lecturer: Gerald Hiken

PROGRAMS OF STUDY

Bachelor of Arts
The requirements for the degree of Bachelor of Arts with a major in Speech and Drama are planned to allow the student wide latitude in developing his special aptitudes. A minimum program is required of all students. Every major in Speech and Drama must take:

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dramatic Literature (90, 91, 92)</td>
<td>12</td>
</tr>
<tr>
<td>Acting; Directing (164a, 164b, 164c)</td>
<td>12</td>
</tr>
<tr>
<td>Visual Art for Theater (170a, 170b, 170c)</td>
<td>9</td>
</tr>
<tr>
<td>Theatrical Makeup (173)</td>
<td>1</td>
</tr>
<tr>
<td>Theater Criticism (95)</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
</tr>
</tbody>
</table>

In addition to the courses listed above, each student must take 9 units to be chosen from:

Senior Seminars in Dramatic Literature (190, 191, 192)
Introduction to the Contemporary Theater (60)
Advanced Seminars in Dramatic Literature (201–208)

or, with evidence of unusual qualifications, from:

Technical Production I (241a, b, c)
Lighting I (251a, b, c)
Acting I (261a, b, c)
Costume I (271a, b, c)
Stage Design I (281a, b, c)
Directing I (291a, b, c)

All students must complete a minor program of not less than 16 units of advanced work chosen from courses offered in a department or departments other than Speech and Drama. The student must maintain a C average in all the course work of the major and minor departments. The minor program is chosen with the approval of the student's faculty adviser.

Special Major Program for the Honors Candidate in Humanities—Students who are planning to take the special Honors Program in Humanities may fulfill the requirements for the major in Speech and Drama by satisfactory completion of the following program:

Acting and Directing (164a, b, c)
Dramatic Literature (90, 91, 92)
Modern European Drama (207, 208)
Electives in theater and drama totaling at least 6 units.

Graduate Program in Humanities

The Department of Speech and Drama also participates in the Graduate Program in Humanities leading to a joint Ph.D. degree in Speech and Drama and Humanities. For a description of that program and fellowships offered in connection with it, see the section “Humanities (Special Programs).”

Teaching Credentials

The degree of Master of Arts in Teaching of Speech and Drama is offered jointly by this Department and the School of Education. The degree is intended for teachers with one or more years of experience and/or a regular teaching credential who wish further to strengthen their academic preparation. The program consists of a minimum of 30 units in the teaching field and 12 units in the School of Education. Detailed requirements for the course are outlined in the School of Education section.

Standard Teaching Credential (Secondary)—Students wishing to obtain the Stanford General Secondary Credential should consult the Credential Secretary of the School of Education for the general requirements, and the teacher training adviser, Professor Helen Schrader, in the Department of Speech and Drama for Departmental requirements.

ADVANCED DEGREES

Any student wishing to enter upon graduate work in the Department of Speech and Drama at Stanford University should apply to the Office of the Director of Admissions. Graduate students, when applying for admission, must furnish their scores on the Aptitude Test of the Graduate Records Examination. Applicants for the doctoral degree must also submit a sample of their best written scholarly work. All graduate students must be degree candidates.

For University regulations governing advanced degrees, see the section “Degrees” in this Bulletin.

Master of Fine Arts

An intensive program in theater arts has been inaugurated for the exceptionally gifted student who wishes to train for a professional career in the fields of acting, directing, costume, lighting, stage design, and technical production. A professional resident company has been formed at Stanford, which will become the producing
organization of the Department of Speech and Drama. The visiting director, the
staff, and the leading actors of this company will serve as teachers in the training
program. The acting program is designed for two years; the curriculum for directors
and designers is planned for three years. For students with a strong background in
Drama, the three-year curriculum could well be reduced to two years. Advanced
standing would be based upon special examination. All students in the latter stages of
the program will work in direct association with the professional company; limited
work with the company is possible during the first year, but the emphasis will be upon
intensive class and project work within the student program.

In addition to regular University requirements for admission, all applicants for
the acting and directing programs will be interviewed; design applicants must submit a
portfolio of their work. While overall scholastic ability will be a factor in admission,
primary emphasis will be placed on evidence of superior potential in theater arts.

The M.F.A. is designed as a terminal degree, but if a candidate successfully com-
pletes his work for the M.F.A. and demonstrates strong interest and ability in teach-
ing and research, he will be urged to continue to the Ph.D. degree.

For further details please write to the Executive Head, Department of Speech and
Drama.

Note—Certain of the following course sequence requirements can be fulfilled by
special examination.

**Costume Design Major**

Candidates for the M.F.A. degree in costume design are required to complete 99
units of course work beyond the Bachelor's degree. The course requirements are as
follows:

**First Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costume I (271a, b, c)</td>
<td>9</td>
</tr>
<tr>
<td>Theater History (297, 298, 299)</td>
<td>9</td>
</tr>
<tr>
<td>Visual Art for the Theater (170a, b, c)</td>
<td>9</td>
</tr>
<tr>
<td>Design I (281a, b, c)</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>

**Second Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costume II (272a, b, c)</td>
<td>9</td>
</tr>
<tr>
<td>Dramatic Literature (190, 191, 192)</td>
<td>12</td>
</tr>
<tr>
<td>Directing I (291a, one quarter only)</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>9</td>
</tr>
<tr>
<td>Lighting I (250a, b, c)</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42</strong></td>
</tr>
</tbody>
</table>

**Third Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costume III (273a, b, c)</td>
<td>6</td>
</tr>
<tr>
<td>Seminar in Stage Arts (397)</td>
<td>3</td>
</tr>
</tbody>
</table>
| Electives (to include courses in Art and Architecture) | 12
| **Total**                            | **21**|

**Scene Design Major**

Candidates for the M.F.A. degree in scene design are required to complete 99
units of course work beyond the Bachelor's degree. The course requirements are as
follows:
First Year

Design I (281a, b, c) ................................................................. 9
Theater History (297, 298, 299) ................................................. 9
Technical Production I (241a, b, c) ............................................. 9
Visual Art for the Theater (170a, b, c) ........................................ 9

Total ..................................................................................... 36

Second Year

Design II (282a, b, c) ................................................................. 9
Costume I (271a, b, c) ................................................................. 9
Directing I (291a, one quarter only) ........................................... 3
Dramatic Literature (190, 191, 192) ............................................. 12
Lighting I (250a, b, c) ................................................................. 9

Total ..................................................................................... 42

Third Year

Design III (283a, b, c) ................................................................. 6
Seminar in Stage Arts (397) .......................................................... 3
Electives (to include courses in Art and Architecture) .................... 12

Total ..................................................................................... 21

Lighting Design, Technical Production Major

Candidates for the M.F.A. degree in lighting design and technical production are required to complete 108 units of course work beyond the Bachelor's degree. The course requirements are as follows:

First Year

Lighting I (250a, b, c) ................................................................. 9
Theater History (297, 298, 299) ..................................................... 9
Visual Art for the Theater (170a, b, c) ......................................... 9
Technical Production I (241a, b, c) .............................................. 9

Total ..................................................................................... 36

Second Year

Design I (281a, b, c) ................................................................. 9
Dramatic Literature (190, 191, 192) ............................................. 12
Directing I (291a, one quarter only) ........................................... 3
Two of the following three courses must be taken: ....................... 18
Lighting II (252a, b, c)
Technical Production II (242a, b, c)
Costume I (271a, b, c)

Total ..................................................................................... 42

Third Year

Technical Production III (246a, b, c) .......................................... 6
Seminar in Stage Arts (397) .......................................................... 3
Theater Management (245, one quarter only) ............................... 3
SPEECH AND DRAMA

Electives ................................................................. 9
  One of the following three courses must be taken: .................... 9
Lighting II (252a, b, c)
Technical Production II (242a, b, c)
Costume I (271a, b, c)

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

DIRECTING MAJOR

Candidates for the M.F.A. degree in directing are required to complete 108 units of course work beyond the Bachelor's degree. The course requirements are as follows:

First Year

Directing I (291a, b, c) ............................................... 9
Dramatic Literature (201, 202, 203) .................................. 9
Theater History (297, 298, 299) ...................................... 9
Acting I (261a, b, c) .................................................. 9

Total ................................................................. 36

Second Year

Directing II (292a, b, c) ............................................... 9
Dramatic Literature (204, 205, 207) .................................. 9
Survey of Lighting and Technical Production (244a, b, c) .......... 9
  One of the following two courses must be taken: .................... 9
Design I (281a, b, c)
Visual Art for the Theater (170a, b, c)

Total ................................................................. 36

Third Year

Directing III (293a, b, c) ............................................. 9
Seminar in Stage Arts (397) ........................................... 3
  One of the following two courses must be taken: .................... 9
Costume I (271a, b, c)
Visual Art for the Theater (170a, b, c)
Electives (to be chosen from 300 and 360 series) ..................... 15

Total ................................................................. 36

(Note—If the "directing" candidate is interested in going on to the Ph.D. degree, his electives should specifically be 360a, b, c, and 206 and 208. If these courses are taken, he will need only 12 additional courses (or, normally 3 quarters' work) to complete the remaining residence requirements for the Ph.D.)

ACTING MAJOR

The candidate for the M.F.A. in acting is required to complete 72 units of course work.

First Year

Acting I (261a, b, c) .................................................. 9
Voice and Movement (263a, b, c) ..................................... 9
Theater History (297, 298, 299) ..................................... 9
Dramatic Literature (190, 191, 192) .................................. 9

Total ................................................................. 36
Second Year

Acting II (262a, b, c) ......................................................... 9
Voice and Movement (263a, b, c) ........................................... 9
Acting III (264) ................................................................. 3
One of the following two courses must be taken: ....................... 9
Visual Art for the Theater (170a, b, c)
Costume I (271a, b, c)
Electives ................................................................. 6

Total ................................................................. 36

Doctor of Philosophy

Candidates are normally expected to complete 108 units of course work beyond
the Bachelor's degree. The course program is planned to occupy nine quarters of
graduate resident work. The degree of Master of Arts is eliminated; no interim
degree is awarded by the Department of Speech and Drama for Ph.D. candidates.

Language Requirements—Examinations in French and German must be passed
by the candidate during his first year of residence. Other languages may be sub-
stituted upon request to the Graduate Study Committee of the Department. After
passing the language examinations, the candidate is required to take a literature
course in one of the language departments at Stanford, or in another university ap-
proved by the Department, in which course reading assignments and class lectures
and discussions are conducted in the original language of the literature studied.

Specialization—During the first year of residence, the candidate, in consultation
with his adviser, submits a plan of study consisting of four fields of specialization.
One of the four fields is designated as the candidate's major field of specialization
and it is expected that his dissertation subject will be chosen from this field, so that
much preparatory research and study for the dissertation will have been completed
before completion of the course work requirements.

One field of specialization is to be chosen from each of the following groups:

1. Comparative drama in one literary period. (Examples: Medieval Drama, Ren-
aissance Drama, European Drama in the Eighteenth Century, Modern Drama from
1870 to 1914, etc.)
2. One major playwright.
3. One national drama. (To be chosen from English, American, French, Italian,
Spanish, German, Scandinavian, Classical.)
4. One dramatic genre, or dramatic criticism. (Examples: Tragicomedy, Farce,
Comedy of Manners, Melodrama, etc.)

Only two areas of study in a candidate's program are permitted to overlap sig-
nificantly. (Examples: French Drama and Molière; or, European Drama of the
Nineteenth Century and Melodrama.) At least one area of study must be before
1700.

The candidate for the Ph.D. degree is required to take all courses in the survey
of dramatic literature sequence (201–208). Eight courses are required from the
special studies in dramatic literature sequence (301–313). Other course requirements
are the course sequence in research and criticism (360a, b, c), theater history (297,
298, 299), directing (291a, b, c). Another 9 units are to be chosen from the following
courses: 261a, 244a, 271a, 281a. A complete sequence may be taken in any one of
these courses to satisfy the requirement. Additional electives totaling at least 12
units must be taken from courses offered in Speech and Drama or by outside depart-
ments.

Examinations—Upon completion of the first year of residence, the candidate must pass
a short preliminary written examination admitting him to candidacy. When course
work is completed, the candidate takes an examination in his four fields of specialization. The candidate's doctoral dissertation must be submitted and approved in final form after the successful completion of the comprehensive examination. The candidate must then pass a University oral examination on his dissertation and his major field of specialization.

FELLOWSHIPS

The Department of Speech and Drama awards a number of fellowships to graduate students in both the M.F.A. and Ph.D. programs. These grants range in amounts from about $1500 to $3500. Completed application forms for fellowships should be filed before January 15 at the Office of Financial Aids at the same time as completed application forms for admission are filed with the Admissions Office.

Limited opportunities are also available for teaching assistantships, but they are usually awarded to the student who has completed a portion of his work in the program.

SPEECH CORRECTION, HEARING, AND SPEECH SCIENCES

For programs and courses in Speech Correction, Hearing, and the Speech Sciences, please refer to the Division of Speech Pathology and Audiology listed in the section “Allied Medical Sciences” in this Bulletin.

Attention of Speech and Drama majors is especially directed to the following courses which may be of interest: Speech Pathology and Audiology 110 (Principles of Phonetics), and Speech Pathology and Audiology 232 (Principles of Voice Training).

SUMMER SESSION

A special brochure is available, with full details of courses given in the summer by the Department of Speech and Drama.

COURSES

SPECIAL PROGRAM FOR FOREIGN STUDENTS

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, Richards), 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, Richards), MWF 4:15 and one hour by arrangement

49. English Communication for Foreign Students III—For students with some facility in spoken English. Emphasis on fluency, idiom, and current usage. Upon recommendation of the adviser, the course may be repeated for a total of 6 units. Prerequisite: consent of instructor.

1 to 3 units, autumn, winter, spring, (Bush, Richards), 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, Richards), TTh 11

59. English Communication for Foreign Students IIIa—For students with some facility in written English. Emphasis on fluency, idiomatic usage, and style. Upon recommendation of the adviser, the course may be repeated for a total of 6 units. Prerequisite: consent of instructor.

1 to 3 units, autumn, winter, spring, (Bush, Richards), MWF 11
SCHOOL OF HUMANITIES AND SCIENCES

GENERAL

1. Characteristics of Spoken Language—Analysis of articulatory and vocal usage as they relate to spoken language. Practicum emphasizing these factors as they facilitate oral communication.

3 units, winter, spring, (Bush, Richards), MWF 10

#30. Oral Interpretation—Basic course in understanding the organization of the logical and emotional content of literature with emphasis on its communication to the listener.

3 units, autumn, winter, spring, (Staff), MWF 9 or 11

RHETORIC AND PUBLIC ADDRESS

#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, autumn, winter, spring, (Hastings, Staff), General sessions (1 hour): T 10, W 9, Th 9 or 11; Section meetings (2 hours): MW 9, 10, 11, or 1:15; TTh 10, 11, or 1:15

120a. Exposition—Focuses on the individual as he experiences the process of communication in an interacting group.

3 units, autumn, winter, spring, (Schrader, Staff), MWF 11 or 1:15

#120b. Argumentation—Reasoning processes and logical proof in analysis and persuasion.

3 units, autumn, winter, spring, (Hastings), MWF 10

120c. Discussion—Focuses on group phenomena which facilitate or inhibit free communication in the solving of problems in an interacting group.

3 units, winter, spring, (Schrader), MWF 10

130. Persuasion Theory—Philosophical, psychological, and rhetorical principles of persuasion.

4 units, winter, (Hastings), MW 2:15-4:05

132. Group Communication—Processes of communication in leadership, conflict, and social pressures of small groups. Prerequisite: 120a or 120c.

4 units, spring, (Schrader), TTh 2:15-4:05

134. Language and Communication—Analysis of symbolic processes.

4 units, spring, (Hastings), MW 2:15-4:05

140. Social Protest—Men and their communication roles in social controversies.

4 units, winter, (Schrader), TTh 2:15-4:05

321. Seminar in Rhetoric and Public Address—May be repeated for credit.

1 to 5 units, any quarter, (Schrader, Hastings), by arrangement

Business and Professional Speaking—See Business 301, Graduate School of Business Bulletin.

Intercollegiate Debate—A program of debate and speaking activities open to all students. Activity credit offered for participation.

THEATER AND DRAMA (UNDERGRADUATE)

#60. Introduction to the Contemporary Theater—Survey of the arts of the theater; lectures and discussion of readings in contemporary drama.

3 units, autumn, winter, (Loper), MWF 9

#90. Development of Drama (Classical and Medieval)—Survey of masterpieces of Western drama from origins in Greece to the Renaissance. Emphasis on the social and theatrical environments of each play’s performance.

4 units, autumn, (Sharp), MW 2:15-4:05

#91. Development of Drama (Renaissance and Baroque)—Survey of the art of drama from the Renaissance to Ibsen.

4 units, winter, (Cole), MW 2:15-4:05
92. Development of Drama (Modern)—Ibsen, subsequent dramatists, English and Continental. Lectures, discussions; critical papers.
4 units, spring, (Sharp), MW 2:15-4:05

95. Theater Criticism—Readings in contemporary techniques. Papers based on performances attended in the area.
3 units, spring, (Loper), MW 2:15-3:40

160. Theater Practice—Credit for participation in productions in acting or stagecraft. May be repeated for total of 9 units. Prerequisite: consent of instructor.
1 to 3 units, any quarter, (Staff), by arrangement

164. Fundamentals of Acting and Directing—Not open to freshmen.
164a. Principles of Acting—Actor's resources and methods, basic body movement.
4 units, autumn, (Hiken, Crowder), ThF 10-12; lab. Th 1:15
4 units, winter, (Loper, Hiken, Crowder), ThF 10-12; lab. Th 1:15
164c. Directing—Techniques of analysis, blocking and composition. Acting projects.
4 units, spring, (Loper, Hiken, Crowder), ThF 10-12; lab. Th 1:15

170a, b, c. Visual Art for the Theater—Survey of painting, sculpture, as it affects theater style. Required of majors and M.F.A. students.
3 units, autumn, winter, spring, (Russell), MW 1:15

173. Theatrical Makeup—Laboratory course in the art of stage makeup. Required of all undergraduate drama majors.
1 unit, autumn, (Russell), S 11-1

190. Senior Seminar—Intensive analysis of selected Greek and Roman plays.
3 units, autumn, (Sharp), MW 11
191. Senior Seminar—Intensive analysis of selected Renaissance plays.
3 units, winter, (Sharp), MW 11
192. Senior Seminar—Intensive analysis of selected Romantic or Modern plays.
3 units, spring, (———), MW 11

193. Special Research—Individual reading in dramatic literature.
1 to 4 units, any quarter, (Staff)

194. Special Projects—Individual projects in theater arts.
1 to 4 units, any quarter, (Staff)

THEATER AND DRAMA
Advanced Undergraduate and Graduate

201. Greek and Roman Drama.
3 units, autumn, (———), MW 11

202. Medieval Drama.
3 units, winter, (———), MW 11

203. Renaissance Drama.
3 units, spring, (Sharp), MW 11

204. Seventeenth and Eighteenth Century Drama (1660 to 1780).
3 units, autumn, (Staff), MW 11, alternate years, to be given in 1966-67

205. Nineteenth Century Drama (1780 to 1880).
3 units, winter, (Staff), MW 11, alternate years, to be given in 1966-67

206. American Drama (1890 to Present).
3 units, spring, (Staff), MW 11, alternate years, to be given in 1966-67

207. Modern European Drama (1880 to 1940).
3 units, autumn, (Cole), MW 2:15-3:40

208. Modern European Drama (1940 to Present).
3 units, winter, (———), MW 2:15-3:40
GRADUATE COURSES FOR M.F.A.

Open by Permission to Unusually Qualified Undergraduate Students

(Note—All courses are year-long and conducted as a combination of class and studio work. These courses are offered as a sequence autumn, winter, and spring.)

241a, b, c. Technical Production I—Introduction to technical production and scenographic techniques.
9 units, all quarters, (Hunt), MWF 11

242a, b, c. Technical Production II—Advanced technical production.
9 units, all quarters, (Hunt), TTh 10, to be given in 1966-67

243a, b, c. Theater Engineering—A study of the use of electrical and mechanical devices for theater equipment, theater planning, and facilitated theatrical production.
9 units, all quarters, (Landry), MWF 9, to be given in 1966-67

244a, b, c. Survey of Lighting and Technical Production—Required of M.F.A. directing majors.
9 units, all quarters, (Hunt), MW 9

245a, b, c. Theater Management—Theater organization, production organization, box-office procedures, publicity, and business procedures.
9 units, all quarters, (Staff), TTh 9, to be given in 1966-67

246a, b, c. Technical Production III—Research and thesis.
6 units, all quarters, (Staff), T 12, to be given in 1967-68

251a, b, c. Lighting I—Introduction to stage lighting.
9 units, all quarters, (Landry), TTh 11

252a, b, c. Lighting II—Advanced stage lighting.
9 units, all quarters, (Landry), M 12 and F 11-1, to be given in 1966-67

253a, b, c. Lighting III.
6 units, all quarters, (Hunt, Landry), one hour by arrangement, to be given in 1967-68

261a, b, c. Acting I—Basic, special problems, and projects (contemporary). Open to seniors with consent of instructor.
9 units, all quarters, (Hiken), T 10-1

262a, b, c. Acting II—Projects in Classical, Shakespearean, Restoration, Nineteenth Century, modern acting.
9 units, all quarters, (———), M 2-5

263a, b, c. Voice and Movement.
9 units, all quarters, (———), S 9-11

264a, b, c. Acting III—Thesis performance.
3 units, any quarter, (———), by arrangement

271a, b, c. Costume I—Introduction to costume history, design and construction.
9 units, all quarters, (Russell), T 9 and Th 9-11

272a, b, c. Costume II—Projects in costume design.
9 units, all quarters, (Russell), T 10

273a, b, c. Costume III—Design research and thesis.
6 units, all quarters, (Russell), T 11, to be given in 1966-67

281a, b, c. Scene Design I—Principles of design and practice.
9 units, all quarters, (———), T 11 and Th 11-1

282a, b, c. Scene Design II—Projects in design.
9 units, all quarters, (———), W 11-1

283a, b, c. Scene Design III—Design research and thesis.
6 units, all quarters, (———), M 11-1, to be given in 1966-67

291a, b, c. Directing I—Principles of directing.
9 units, all quarters, (———), MWF 10; lab. by arrangement
292a, b, c. Directing II—Preparation for production.
9 units, all quarters, (Staff), MWF 10

293a, b, c. Directing III—Thesis production.
9 units, all quarters, (Staff), Th 11-1

297. Theater History (Classical).
3 units, autumn, (———), MWF 9

298. Theater History (Baroque).
3 units, winter, (Cole), MWF 9

299. Theater History (Modern).
3 units, spring (———), MWF 9

PH.D. COURSES

301. Classical Drama Seminar—Prerequisite: previous or concurrent registra-
tion in 201.
3 units, autumn, (———), MW 2:15-4:05

302. Medieval Drama—Prerequisite: previous or concurrent registration in 202.
3 units, winter, (———), MW 2:15-4:05

303. English Drama (1550–1680)—Prerequisite: previous or concurrent regis-
tration in 203.
3 units, spring, (Sharp), MW 2:15-4:05

304. French Drama, Seventeenth Century—Prerequisite: previous or concurrent
registration in 204.
3 units, MW 2:15-4:05, alternate years, to be given 1966–67

305. Italian and Spanish Drama, Sixteenth–Eighteenth Century—Prerequi-
site: previous or concurrent registration in 203 or 204.
3 units, MW 2:15-4:05, alternate years to be given 1966–67

306. English Restoration and Eighteenth Century—Prerequisite: previous or
concurrent registration in 204.
3 units, MW 2:15-4:05, alternate years, to be given 1966–67

307. American Drama to 1890—Prerequisite: previous or concurrent registration
in 205.
3 units, MW 4:15-6:05, alternate years, to be given 1966–67

308. American Drama, 1890 to Present—Prerequisite: previous or concurrent
registration in 206.
3 units, MW 4:15-6:05, alternate years, to be given 1966–67

309. European Drama, 1750 to 1870—Prerequisite: previous or concurrent regis-
tration in 204.
3 units, MW 4:15-6:05, alternate years, to be given 1966–67

310. Modern Drama, 1870 to 1940—Prerequisite: previous or concurrent regis-
tration in 207.
3 units, autumn, (Cole), MW 4:15-6:05

311. Modern Drama, 1940 to Present—Prerequisite: previous or concurrent regis-
tration in 208.
3 units, winter (———), MW 4:15-6:05

312. Dramatic Criticism—Prerequisite: previous or concurrent registration in
360a and 360b.
3 units, MW 4:15-6:05, alternate years, to be given in 1966–67

313. Seminar in Comedy—Comedy as a dramatic form; emphasis on trends in
American comedy, various historical theories of comedy.
3 units, MW 2:15-4:05, alternate years, to be given in 1966–67

360a. History of Dramatic Criticism.
3 units, autumn, (———), MWF 1

360b. Contemporary Critical Techniques.
3 units, winter, (———), MWF 1

360c. Research and Bibliography.
3 units, spring, (———), MWF 1
390. Special Research in Drama.
1-4 units, all quarters, (Staff), by arrangement

397. Seminar in Stage Arts.
3 units, spring, (Staff), MWF 10

400. Dissertation Research.
All quarters, (Staff), by arrangement

STATISTICS

Emeritus: Quinn McNemar

Executive Head: Lincoln E. Moses
Professor of Business and Industrial Statistics: Harvey M. Wagner
Associate Professors: Milton Vernon Johns, Rupert Griel Miller
Assistant Professor: Bradley Efron. Visiting: John W. Van Ness

OFFERINGS AND FACILITIES

The Department's purposes are to acquaint students with the role played in science and technology by probabilistic and statistical ideas and methods, to provide instruction in the theory and application of techniques that have been found to be commonly useful, and to train research workers in probability and statistics. There are courses for general students as well as for those who plan careers in statistics in government, business, industry, and teaching.

General students with an interest in the principles of statistical inference and the theory of making decisions in the face of uncertainty should take Statistics 50. Statistics 110 covers the most important techniques used in the analysis of experimental data in engineering and science. Statistics 116 provides a general introduction to the theory of probability. The sequence 116, 119, 120 is a basic one-year course in mathematical statistics; the sequence 116, 217a, and 217b is a basic one-year course in probability theory.

Students interested in computing and data processing have access to the Stanford Computation Center, which contains an IBM 7090 and a Burroughs 5000.

The requirements for a degree in statistics are flexible, depending on the needs and interests of the student. Among the courses which may be counted toward a degree in Statistics are certain courses offered by the Departments of Mathematics, Economics, Psychology, Electrical Engineering, Industrial Engineering, and the Graduate School of Business.

PROGRAMS OF STUDY

Bachelor of Science

The following Departmental requirements are in addition to the University's basic requirements for the Bachelor's degree:

1. Mathematics through Mathematics 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.
written examination to establish proficiency will be required and must be taken before the University oral examination.

FELLOWSHIPS AND ASSISTANTSHIPS

A variety of fellowships and assistantships are available. Generally they cover the student's tuition and pay a stipend of $2,025 for the academic year (or if the student has dependent children, $2,250). The duties are variable and may include any or all of, grading papers, teaching sections of undergraduate courses, research and computation assistance to investigators. A smaller number of assistantships are available in Summer Session. All applicants for financial assistance are required to take the Aptitude Test and the Advanced Test in Mathematics of the Graduate Record Examination. For details concerning this test see the Information Bulletin. Overseas applicants, who may not receive the Information Bulletin promptly, should write directly to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey.

COURSES

7. Introduction to Statistics—Especially designed for students in economics, sociology, and other social sciences. (Same as Economics 7 and Sociology 7.)

5 units, autumn, (Solomon), MTWThF 10


3 units, autumn, (Chernoff), MWF 2:15
winter, (Olkin), MWF 9
spring, (Parzen), 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, (Efron), MTWThF 11
winter, (______), MTWThF 2:15
spring, (______), 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, (Efron), MTWThF 2:15

#63. Mathematics for Social Scientists—Continuation of 62. Special version of Mathematics 43 primarily for students majoring in a behavioral science.

5 units, spring, (Efron), MTWThF 2:15

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, (Efron), MWF 3:15

110. Statistical Methods in Engineering and the Physical Sciences—Use of statistical methods in research, production. Measurement errors, comparison of two or more means, curve fitting, correlation, design of engineering experiments. Prerequisite: Calculus.

4 units, autumn, (Lieberman), MW 4:15 and TTh 10
winter, (______), MTWF 9
spring, (______), MTWF 10
summer, (______), MTWThF 11

111. Elementary Experimental Design and Analysis of Variance—Randomized blocks; incomplete randomized blocks; factorial experiments, confounding; fractional factorial experiments; Latin squares; analysis of covariance, multiple regression. Prerequisite: an elementary statistics course.

3 units, spring, (______), 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 9
winter, (________), MTWF 11
spring, (Stein), MTWF 11
summer, (________), MTWFThF 1:15

119. Elementary Statistical Inference—Review of probability; distribution theory; sampling, sampling distributions; univariate, bivariate normal distribution; correlation, regression. Prerequisite: 116 or grade of B in 27.

4 units, winter, (Solomon), MWF 9

120. Statistical Inference—Point estimation; interval estimation; tests of hypothesis; linear hypothesis; distribution free methods; sequential analysis. Prerequisite: 119.

4 units, spring, (Solomon), MWF 9

136. Introduction to the Theory of Games—Two person-zero sum games; strategy; minimax solutions; infinite games. Prerequisite: 27 or equivalent.

3 units, autumn, (________), MWF 3:15

150. Elementary Statistics—For graduate students. Lectures same as Statistics 50.

4 units, autumn, (Efron), MTWThF 11
winter, (________), MTWThF 2:15
spring, (________), MTWThF 11

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: 50 or equivalent.

3 units, winter, (Moses), MWF 10

152. Introduction to Operations Research I—Introduction to deterministic models in operations research. Linear, non-linear, and dynamic programming. Network analysis, inventory theory, simplex method, transportation problem, dual theorem, convex programming, integer programming, structure of deterministic dynamic programming problems, minimax theorem. Matrix notation will be introduced. (Enroll in I.E. 152.) Not open to graduate students. See 252. Prerequisite: Differential Calculus.

3 units, winter, (________), MW 4:15-5:30


3 units, spring, (________), MWF 11

199. Independent Study—For undergraduates. (Staff)


3 units, spring, (Madott), MWF 11

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. (Enroll in Philosophy 206.) Prerequisite: Statistics 63 or Mathematics 43 or equivalent.

3 units, autumn, (Suppes), TTh 3:15 and one hour by arrangement, to be given in 1966–67

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. (Enroll in Philosophy 207.) Prerequisite: Statistics 63 or Mathematics 63 or equivalent.

3 units, winter, (Suppes), TTh 3:15 and one hour by arrangement, to be given in 1966–67

208. Mathematical Models in Behavioral Sciences: Psychometrics—Examination of mathematical models in factor analysis, mental testing, latent structure analysis, scaling theory, and related topics.

3 units, 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 or equivalent.

3 units, spring, (Lieberman), MWF 2:15

217a. 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, (Miller), MWF 1:15

217b. Introduction to Stochastic Processes—Continuation of 217a.

3 units, spring, (Miller), MWF 1:15


3 units, winter, (Solomon), MWF 9

220. Statistical Inference—For graduate students. Lectures same as Statistics 120.

3 units, spring, (Solomon), 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

222. Analysis of Variance II—Special topics under Model I; consequences of relaxing assumptions; randomization basis of inference; components of variance; applications. Prerequisite: 221.

3 units, winter, (Stein), MWF 2:15

230a. Advanced Probability—Basic concepts; distribution functions and their Fourier transforms; weak and strong convergence theorems; random walk problems; martingales. (Enroll in Mathematics 230a, b.)

3 units, winter, (Chung), MW 3:15–4:30


3 units, spring, (Chung), MW 3:15–4:30

236a. Mathematical Statistics—A survey of classical and modern statistics from an advanced mathematical point of view. Probability, games and decision theory, estimation, testing hypothesis, confidence intervals, Neyman-Pearson theory, large sample theory, non-parametric inference, sequential analysis, design of experiments. Prerequisites: 220; completion of, or concurrent registration in 221 and Mathematics 205a.

3 units, autumn, (Chernoff), MWF 9
3 units, winter, (Chernoff), MWF 9

236c. Mathematical Statistics—Continuation of 236b.  
3 units, spring, (Efron), MWF 9

242a. Introduction to Time Series Analysis—Model fitting and prediction theory, correlation analysis, spectral analysis, and regression analysis of univariate and multivariate time series. Applications to communication theory (extraction and detection of signals in noise), statistical control theory, and economic time series. Prerequisites: 217a, 219, and Computer Science 136.  
3 units, autumn, (Parzen), MW 4:15-5:30

242b. Introduction to Time Series Analysis—Continuation of 242a.  
3 units, winter, (Parzen), MW 4:15-5:30

252. Operations Research—For graduate students who have not had the equivalent of I.E. 152 and 153. See I.E. 152 and 153 for course content. (Enroll in I.E. 252.) Prerequisites: Calculus and Statistics 27 or 110 or 116.  
4 units, autumn, (——–), MTWF 10; (Hillier), MW 4:15-6:05

253. Seminar in Operations Research—Case studies and papers appearing in the operations research literature. Student teams work in local industry on problems in operations research. Special topics, including some presentations by guest specialists. (Enroll in I.E. 253.) Prerequisites: At least two courses in operations research.  
3 units, spring, (Lieberman), MW 4:15-5:30

3 units, winter, (Wagner), TTh 10:45-12:00

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, (Veinott), MWF 3:15

257. Data Processing in Operations Research—Seminar in selected topics in the application of electronic computers to operations research activities. Emphasis on the use of simulation techniques. (Enroll in I.E. 257.) Prerequisites: I.E. 141 and at least two courses in Operations Research.  
3 units, spring, (Wagner), MTW 3:15

258. Queuing Theory—A survey of queueing theory and its application. Birth-death process. Other useful models where the inter-arrival or the service-time distributions, or both, are non-exponential. Special service disciplines. Statistical estimation of model parameters. (Enroll in I.E. 258.) Prerequisites: 217a, b, or 116 and I.E. 252, or equivalent.  
3 units, spring, (Hillier), TTh 4:15-5:30

260a. Workshop in Biostatistics—Techniques useful in biological applications including bioassay, quantal response, epidemiology. Informal training in medical science by medical school faculty. Open to second-year graduate students in Statistics.  
2 to 5 units, autumn, (Miller, Moses), Th 1:15–3:05 and by arrangement

260b. Workshop in Biostatistics—Continuation of 260a.  
2 to 5 units, winter, (Miller, Moses), Th 1:15–3:05 and by arrangement

260c. Workshop in Biostatistics—Continuation of 260b.  
2 to 5 units, spring, (Miller, Moses) Th 1:15–3:05 and by arrangement

5 units, (Staff)
420

SCHOOL OF HUMANITIES AND SCIENCES

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

Registration in courses numbered 300 and above generally requires completion of Statistics 236a, b, c (or concurrent registration, with the permission of the instructor).

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, spring, (Staff), by arrangement

324a. Multivariate Analysis—The multivariate normal distribution and related distributions such as the Wishart distribution and Hotelling’s T^2. Statistical inference for the multivariate normal distribution. Multiple regression, canonical correlations, multivariate analysis of variance, classification problems. Application of group theory to multivariate analysis.
   3 units, winter, (Stein), MWF 10

324b. Multivariate Analysis—Continuation of 324a.
   3 units, spring, (Stein), MWF 10

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, to be given in 1966-67

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, to be given in 1966-67

   3 units, to be given in 1966-67

332b. Large Sample Theory—Continuation of 332a.
   3 units, to be given in 1966-67

336a. 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. Prerequisites: 236a, b, c.
   3 units, to be given in 1966-67

336b. Decision Theory and Statistical Inference—Continuation of 336a.
   3 units, to be given in 1966-67

343a. Foundations of Time Series Analysis—Hilbert space and function space methods of studying the probabilistic structure and statistical theory of time series. Prerequisites: 242 and Mathematics 205a.
   3 units, to be given in 1966-67

343b. Foundations of Time Series Analysis—Continuation of 343a.
   3 units, to be given in 1966-67

345. Time Series Analysis Seminar—Discussion of current theoretical and empirical research on time series analysis.
   3 units, spring, (Parzen), MWF 1:15

381. Special Topics in Decision Theory.
   3 units, to be given in 1966-67
384. Special Topics in Multivariate Analysis: Matrix Analysis and Inequalities—Consideration will be given to those topics in matrix theory and inequalities which are generally omitted from courses in matrix theory. Applications in statistics will be stressed. Prerequisites: Mathematics 114a, b. Recommended: Statistics 220.
3 units, autumn, (Olkin), MW 2:15–3:45

386a. Seminar in Sequential Analysis.
3 units, winter, (Chernoff), MWF 2:15

386b. Seminar in Sequential Analysis—Continuation of 386a.
3 units, spring, (Chernoff), MWF 2:15

392. Special Topics in Stochastic Processes.
3 units, to be given in 1966–67

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

Dean: Bayless Manning
Professors: Marc A. Franklin, John H. Merryman, Carl B. Spaeth
Lecturer: George Torzsay-Biber

THE WORK OF THE LAW SCHOOL

The School of Law was established as a department of the University in 1893. Its purpose is to provide a thorough legal education for students who are fitted by their maturity and their previous academic training to pursue professional study under university methods of instruction. The curriculum leading to the first degree in law (LL.B.) constitutes an adequate preparation for the practice of law in any English-speaking jurisdiction. Graduate work leading to the degrees of Master of Laws and Doctor of the Science of Law is also offered. (For full Law School Curriculum and Faculty see the Law School Bulletin.)

COURSES

Graduate

The following courses are open to qualified graduate students of other departments of the University upon permission of the instructor:

327. Selected Problems in International Law and Organization—Seminar. Case studies will include Korea, Cuba, Berlin, the Congo, and the Middle East. Reports and participation in the seminar by faculty from other University departments including History, Economics, and Political Science.

2 units, winter, spring, (Spaeth)

334. Introduction to the Civil Law System—This introductory course will be conducted in English and will be based on materials in English. It is the basic comparative law offering, its function being to introduce the student to the civil law system. Among the matters discussed will be the history of Roman law in Europe following the fall of the Roman Empire; the movement for codification and reform in the Eighteenth and Nineteenth centuries and the nature and impact of the Code Napoleon; the structure of the legal process in Italy and the roles played by legislature, executive, court, public authority and the legal profession; civil procedure, evidence and the trial of civil actions in Italian courts; the Italian Civil Code, and the movement toward unification of private law in Western Europe.

4 units, winter, (Merryman)

335. Selected Problems in Comparative Law—Seminar on selected problems. Sessions will be conducted in English, but the outside reading and research will require a reading knowledge of Italian, French, German or Spanish (or, in appropriate cases and by special arrangement, some other language). Emphasis will be placed on reading, research, and the preparation of a paper.

3 units, spring, (Merryman)

337. Roman Law—Study of Roman law as it has developed from the time of Augustus to that of Justinian. Although the private law will be studied in its entirety, emphasis will be on those parts which are still operative in modern civil law systems and in international law. Legal institutions will be studied through actual problems drawn mainly from Justinian's Digest and their solutions will be discussed in historical context. The main purpose of the course is to identify and study the fundamental principles of Roman law and, in addition, to provide a background for further study in
jurisprudence, legal history, and comparative law. Roman text will be provided in English translation. Some knowledge of Latin is desirable but not required. A paper will be required.

2 units, winter, (Torssay-Biber)
1 unit, spring, (Torssay-Biber)

**Nonprofessional**

The following nonprofessional course, open to juniors and seniors, as well as to graduate students in other departments, may be counted toward the A.B. degree but not toward professional degrees in law.

104. Law in Society—This course is designed for students who do not intend to undertake the professional study of law. Its purpose is to provide insight into how the law and legal institutions function as one important means of social control. Cases and other materials are employed to focus attention upon three related topics: (1) the processes of legal decision making; (2) the change of legal doctrine in response to altered societal conditions and problems; (3) the influence of the law upon other social institutions and the course of social change.

4 units, winter, (Franklin), MTWTh 10
The School of Medicine was established as a department of the University in 1908, when the Cooper Medical College, which had been operating in San Francisco, was transferred to Stanford. Until 1959 clinical teaching and some teaching of the basic medical sciences were carried out in San Francisco, while the remainder was conducted on the University campus near Palo Alto.

In 1953 the Trustees of the University determined that the School of Medicine should be consolidated on the University campus in new facilities. Following many months of planning and preparation, and the development of a new program of medical education, and the construction of the Stanford Medical Center buildings for teaching, research and patient care activities, the School began its operation at Stanford in September, 1959.

The purposes of the School of Medicine are to provide a basic education in medicine for students working toward the Doctor of Medicine degree, to offer advanced work in the basic sciences leading to the Doctor of Philosophy degree, and to conduct teaching and research programs to advance knowledge of the medical and related sciences and application of that knowledge to problems of illness and health. The following section outlines the plan of work toward the M.D. degree which is described in more detail in the separate School of Medicine Bulletin.

THE STANFORD PLAN OF MEDICAL EDUCATION

The Stanford Plan of Medical Education is a five-year program which emphasizes medical education as an integral part of University education. The medical sciences are presented not only as they relate to medical knowledge and the treatment of patients, but also in the context of developing human knowledge. The unity of the medical sciences is stressed, rather than their diversity. Other major concerns are the role of medicine in society and the parts played by the patient and physician as members of society. The program is based on the belief that medical education is graduate education and that firsthand experience with the scientific method is essential. Therefore the Stanford Plan encourages learning in terms of attitude toward, and approach to, problems in medicine rather than in terms of acquiring techniques or accumulating data at the expense of interpretation. Each student is given maximum opportunity to develop his own interests as they complement the basic knowledge included in the work required of all students.

A student entering this program will find a thorough grounding in the humanities valuable, in addition to a basic understanding of the natural sciences. In addition, he will benefit from knowledge of both a modern foreign language and of mathematics because these subjects contribute to the breadth of his liberal education and to his ability to take the fullest advantage of his medical education. The Medical Faculty believes it would be unduly restrictive to require these courses as a condition for admission, but urges any student contemplating a career in medicine to consider their usefulness seriously.

The striking feature of the program is the provision of time equivalent to one academic year which the student may devote to work anywhere in the University. This time, designated "University time" for convenience of identification, is distributed through the first three years of the program in such a manner that its combination with the free time in the medical course 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 offers a five-academic-year program leading to a Bachelor of Science degree and certification as a Public Health Nurse. The nursing major commences in the junior year. See the separate School of Nursing Bulletin for details.

DIVISION OF PHYSICAL THERAPY

Director: Lucille Daniels
Associate Professors: Lucille Daniels. Clinical: Herbert Browne, Helen Hardenbergh
Instructors: Helen Blood, Barbara Kent. Clinical: Donna J. Jensen, Michael Keropian

OFFERINGS AND FACILITIES

The following programs in physical therapy are offered:

1. A four-year course leading to the Bachelor of Arts degree.
2. A four-quarter, 12-month course for students with the Bachelor's degree and adequate background in the basic sciences.
3. The Master of Arts degree.

Program 1, plus an additional quarter of clinical training, and Program 2 conform to the standards of the Council on Medical Education and Hospitals of the American Medical Association and the American Physical Therapy Association. Both programs prepare students for the examination for registration in California and other states.

All prerequisite courses and the basic science courses that are a part of the physical therapy curriculum are given in the respective departments on the campus. Courses in medical science and physical therapy theory and technique are held in the Edwards Building of the new Medical Center which houses lecture, laboratory and research rooms, a library, and clinics.

Following initial directed clinical experience in the University's integrated rehabilitation program, students are assigned to affiliated hospitals and treatment centers in the Bay area to assure a well-rounded background of clinical work.
ADMISSION

Graduate students applying for the program leading to the certificate in physical therapy or to the Master of Arts degree are admitted autumn quarter. Admission dates for undergraduates and general information for all students will be found in the Information Bulletin of the University.

SCHOLARSHIPS, TRAINEESHIPS, LOAN FUNDS

General University scholarships and fellowships are available and are listed in the booklet, Student Aid Funds; Awards and Prizes. In addition, a number of special scholarships for physical therapy students are offered by such organizations as the 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 Marian Williams Memorial Scholarship is awarded through the Division of Physical Therapy; the Mary McMillan scholarships are under the auspices of the American Physical Therapy Association.

The U.S. Government offers traineeships for both undergraduate and graduate students through the Vocational Rehabilitation Administration and traineeships for graduate students from the Public Health Service. The California State Department of Mental Hygiene offers assistance to undergraduate and graduate students.

The Information Bulletin lists the long-term and short-term loan policies of the University and the details of the National Defense Student Loan Program. Information about scholarships, commissions, and fellowships may be obtained from the office of the Division.

COMMISSIONS IN THE ARMED SERVICES

The Air Force and the Navy offer commissions to senior women in the Bachelor's degree program, and to graduate women who are accepted for the 12-month course. Students pay tuition and maintenance from the 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 (see adviser for course selection), Anatomy 114, Practical Anatomy.

Physical Therapy 150 to 195, and at least one third- or fourth-year course in psychology are required. Education 155, Elementary Analysis of Body Movement, 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, 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 3:15-5:05

150. Elements of Pathology—Basic medical terminology; the causes, process, and effects of disease; repair of tissues following injury.
   2 to 3 units, autumn, (Hardenbergh), T 8:00-9:50

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, (Daniels, Graham), Th 10:00-11:50 and two hours by arrangement

162. Physical Agents I—Analysis of the principles underlying the use of electrotherapy, massage, and hydrotherapy; practice of essential techniques.
   3 units, autumn, (Staff), MWF 10:00-11:50 and open labs. by arrangement

163. Physical Agents II—Continuation of 162.
   4 units, winter, (Staff), lec. M 11:00-11:50 and F 1:15-2:05; lab. WF 8:00-9:50 and open labs. by arrangement

170. Clinical Medicine I—Basic lectures in orthopedics, medicine, and surgery.
   3 units, winter, (Browne, Special Lecturers), M 8:00-9:50 and F 2:15-3:05

172. Clinical Medicine II—Basic lectures in medicine, neurology and pediatrics.
   2 units, spring, (Staff, Special Lecturers), Th 1:15-3:05

182. Kinesiology and Therapeutic Exercise I—Biomechanics and neuroanatomy related to body motion; theory and practice of neuromuscular reeducation; tests and measurements.
   4 units, autumn, (Forward, Kent, Semans), M 3:15-5:05 and WF 8:00-9:50; open labs. by arrangement

183. Kinesiology and Therapeutic Exercise II—Continuation of 182.
   4 units, winter, (Forward, Kent, Semans), lec. WF 11:00-11:50; lab. Th 8:00-9:50 and F 2:00-4:05 and open labs. by arrangement
184. **Kinesiology and Therapeutic Exercise III**—Continuation of 183 and application of exercise in the treatment of orthopedic, neurological and other physical disabilities.

2 units, spring, (Forward, Kent, Semans), TTh 9:00-11:50

192. **Clinical Problems in Physical Therapy**.

2 units, summer, (Daniels, Graham), S 9:00-10:50

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, (Blood, Kent), by arrangement

200. **Directed Clinical Experience in Physical Therapy**—Students are assigned to treatment facilities at Stanford and in the Bay area for full-time work with patients.

3 to 8 units, any quarter, (Blood, Kent), by arrangement

**Advanced Courses**

Courses offered in the Division of Physical Therapy and in related areas of basic science, psychology, education, and speech pathology allow flexibility in individual programs for candidates with interests in administration, teaching, or research. A minimum of 30 units must be selected from the following:

220. **Advanced Physical Therapy for Musculoskeletal Disorders**—Regional approach to anatomy and kinesiology of limbs and trunk with consideration of more common disabilities; current treatment, and analysis of related therapeutic exercise procedures. Review of prosected anatomical material.

5 units, autumn, (Staff), M 3:15-5:05 and WF 9:00-10:50

221. **Measurement and Analysis in Kinesiological Problems**—Electromyography and dynamometry; biomechanics and neuroanatomy related to body movement.

5 units, winter, (Staff), MWF 10:00-10:50 and T 8:00-9:50


5 units, spring, (Semans, Forward), by arrangement

224. **Analysis of Neuromuscular Disorders in Cerebral Palsy**.

4 units, summer, (Semans, Forward), by arrangement

230. **Analysis of 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, (Forward), WF 7:30-9:30 p.m.

232. **Curriculum Development and Instruction**—Objectives, organization, content, techniques in teaching courses in physical therapy.

3 units, winter, (Daniels), M 1:15-3:05 and W 1:15-2:05

233. **Directed Teaching in Physical Therapy**.

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

234. **Seminar in Administration**—Administrative problems in hospitals, clinics, schools of physical therapy; interprofessional relationships in comprehensive patient care.

3 units, autumn, (Daniels), T 1:15-3:05 and Th 1:15-2:05

236. **Principles and Practices of Out-of-Hospital Physical Therapy**—Development of fundamental concepts of patient care with consideration of organization,
administration, interpersonal and interprofessional relationships and clinical application.

3 units, spring, (Blood), MWF 10:00-11:50

240. Continuing Case Conferences in Rehabilitation—Observation of the care of patients with extensive disability and the use of the case conference technique for the integration of services; case studies and reports.

1 to 2 units, any quarter, (Staff), T 1:15-3:05

244. Directed Clinical Experience in Special Areas of the Field—For therapists wishing to strengthen their background in special areas by short-term periods in facilities such as thoracic surgery, amputation, and cerebral palsy centers.

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

245. Clinical Supervision of Students—Methods of orientation, analysis of performance, and evaluation of students in the clinic.

2 to 3 units, any quarter, (Graham), by arrangement

246. Individual Work.

1 to 8 units, any quarter, (Staff), by arrangement

280. Seminar in Research and Thesis Problems—Basic principles of research with emphasis on material applied to physical therapy./ Biostatistics.

3 units, autumn, (Forward), MF 1:15-2:05 and W 1:15-3:05


5 to 8 units, (Staff), by arrangement

295. Research.

(Staff), by arrangement

DIVISION OF SPEECH PATHOLOGY AND AUDIOLOGY

Emeritus: Virgil A. Anderson (Professor)

Director: Hayes A. Newby

Professors: Jon Eisenson, Hayes A. Newby, Earl D. Schubert

Associate Professors: Richard F. Dixon, Dorothy A. Huntington

Assistant Professors: Clara N. Bush, James H. Dewson III, John F. Font

Instructors: Robert H. Gottsleben, Virginia Puich, Ellen Seefeldt. Clinical: Lyman S. Barrett, Donald R. Calvert

OFFERINGS AND FACILITIES

Training programs in the Division of Speech Pathology and Audiology are designed to prepare students for professional careers, for teaching at various academic levels, and for research in the fields of speech pathology, audiology, and speech and hearing sciences. The rapid expansion of these fields in recent years has created many opportunities for properly trained individuals to work in hospital clinics, rehabilitation centers, in industry, and in various local, state, and federal agencies dealing with the handicapped. In addition, the curriculum provides preparation for careers in public school speech and hearing work and for private practice.

The program of the Division is so organized, however, as to make ample provision for electives outside 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. Although a student may specialize in any one of the three, he is expected to have some background in the other two as well. Undergraduate programs provide specializations for the degree only in speech pathology and/or audiology.

The courses in the Division are numbered according to the following scheme:

- 0 to 9 on any level (0 to 9, 100 to 109, 200 to 209, etc.) are *general*
- 10 to 39, Speech Sciences
- 40 to 59, Speech Correction
- 60 to 79, Combined Speech and Hearing
- 80 to 99, Audiology (hearing)

The only courses in the Division that provide graduate credit for the A.M. or Ph.D. degrees are those numbered 200 or above.

**Programs of Study**

**Bachelor of Arts**

The following requirements are in addition to the University's basic requirements for the Bachelor's degree:

1. As a minimum program, the satisfactory completion, with an average grade of C or better, of the following courses:

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>Principles of Phonetics</td>
<td>4</td>
</tr>
<tr>
<td>130</td>
<td>Introduction to Speech Science</td>
<td>4</td>
</tr>
<tr>
<td>141</td>
<td>Speech Correction</td>
<td>5</td>
</tr>
<tr>
<td>180</td>
<td>Introduction to Audiology</td>
<td>4</td>
</tr>
<tr>
<td>220</td>
<td>The Psychology of Speech</td>
<td>4</td>
</tr>
<tr>
<td>232</td>
<td>Principles of Voice Training</td>
<td>3</td>
</tr>
<tr>
<td>281</td>
<td>Hearing Measurements and Interpretation</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Speech and Drama 20. Public Speaking: Practice and Criticism</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Speech and Drama 1. Characteristics of Spoken Language or</td>
<td>3</td>
<td></td>
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<tr>
<td>Speech and Drama 30. Oral Interpretation</td>
<td>3</td>
<td></td>
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</tbody>
</table>

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 or ....................... 4
   291. Hearing Aids and Residual Hearing ................... 3
   270. Clinical Practice in Speech and Hearing .............. 1

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).

The minimum number of graduate units required by this Division for the Master's degree is 45. The typical candidate requires six quarters of academic work in order to complete all requirements for the A.M. degree. Students with superior prior preparation may complete their work in four quarters; others may require at least eight quarters. Within limits, each program is planned individually to fit the needs, interests, and previous background of the student. This program may include course work offered in other departments of the University. Four units may be devoted to a thesis. The thesis is optional. Candidates who expect to pursue a doctoral program and others who show research promise will be encouraged by their advisers to elect to write a thesis.

Examinations—Early in his first quarter of residence the candidate will take a diagnostic examination covering various subjects. These include speech pathology, audiology, speech science, phonetics, and the psychology of speech. These examinations are truly diagnostic; they are not recorded as "passing" or "failing," but are used as a basis for advising the student and planning his program.

Near the end of his final quarter of course work the student must pass a written examination covering the three areas: speech pathology, audiology, and speech and hearing sciences. The relative emphasis devoted to each of these three areas in the examination will vary according to the particular specialization of the student. Students who have not completed the degree within three years from the date of filing for candidacy must reapply.

Doctor of Philosophy

The University's basic requirements for the doctorate (residence, dissertation, examination, etc.) are discussed in the section "Degrees" in this Bulletin. The student may specialize in any one of the three fields—speech pathology, audiology, or speech and hearing sciences. Normally he is expected to acquire a substantial background in the other two as well.

The doctoral program cannot be laid out in advance in terms of specific courses routinely required, but it is planned individually with the needs and interests of the candidate in mind. The general University requirements for the doctorate are followed as they apply to residence, application for candidacy, etc. A reading knowledge of one foreign language is required.

All doctoral candidates must complete the following courses: 300 (Introduction to Graduate Study), 308 (Research Methods), and 400 (Doctoral Research) which is the formal course registration for the dissertation. Fifteen units of 400 must be included in the candidate's program. The candidate is expected to attend a special doctoral dissertation seminar during each quarter of his residence or until his dissertation has been completed. (See course 400 for days and hours.) Candidates for the doctorate may include a formal minor as a part of their total program. The minor is chosen in consultation with the candidate's major adviser, but the content and details of the minor program are specified and administered by the department in which the minor is taken.

Examinations—The doctoral candidate takes the same diagnostic examinations as described earlier for the Master's degree. Not later than the beginning of the quarter
in which the candidate expects to take his University oral examination, he must pass written examinations administered by the Division. Content areas for these examinations are determined by the candidate's advisory committee. Upon the candidate's successful completion of these examinations, the staff administers an oral examination as a basis for admission to the University oral examination.

Postdoctoral

A limited number of postdoctoral fellows will be accepted each year in speech pathology, audiology, and speech and hearing sciences. For further information, write to the Director.

Teaching Credentials

Anyone interested in earning a credential that would authorize the holder to work in the public schools of California as a speech therapist and hearing specialist should consult the credential adviser in the Division.

Speech and Hearing Clinic

Throughout the year, including the summer quarter, a Speech and Hearing Clinic is maintained by the Division for the purpose of diagnosing and treating speech and hearing disorders. The primary purpose of the Clinic is to provide students in training actual experience with a variety of speech and hearing disorders under the supervision of the staff. A secondary purpose is to serve the Medical Center, the University, and the community as a diagnostic and rehabilitative agency for individuals who have problems of speech or hearing. Clinical services are available to both children and adults, either individually or with a group. University students may receive the service without charge by registering for Speech Pathology and Audiology 1. Adult stuttering and lipreading groups meet weekly. Information concerning any of the services of the Clinic can be obtained by calling the Clinic reception desk—321-1200, Local 5416.

Scholarships and Assistantships

The University has a number of scholarships and fellowships available. In addition, the Phi Chapter of Kappa Alpha Theta Fund and the J. D. Zellerbach Fund provide scholarships specifically for graduate students in Speech Pathology and Audiology. Application for these special scholarships should be made directly to the Director of the Division of Speech Pathology and Audiology.

Some teaching, research, and clinical assistantships are available to students who have sufficient background of training and experience. Some of these involve employment in nearby medical and research facilities and hence offer valuable experience in addition to the financial remuneration. In addition, traineeships from the Vocational Rehabilitation Administration and fellowships from the Children's Bureau and the Office of Education are available for graduate students with the proper qualifications. A limited number of postdoctoral fellowships in audiology are available from the National Institute of Neurological Diseases and Blindness. Application for these traineeships and fellowships should be made directly to the Division of Speech Pathology and Audiology.
**Courses**

1. **Speech Clinic**—Remedial work in speech disorders, hearing problems. Open to all students in need of corrective treatment.
   
   *No credit, any quarter, (Font, Staff), by arrangement*

2. **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.
   
   *3 units, spring, (Puich, Staff), Th 3:15-5:05*

3. **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*

4. **Principles of Phonetics**—English phonetics as applied to articulation, standards of pronunciation, teaching of speech, speech correction.
   
   *4 units, autumn, (Seefeldt), MWF 1:15*

5. **Introduction to Phonetic Theory**—Descriptive and historical phonetics as applied to English. Prerequisite: some acquaintance with phonetic transcription.
   
   *2 units, autumn, (Bush), TTh 1:15*

6. **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), MWF 2:15*

7. **Speech Correction**—Classification, diagnosis, treatment of speech disorders. Supervised observation in Speech Clinic.
   
   *5 units, winter, (——), MWFThF 10 and one hour by arrangement*

8. **Clinical Methods**—Theory, practical demonstrations of materials, techniques applicable to speech and hearing therapy.
   
   *3 units, spring, (Puich), M 3:15-5:05 and W 3:15*

9. **Introduction to Audiology**—Anatomy, physiology, acoustics of hearing; survey of field of audiology.
   
   *4 units, autumn, (Dixon), MWF 8*

**Advanced Undergraduate and Graduate Courses**

10. **The Psychology of Speech**—Origin, development of speech, semantics; relation of speech to thought, emotion, personality.
    
    *4 units, autumn, (Eisenson), MWF 9*

11. **The Auditory Process**—A systematic survey of our current knowledge of the operation of the auditory system. Emphasis is placed on acquiring a knowledge of the acoustic signal, and on an understanding of the methods of measuring a sensory process.
    
    *3 units, winter, (Schubert), TWTh 11*

12. **Models for Communication**—A discussion of the various organizational structures imposed on language for the purpose of analyzing, controlling, or refining communication. Systematic patterns ranging from simple grammar to information theory are scrutinized and evaluated.
    
    *3 units, summer, (Schubert), MWF 10*

13. **Advanced Speech Science**—Acoustic characteristics of voice and speech.
    
    *3 units, spring, (Huntington), MWF 1:15*

14. **Principles of Voice Training**—Theories, methods of training speaking voice as applied to both normal, abnormal voice. Problems in teaching of diction. Prerequisites: some background in voice and a course in phonetics.
    
    *3 units, spring, (——), MWF 2:15*

15. **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, (——), MWF 10*
250. **Stuttering.**
   3 units, winter, (Font), MWF 1:15
   summer, (---), MTWF 1:15
252. **Aphasia**—Historical survey, pathology; methods of testing, diagnosis, therapy.
   3 units, winter, (Eisenson), MWF 9
   summer, (Eisenson), MTWF 9
253. **Aphasia in Children**—Language and related disorders. Prerequisite: permission of instructor.
   3 units, spring, (Eisenson), MWF 9
254. **Speech Problems in Cerebral Palsy.**
   3 units, summer, (Pujich), MWF 2:15
264. **Clinical Testing and Diagnosis**—Theory, practice in use of tests, other diagnostic techniques that can be applied to speech correction.
   4 units, autumn, (Font), MWF 11 and one hour by arrangement
   summer, (Font), MTWF 11 and one hour by arrangement
270. **Clinical Practice in Speech and Hearing**—Prerequisite: 141 or equivalent, or permission of instructor.
   1 to 4 units, any quarter, (Pujich, Staff), Th 4:15 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, autumn, (Newby), MWF 8 and one hour by arrangement
   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
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, (Seejeldt), MTWF 11
290. **Language Training for the Deaf Child**—Unless otherwise arranged the student is expected to register for 1 unit of 270 concurrently with this course. Prerequisite: permission of instructor.
   4 units, autumn, (Pujich), MTWF 10
291. **Hearing Aids and Residual Hearing**—Amplification as a rehabilitative measure. Counseling and training the hearing-aid user. Prerequisite: permission of instructor.
   3 units, summer, (Dixon), MTWF 8
300. **Introduction to Graduate Study**—Required of all candidates for graduate degrees.
   2 units, autumn, (Huntington), MF 2:15
301. **Research**—Independent study for graduate students.
   1 to 3 units, any quarter, (Staff), by arrangement
304. **Master of Arts Thesis.**
   1 to 4 units, any quarter, (Staff), by arrangement
308. **Research Methods**—Required of all Ph.D. candidates. Prerequisite: some training in statistics.
   3 units, winter, (Huntington), MWF 10
310. **Experimental Phonetics I**—Study of experimental work in physiological characteristics of speech. Lectures, demonstrations, laboratory.
   4 units, autumn, (Huntington), T9-11 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, (Schubert), MTWF 11

330. Seminar in Speech Sciences—Material will vary from year to year; hence, may be repeated for credit.
   4 units, spring, (Bush), MW 3:15-5:05

340. Seminar in Speech Pathology—Material will vary from year to year; hence, may be repeated for credit.
   4 units, autumn, (——), MW 3:15-5:05
   winter, (——), MF 3:15-5:05
   3 units, summer, (——), MW 3:15-5:05

360. Medical Backgrounds of Speech and Hearing Disorders—Anatomical, physiological, and neurological bases for organic disorders of speech and hearing. Taught by members of the Medical School Staff.
   4 units, winter, (Newby, Medical Staff), MF 11 and W 4:15-6:05

366. Acoustic Instrumentation I—Basic principles of electronic circuits. Description and application of instrumentation commonly used in speech and hearing sciences. Prerequisite: permission of instructor.
   3 units, autumn, (——), M 7-10 p.m.

367. Acoustic Instrumentation II—Continuation of 366.
   3 units, winter, (——) M 7-10 p.m.

370. Clinical Internship—In-service clinical practice and observation in selected speech and hearing centers. Prerequisite: permission of instructor.
   2 to 12 units, any quarter, (Font, 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 3:15-5:05
   3 units, summer, (Newby), MW 3:15-5:05

381. Seminar in Experimental Audiology—Material will vary from year to year; hence, may be repeated for credit.
   4 units, autumn, (Dewson), MW 3:15-5:05

   4 units, autumn, (Schubert), MTWF 11

393. Experimental Audiology II: The Peripheral Mechanism—Study of the mechanics and electrophysiology of the middle and inner ear. Analysis of the ear as a transducer, and of the neural encoding process. Prerequisite: permission of instructor.
   4 units, winter, (Dewson), MTWF 1:15

394. Experimental Audiology III: Central Auditory Mechanisms—Anatomy and physiology of the central auditory system. Demonstration of the electro-physiological research procedures. Prerequisite: permission of instructor.
   4 units, spring, (Dewson), MWF 10 and one hour by arrangement

400. Doctoral Research.
   1 to 15 units, any quarter, (Staff), T 4:15
ANATOMY

Emeriti: Charles Haskell Danforth, William Walter Greulich, Arthur William Meyer (Professors)

Acting Executive Head: Donald James Gray
Professors: Donald James Gray, Hadley Kirkman, Robert Stuart Turner
Associate Professors: Robert L. Hunter, Donald L. Stilwell, Jr.
Assistant Professors: A. Kent Christensen, Henry J. Ralston III
Lecturer: Bernard O. A. Thomas

PROGRAMS OF STUDY

Instruction in the Department of Anatomy is planned primarily to meet the needs of students in medicine, but, insofar as facilities permit, all of the courses are open to other properly qualified third- and fourth-year undergraduate and graduate students. Those who are not registered in medicine but wish to take work in the Department should make arrangements in advance with the instructors concerned.

Facilities are available for a limited 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, (———), TTThF 4:15-5:05

#114. Practical Anatomy—Brief survey of human body by dissection, study of anatomical preparations. Lectures, demonstrations. For students of nursing, physiotherapy, hygiene, physical education or others similarly qualified. Cannot be substituted for any part of Anatomy 121.

5 units, autumn, (Baba), TWThF 1:15-4:05

121. Dissection of the Human Body—Lectures, demonstrations. A few non-medical students may be admitted by special arrangement.

3 units, winter, (Gray, Peckham, Ralston), Th 1:15-4:05 and S 8:00-11:50

5 units, spring, (Turner, Baba, Peckham), W 2:15-5:05 and ThF 1:15-4:05
122. Normal Histology and Microscopic Anatomy—Elementary structure, activities of the animal cell; histology; development of tissues, their combination into the organs of vertebrates, with special reference to man.
   2 units, autumn, (Kirkman, Hunter, Christensen), S 9:00-11:50 and W 2:15-5:05 (last 2 weeks)
   1 unit, spring, (Kirkham, Hunter, Ralston), F 11:00-11:50 and S 8-9:50

145. Individual Work—When circumstances warrant, work not specifically provided for in scheduled courses may be carried on under supervision of one or more members of staff.
   Any quarter, (Staff), by arrangement

201. Topographical Anatomy—Laboratory study of fetal, infantile, adult cadavers; dissected and specially injected preparations, student reports relevant to this material. Prerequisite: 121 and 122.
   2 to 5 units, any quarter, (Gray), by arrangement

203. Research—By individual arrangement, approved by Department faculty.
   Any quarter, (Staff), by arrangement

204. Dissection of the Fetus—General introduction to fetal anatomy, or review and intensive study of selected regions. Enrollment limited. Ordinarily, prerequisites: 121 and a course in embryology.
   Any quarter, (Gray), by arrangement

207. Histological and Cytological Technique—General principles of microtechnique, 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. Cell Biology—Lectures on the structure and functions of cells as revealed by electron microscopy and other modern techniques. Prerequisites: some background in histology and permission of instructor.
   3 units, autumn, (Christensen), TThF 4:15-5:05

211. Chemical Basis of Morphology—A series of lectures and laboratory procedures emphasizing and providing experience in histochemical techniques in combination with starch gel and acrylamide gel electrophoretic methods as tools for the study of the chemical substances that compose cells and tissues.
   3 units, winter, (Hunter), TThF 4:15-5:05

221. Dissection of the Human Body.
   3 units, autumn, (Gray, Peckham, ———), M 8:00-11:50 and S 9:00-11:50
   3 units, winter, (Gray, Baba, Christensen), M 8:00-11:50 and F 9:00-11:50
   2 units, spring, (Turner, Baba, Peckham), S 9:00-11:50

222. Normal Histology and Microscopic Anatomy.
   1 unit, autumn, (Kirkham, Hunter, Christensen), F 9:00-11:50
   2 units, winter, (Kirkham, Hunter, Christensen), S 9:00-11:50

323. Neuroanatomy—Structure of central nervous system of man, dissections, prepared slides, dissections of central nervous systems of other mammals. Prerequisite: 122.
   5 units, autumn, (Turner, Stilwell, Rolston), MWF 9:00-11:50
PROGRAMS OF STUDY

The Department offers a first-year course in modern biochemistry which is required of medical students and open to qualified graduate students and senior undergraduates. Also a series of advanced courses are given by the Department; these are open to medical and graduate students who have completed the first-year course. (Additional qualifications are necessary for certain courses.)

ADVANCED DEGREES

The degree of Doctor of Philosophy is given by the Department, but not the Master's degree. Remission of fees and a personal stipend are available to those students accepted. For further information, applicants should write to Dr. G. R. Stark. A strong undergraduate background in chemistry (both physical and organic) is recommended. General University regulations about the Ph.D. degree are summarized in the section "Degrees" in this Bulletin; the requirements of the Biochemistry Department are tailored to fit the background and interests of the student. Graduate students in other departments who wish to choose Biochemistry as a minor must obtain the approval of the Department.

Postdoctoral research training is available to graduates holding a Ph.D. or M.D. degree. Several fellowships, carrying stipends at current national levels, are awarded by the Department. Qualified graduates may apply to the departmental executive for further information. At present the chief research interests of the Department are in nucleic acids and proteins: their enzymatic synthesis, chemical structure, and biochemical functions; and in the biochemistry of viral infection.

COURSES

101, 102. Biochemistry Lectures—These deal with basic biochemistry, and with special biochemical aspects of the various life processes. Required of medical students in Year 1, and open to graduate and advanced undergraduate students.

101. 4 units, autumn, (Staff), MTWTh 11
102. 4 units, 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 1:00-4:50 and T 1:00-3:50

103. Mechanisms of Biochemical Reactions—Detailed examination of a few selected topics; examples will be taken from processes such as enzyme-catalyzed hydrolyses and group transfer reactions, participation of coenzymes in enzymatic reactions, modification of enzyme structure and activity through interaction with other molecules, synthesis of nucleic acids and proteins, helix-coil transitions in nucleic acids. Prerequisite: three quarters of organic chemistry; 101, 102 also recommended. Consent of the instructor required both for auditors and students enrolling for credit.

3 units, spring, (Staff), MWTTh 1

201. Research and Special Advanced Work.

By arrangement


By arrangement

211. Biochemical Genetics.

2 units, (Kaiser), to be given in 1966–67

212. Special Topics in Biochemistry.

2 units, (Lehman), to be given in 1967–68

213. Biosynthesis of Proteins.

2 units, (Hogness), to be given in 1967–68

214. Ultracentrifugal Techniques of Studying Proteins and Nucleic Acids

The course will include theory, some laboratory work, and methods of computing results. Topics to be covered are the measurements of molecular weight, sedimentation and diffusion coefficients, heterogeneity, and also, for nucleic acids, the study of
strand dissociation and recombination. Limited enrollment: consent of instructor required. Prerequisites: 101, 102, first-year physical chemistry, and a knowledge of calculus.

2 units, autumn, (Baldwin)

215. Special Topics in Biochemistry.
2 units, (Berg), to be given in 1966-67

217. Physical Chemistry of Proteins.
2 units, (Stryer), to be given in 1967-68

218. Chemistry of Proteins—Reactions of the functional groups of proteins and the effects of chemical modification on activity and structure; techniques in the determination of primary structure. Prerequisites: 101, 102, and three quarters of organic chemistry.

2 units, winter, (Stark)

GENETICS

Executive Head: Joshua Lederberg*
Professor: Joshua Lederberg
Associate Professors: Leonard A. Herzenberg, Eric M. Shooter
Assistant Professor: Walter F. Bodmer
Research Physicists: Elliott C. Levinthal, Sidney Liebes, Jr.


PROGRAMS OF STUDY

In addition to the courses required for the medical students, the Department of Genetics offers advanced courses for undergraduate and graduate students; programs of study and research training leading to a Ph.D. in Genetics; and research training to holders of the Ph.D. or M.D. Financial support for predoctoral and postdoctoral trainees is available, including full tuition and personal stipend at current national levels.

The Department of Genetics is particularly interested in applicants for the Ph.D. degree who have proved their outstanding qualifications in chemistry, physics, and mathematics or computation, and have since become interested in fundamental aspects of biology. It is equally interested in students with an undergraduate program in biology who have a strong background in chemistry, physics or mathematics. The Department administers a Ph.D. program of unusual flexibility, especially for students of exceptional capability and with well defined goals, whom it can accommodate regardless of previous formal training in biology. By cooperation with other departments we can promote the attainment of high professional competence in a source field together with the necessary standing in biological theory and technique. Well qualified students are invited to apply to the Departmental executive for further information on these opportunities.

The principal areas for which research training is available at the present time are the function of DNA in bacteria, immunogenetics and somatic cell genetics, biochemical neurogenesis, the investigation of extraterrestrial life, genetic demography, and population genetics.

The Lt. Joseph P. Kennedy Jr. Laboratories for Molecular Medicine are under construction to further basic research in the etiology of mental retardation and the pathology of intellectual development. These facilities offer unusual opportunities for research and study in the fields of molecular biology, heredity, neurobiology, and developmental medicine. An Instrumentation Research Laboratory, under NASA support, also offers special opportunities in the use of advanced instrumentation, with special emphasis on real-time computer-linked devices. Research in any of the areas...
indicated can be applied toward the Ph.D. degree in genetics or in other degree programs by individual arrangement.

For further information on the availability of the following courses, consult the quarterly *Time Schedule*, or inquire at the Department Office. Additional courses in genetics are included in the listing of the Department of Biological Sciences.

**COURSES**

103. Physics and Technology of Analytical Instruments—A review of the physical principles underlying analytical instruments encountered in medical research and applications of these principles to instrumental components and design.

3 units, autumn, (Levinthal, Liebes), MWF 4

199. Supervised Study.

200. Individual Research.

201. Medical Genetics—Topics in general genetics and their application to human biology and pathology. Nonmedical students who wish to enroll in this course must obtain special permission from the Department of Genetics.

2 units, winter, (Staff), ThF 8

202. Medical Genetics—Continuation of 201.

2 units, spring, (Staff), TW 8

249. Cytogenetics—Principles and modern methods of analysis of major cellular components. The structure and design of chromosomes from bacteriophages to higher organisms. The influence of chromosomal changes in development and evolution. (Enroll in Biological Sciences 249.) Prerequisites: Biology 1, 2 and 3 or 10, 11 and 12, knowledge of genetics, and consent of instructor.

3 units, autumn, (Ganesan), MWF 10

302. Genetics Seminar.

(Staff), alternate F 4:15


2 units, winter, (Hersenberg), T 4:15, alternate years, to be given in 1965–66

307. Epigenetics—Developmental genetics, gene-cytoplasm relationships and cytoplasmic inheritance. Prerequisite: consent of instructor.

2 units, winter, (Bodmer), W 7:45 p.m., alternate years, to be given in 1966–67

308. Mathematical Genetics—Mathematical models in population genetics, ecology, population growth, and epidemiology. The first part of the course will deal mainly with deterministic models in population genetics (Enroll in Mathematics 279a, b.) Prerequisite: consent of instructors.

3 units, autumn, winter, (Bodmer, Karlin, McGregor), by arrangement, alternate years, to be given in 1965–66

**GYNECOLOGY and OBSTETRICS**

*Executive Head:* Charles E. McLennan

*Professor:* Charles E. McLennan

*Associate Professor:* Eugene C. Sandberg

*Assistant Professors:* Allen H. Gates, Robert C. Goodlin, Emmet J. Lamb

*Research Associate:* Margaret T. McLennan

**PROGRAMS OF STUDY**

While the principal instruction in the Department is for students in medicine, candidates for the degree Master of Arts in Medical Sciences may major in Physiology of Reproduction. Candidates will be expected to have completed 45 quarter
units, at least 15 units of which shall be from the following courses (or their equivalents): Anatomy 122, 145, 204, 222; Biochemistry 101, 102; Biology 103, 105, 142, 243; Physiology 251; 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 12 and 116 or their equivalent. (Staff), by arrangement

401. Physiology of Reproduction—Open to medical students, upper division students majoring in biology, and graduate students. Limited to 8 students per quarter. Project research 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

MEDICAL MICROBIOLOGY

Emeriti: Edwin William Schultz (Professor); Helen Sharp Thayer (Instructor)

Executive Head: Sidney Raffel
Professors: Charles Egolf Clifton, Sidney Raffel, Carlton E. Schwerdt
Associate Professor: Robert J. Roantree
Assistant Professor: Leon T. Rosenberg

PROGRAMS OF STUDY

The Department of Medical Microbiology offers, in addition to the courses required of students of medicine, a group of courses for students who wish to specialize in various aspects of medical microbiology. An undergraduate program leading to the degree of Bachelor of Arts in Medical Microbiology is offered to seniors who have completed all of the essential premedical sciences (Biological Sciences, 15 quarter units; Chemistry, 24 quarter units; Physics, 12 quarter units), as well as Quantitative Analysis (Chemistry 110, 111). The following courses in the Department are normally covered during the senior year: Medical Microbiology 101, 225, 231, 238, 240, 315; in addition, Biochemistry 101 and 102 are required. Students who fall below an average grade of C in Departmental subjects completed will become ineligible for more advanced courses.

ADVANCED DEGREES

Master of Arts

Preference in selection of students for available places is given to candidates for the Ph.D. degree. Candidates for the degree of Master of Arts will be expected to have completed the premedical requirements (see above) and Quantitative Analysis
(Chemistry 110, 111), and to complete the following courses: Medical Microbiology 101, 225, 231, 238, 240, 315 and Biochemistry 101, 102. (Biochemistry 102a may be taken depending upon individual interests.) At least 15 units of research work bearing on the thesis subject must be completed. A grade average of B in Departmental courses is required for admission to thesis work. Each candidate is expected to pass an oral examination of two hours’ duration covering the fundamentals of medical microbiology, immunology, and virology at the end of the first year of work. A reading knowledge of French or German is required.

Doctor of Philosophy

Candidates for the degree of Doctor of Philosophy must meet the same preliminary requirements as listed for the Master’s degree and will follow such courses as are approved by the major professor and the Department faculty, subject to general University regulations covering this degree. The following courses should be included in the first year or two of graduate work, if the equivalents were not included in the undergraduate program: Biology 124, 129, 248; Biochemistry 101 and 102; completion of the foreign language requirement (one language). The following courses are recommended depending upon the field of major interest of the candidate: Anatomy 112, 122 (or Biology 103); Biochemistry 102a; Basic Medical Sciences 102 or Chemistry 171, 173, 175; Mathematics 10, 11, 21, 22, 23; General Human Pathology (autumn, winter and spring quarters, Wednesday 9-12); and Psychology 60 or Statistics 50.

A grade average of B in Departmental and related subjects is required for admission to research work. In addition to this, the student is expected to pass an oral examination covering the fundamentals of general and medical microbiology, immunology and virology toward the end of his first year of graduate work. Students who enter the Department with advanced standing in microbiology from other institutions are expected to take the final examination in Course 225, and in such other courses as may be stipulated, at the earliest time these examinations are regularly scheduled. In addition, such students are also required to pass the oral examination during their first year of residence.

COURSES

101. General Bacteriology—Survey of fundamental aspects of bacteriology. Prerequisites: Biology 1, 2, 3, and Chemistry 1, 2, 3.
   5 units, autumn, (Clifton, Staff), MWF 1:15; lab. MWF 2:15-4:05

121. Basic Medical Microbiology—An introduction to the principles of immunology, primarily for first-year medical students.
   2 units, spring, (Staff), T 1:15-4:05 and W 1:15

225. Medical Microbiology—A course of lectures and laboratory exercises covering the fundamentals of pathogenic bacteriology, with particular reference to the bacteria and viruses of importance in infectious diseases of man. The course includes a discussion of the essential aspects of immunology and serology, of practical laboratory diagnosis, and of preventive measures. Prerequisites: required premedical sciences and 101, and 221 or 231.
   5 units, spring, (Staff), M 8-12 and ThF 9-12

231. Immunology and Serology—Lectures, demonstrations covering infection, immunity, antigen-antibody reactions. Prerequisites: 101 or 225, Biology 103, and Biochemistry 101.
   3 units, winter, (Raffel, Roantree, Rosenberg), MW 1:15 and F 2:15

231a. Immunology and Serology Laboratory.
   3 units, winter, (Raffel, Roantree, Rosenberg), MW 2:15-5:05 and F 3:15-5:05

238. Bacterial Physiology—Lectures on physical, chemical aspects of bacterial growth, behavior. Prerequisites: 101 and Biochemistry 101.
   5 units, spring, (Clifton), MTWThF 1:15
240. Virology—Lectures, demonstrations on general nature of plant, animal viruses, their relationships with their hosts. Prerequisites: 101 and 231, and Biochemistry 101. 
3 units, winter, (Schwerdt), TThF 1:15

240a. Virology Laboratory.
2 units, winter (Schwerdt), TTh 2:15-5:05

250. Advanced and Special Work—Students who have completed necessary basic courses with satisfactory grade average may be admitted by instructor to advanced work on informal basis in: (a) general bacteriology, including bacterial physiology; (b) medical bacteriology; (c) immunology and serology; or (d) virology. 
5 to 10 units, any quarter, (Clifton, Raffel, Roantree, Rosenberg, 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) virology. Grade average of B in bacteriological subjects required for admission to research or thesis work. 
5 to 10 units, any quarter, (Clifton, Raffel, Roantree, Rosenberg, Schwerdt), 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, Raffel, Roantree, Rosenberg, 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, (Raffel, Roantree, Rosenberg), by arrangement

PATHOLOGY

Executive Head: To be announced
Professors: David Glick, Lelland J. Rather, Lucien J. Rubinstein
Associate Professor: Bruno Gerstl
Assistant Professors: Jon C. Kosek, Robert C. Rosan, Alexander M. Saunders, Lloyd Silverman
Instructor: Lysia S. Forno

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 Professors: Anthony James Hance, Ernest F. Zimmerman

PROGRAMS OF STUDY

The principal instruction offered by the Department of Pharmacology is for students in medicine. However, the required courses for medical students (Pharmacology 101, 201, 301) and elective courses are also open to qualified graduate students not registered in medicine. Programs leading to the degree of Doctor of Philosophy must be worked out by each student with the Department faculty. Candidates for the degree of Master of Arts are not accepted. Research opportunities are available for qualified students and for postdoctoral fellows. Prospective candidates for an advanced degree should consult the University's general requirements described in the section "Degrees" in this Bulletin, and obtain further information from the Department. Consult Time Schedule for additional elective courses.

COURSES

REQUIRED COURSES

   1 unit, winter, (Staff), F 11
   2 units, spring, (Staff), TTh 11

201. Pharmacology—Lectures and demonstrations. Drugs acting on renal, endocrine, reproductive, and other systems; general pharmacology; toxicology; chemotherapy of infectious disease.
   2 units, autumn, (Staff), TW 8
   2 units, winter, (Staff), TW 8
   2 units, spring, (Staff), ThF 8

301. Pharmacology—Lectures and laboratory exercises. Problems of drug evaluation.
   3 units, winter, (Staff), M 8–12 and T 11

Neurological Sciences—Neuropharmacology and psychopharmacology are taught in the winter and spring quarters in the interdepartmental course Neurological Sciences, described in the School of Medicine Bulletin.

ELECTIVE COURSES

203. Cellular Regulatory Mechanisms in Carbohydrate Metabolism — A course of lectures and discussions on the different regulatory processes which keep the carbohydrate catabolic reactions in the cell in pace with its energy requirement; the effect of different hormones on the carbohydrate metabolism at the cellular and subcellular level. Prerequisite: Biochemistry 101 (first quarter) or equivalent.
   1 unit, winter, (Mansour), T 4:15, to be given in 1966–67

204. Recent Advances in Molecular Pharmacology — Assigned readings and discussion of selected topics in the recent literature. Students should be conversant
with modern biochemistry and genetics, and should have taken (or be taking) courses in physiology and general pharmacology.

205. Drug Metabolism—Lectures and discussions on the metabolic conversions of foreign compounds in the mammalian organism, including factors such as species, age, and genetic variability.

1 unit, spring, (Goldstein), W 4:15

207. The Anti-Cancer Drugs—A joint course offered by the Departments of Pharmacology, Radiology, and Medicine. The biochemical basis of action of the anti-cancer drugs will be developed in detail, and current research trends (including clinical aspects) will be discussed by invited lecturers. Open to medical staff, and advanced medical and graduate students. (Same as Radiology 207.)

2 units, spring, (Staff), W 7:30–9:30 p.m., to be given in 1966–67

208. Neuropharmacology—Fundamental considerations in the study of drug action on the central nervous system.

1 unit, spring, (Killam), T 4:15, to be given in 1966–67

213. The Use of Drugs in Population Control—Lectures and seminar discussion about population growth and its control through the use of pharmacological agents.

2 units, autumn, (Kalman), T 4:15–6:05, to be given in 1966–67

214. Regulation of Calcium Transfer in Biological Systems.

1 unit, autumn, (Dreisbach), T 4:15

215. Antibiotics—Discussion of the mechanism of action, with special emphasis on antibiotics which have been used to elucidate specific biochemical pathways.

1 unit, autumn, (Zimmerman), T 4:15, to be given in 1967–68

250. Tutorial Program—Guided readings in the literature of any area of pharmacology. A critical review paper may be required. Primarily for graduate students in pharmacology.

Any quarter, (Staff), by arrangement

251. Introduction to the Scientific Literature—Assigned readings and oral reports. Limited to graduate students in pharmacology.

1 unit, autumn, (Goldstein), by arrangement

252. Research Methods in Pharmacology—Training in laboratory techniques applicable to pharmacological research. Primarily for graduate students in pharmacology.

Any quarter, (Staff), by arrangement

259. Research Seminar—A weekly conference for discussion of current research in pharmacology.

1 unit, any quarter, (Staff), by arrangement

300. Research—With the approval of the Department qualified students may elect research work in any area of pharmacology.

Any quarter, (Staff), by arrangement

PHYSIOLOGY

Emeritus: James Percy Baumberger (Professor)

Acting Executive Head: F. Eugene Yates
Professors: Jefferson M. Crismon, Ronald Grant. Acting: Leo A. Sapirstein (Radiology)

Associate Professors: George A. Feigen, F. Eugene Yates
Assistant Professors: Julian M. Davidson, David F. Lindsley, Geronimo Terres, Jr.
Lecturer: Noel Thompson

PROGRAMS OF STUDY

The Department of Physiology offers required and elective courses for students in the School of Medicine, open also to other qualified graduate students. In addition,
the department offers two advanced laboratory courses restricted to Ph.D. candidates in physiology.

The department offers the Ph.D. degree, but not the Master's or Bachelor's degrees.

GRADUATE STUDY

Students with undergraduate or Master's degrees who have completed a year each of college chemistry (including lectures in organic chemistry), physics, calculus (differential and integral), and biology will be considered for admission to graduate study. An applicant must file a report of his scores (aptitude and advanced biology) on the Graduate Record Examination as part of his application. In the case of certain students, especially those with degrees in engineering or physics, the Department will consider admission even if the above requirements have not been met. In those cases the students will be expected to complete the requirements during their graduate studies.

Emphasis is placed on providing all graduate students with a strong background in the laboratory study of major physiological phenomena, from which they may undertake highly individual courses of advanced research and study. The total course of study is expected to occupy four years, including three summers. Required courses for all students are: Biochemistry 101 and 102 (without laboratory), Physical Chemistry (Chemistry 171 and 173, or Physiology 102), and Physiology courses 150, 151, 250, 251, 350, 351, 310, and 311. In addition, students will take any six of these Physiology courses: 300, 301, 302, 303, 305, 306, 307, 308, and 309. Other courses in computer science, mathematics, statistics, chemistry, physics, biology or engineering may be arranged by agreement between the student and his faculty supervisor, but they are not required.

Qualifying examination—At the end of the second year in residence as a graduate student, each Ph.D. candidate will be given a written examination covering the material of the first two years of courses. This examination may be taken only after the respective course examinations have been successfully passed, and will be more comprehensive than the course examinations. Students may undertake individual programs of study after passing this examination, and the language examination.

Language examination—A reading knowledge of any one of the following languages is required: French, Russian, or German.

Dissertation and University Oral Examination—The results of independent, original work by the students are to be presented in a dissertation. The oral examination will be largely a defense of the dissertation.

FINANCIAL AID

Research assistantships or teaching assistantships are occasionally available to graduate students who have completed substantial work toward the Ph.D. degree in physiology. Tuition aid may be awarded to students holding research assistantships, and to a few first-year students.

Support for qualified students in years two through four may be applied for from the National Science Foundation and the U.S. Public Health Service.

COURSES

102. Biophysical Chemistry—Lectures and demonstrations in thermodynamics, phase equilibria, kinetics, transport phenomena, and the physical chemistry of macromolecules. (Same as Basic Medical Sciences 102 in the School of Medicine curriculum.)

3 units, autumn, (Yates, Terres, Interdepartmental Staff), W 2-5 and S 11

150. Muscle Nerve—Lecture course on muscle contraction and membrane excitability.

1 unit, winter, (Lindsley, Feigen), F 1
PHYSIOLOGY

151. Circulation—Lectures, laboratory, and demonstrations in mammalian circulation.
   4 units, spring, (Crismon, Sapirstein), M 11-5 and W 11

207. Research—Original laboratory research planned for individual students by the appropriate staff member and carried out under his guidance. Maximum 14 units in any one quarter. Open to graduate students only.
   Any quarter, (Staff), by arrangement

250. Control of Fluid Environment—Lectures and demonstrations in respiration, circulation, renal function, and acid-base balance.
   4 units, autumn, (Terres, Sapirstein, Staff), Th 8-11 and FS 8

251. Endocrinology and Gastrointestinal Function—Lectures, laboratory, and demonstrations.
   3 units, winter, (Davidson, Yates, Staff), Th 9-12 and S 8

300. Central Nervous System and Behavior—Lecture and discussion course dealing with selected topics related to the brain and the role of the brain in the control of behavior. Topics will be selected on the basis of their interest to the group, and their pertinence to present-day neurophysiology and behavioral neurophysiology. Prerequisites: Physiology 350, 351 and Anatomy 323, or permission of instructor.
   2 units, spring, (Lindsley), T 7:30-9:30 p.m., biennially, to be given in 1965-66

301. Peripheral Circulation—Lectures and demonstrations on regulation of the peripheral circulation with emphasis on special features of the circulation in man. Prerequisites: Physiology 150 and 151, or equivalent.
   3 units, autumn, (Crismon), W 4-6 and F 4, triennially, to be given in 1966-67

   3 units, autumn, (Thompson), W 4-6 and F 4, triennially, to be given in 1965-66

303. Physiological Control Systems—A lecture course for biologists on the systems analysis approach to selected physiological systems under negative feedback control. Examples for detailed analysis include regulation of arterial pressure, alveolar ventilation, adrenocortical function and pupillary area. The course includes a discussion of time bases ("biological clocks"). Use of the analog computer in the study of physiological processes is demonstrated. Prerequisites: Physiology 150, 151, 250, 302, and one year of calculus.
   3 units, winter, (Yates), W 4-6 and F 4, triennially, to be given in 1965-66

304. Immunophysiology Laboratory—A laboratory course in quantitative immunophysiology emphasizing basic immunochemical 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; quantitative tissue anaphylaxis. Limited to 15 students. Prerequisite: Biology 105 or consent of instructor.
   4 units, (Feigen, Terres), M 4:15; lab. Th 9:00-4:05, biennially, to be given in 1966-67

305. Circulation—Recent developments in cardiovascular physiology. Special emphasis will be placed on problems of regional blood flow measurement, analysis of disappearance curves of injected materials and transcapillary transfers. No formal laboratory will be offered, but interested students will have the opportunity to participate in experiments on these and related subjects in the Palo Alto–Stanford Hospital. Prerequisites: Physiology 150, 151, 250, 251, and calculus.
   2-5 units, autumn, (Sapirstein), T 7:30-9:30 p.m., triennially, to be given in 1967-68

   2 units, spring, (Feigen), T 7:30-9:30 p.m., triennially, to be given in 1967-68
307. Neurophysiology—Consideration in depth of selected aspects of central nervous system physiology. New concepts as well as new research data will be examined. Topics to be discussed will be announced in the previous quarter and students will be expected to have read much of the relevant literature before class begins. Prerequisites: completion of Physiology 350 and 351.

2 units, winter, (Grant), T 7:30–9:30 p.m., triennially, to be given in 1967–68

308. Neuroendocrinology—A lecture and discussion course on selected topics of current interest in the general area of nervous and endocrine system interrelationships. Special emphasis will be placed on mechanisms for control of adenohypophysial function; behavioral aspects of neuroendocrinology will also be treated. Prerequisites: Physiology 251, 350, 351, and Anatomy 323, or permission of instructor.

2 units, spring, (Davidson), T 7:30–9:30 p.m., triennially, to be given in 1966–67

309. Respiration—A lecture course designed to cover recent advances in mammalian respiration. Emphasis will be placed on the structure and function of hemoglobin, control of respiration, and environmental adaptation. Prerequisite: Physiology 250.

2 units, winter, (Terres), T 7:30–9:30 p.m., triennially, to be given in 1966–67

310. General Physiology—A quantitative, experimental approach to problems in thermodynamics, kinetics, transport, and bioelectric phenomena. Restricted to Ph.D. candidates in physiology.

2 units, winter, (Feigen, Terres), TTh 2–5

311. Advanced Mammalian Physiology—Experimental investigation of interactions of organ systems; adaptation. The course introduces the student to modern techniques of surgery, instrumentation, analog modelling of systems, and data reduction in various fields of physiology. Prerequisite: Physiology 310.

4 units, autumn, (Crismon, Grant, Staff), ThF 1–6

350. Neurological Sciences—Lectures and demonstrations. (Same as Neurological Sciences in the School of Medicine curriculum.)

3 units, autumn, (Grant, Lindsley, Interdepartmental Staff), S 8–11

351. Neurological Sciences—Continuation of 350, with laboratory.

6 units, winter, (Grant, Lindsley, Interdepartmental Staff), WS 8–12
BIOPHYSICS LABORATORY

Director: Mitchel Weissbluth
Professor: Henry S. Kaplan (Radiology)
Associate Professor: Marsden S. Blois, Jr. (Dermatology)
Assistant Professors: Kendric C. Smith (Radiobiology), Mitchel Weissbluth (Radiologic Physics)
Lecturers: Philip C. Hanawalt, Earl Jacobs, Howard H. Pattee
Research Associates: John E. Maling, Ellen Weaver

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, magnetic and optical properties of metallo-proteins, theoretical biophysics.

PROGRAM OF STUDY

The program is designed for graduate students only, and leads to the degree of Doctor of Philosophy in Biophysics. The requirements for the degree are as follows:

1. Training in physics equivalent to that of an undergraduate physics major at Stanford. Students with a comparable background will automatically satisfy this requirement; others will need to take only those courses in which deficiencies exist.

2. A graduate minor in one field selected from biology, chemistry, or physics. The requirements for the minor, as specified by the respective departments are as follows:
   a) Minors in physics must take either Physics 210, 211, and 212 or Physics 130, 131, and 132, with the appropriate prerequisites. All physics minors must pass the comprehensive examination given to physics majors, but need take this examination only when they feel prepared for it.
   b) Minors in chemistry must complete, with a grade point average of 3.00 or better, at least 12 units of chemistry courses more advanced than those that meet the minimum requirements for the Bachelor's degree in chemistry. At least 3 units must be from Chemistry 221, 223, 225, 233, 235, or 272.
   c) Minors in biology must complete the Departmental course requirements for the Ph.D. degree with a 3.00 average, or must pass the Departmental qualifying examination.

Students may petition for permission to substitute other fields of specialization (e.g., mathematics, electrical engineering) to satisfy the requirements of the minor.

3. Completion of the following courses with a grade point average of 3.00 or better:
   a) Chemistry 171, 173, 175.
   b) Biochemistry 101, 102, 102a.
c) Biology 113a, 114.
e) Four units of any other life science courses which include laboratory work.

4. Reading ability in one language selected from French, German or Russian.
5. After fulfilling the above requirement, each student must pass a comprehensive examination based primarily on course material. He may then apply for Ph.D. candidacy.
6. Each student is required to pass the University oral examination which is to be taken only after the student has substantially completed his research.
7. The satisfactory completion of research and acceptance of the resulting dissertation conclude the requirements.

COURSES

200. Molecular Biophysics—A survey of physical approaches to biological problems at the molecular level. Lectures include discussion of intra- and intermolecular forces and their relation to biological structure, physical methods for characterizing macromolecules, the interaction of electromagnetic radiation with biological molecules, isotopic tracer techniques, and classical physics of cellular processes. Assigned readings and problems. Prerequisites: Biology 10, Chemistry 121, and Physics 57, or permission of instructor.
3 units, autumn, (Hanawalt), MWF 10

220, 221. Energy and Entropy Transformations—A rigorous analysis of the energy, entropy and information transformations accomplished by living organisms. The lectures will include a generalized theoretical development of the fundamental principles of energy, entropy and information transformations in open systems and their application to the detailed reactions of cell metabolism and to the origin and evolution of complex chemical systems and life. Prerequisite: permission of instructor.
220. 3 units, winter, (Jacobs), by arrangement
221. 2 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 band 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, autumn, (Weissbluth), TTh 1:15
231. 2 units, winter, (Weissbluth), TTh 1:15
232. 2 units, spring, (Weissbluth), TTh 1:15

3 units, spring, (Pattee), MWF 1:15

1 unit, spring, (Pattee), by arrangement

250. Molecular Photobiology—Lecture topics include photochemistry of molecules of biological interest, effects of ultraviolet light on simple biological systems, photoreactivation, photodynamic action, etc.
2 units, spring, (Hanawalt, Smith), W 11–1

252. Radiation Biology—Radiological physics, target theory and other mechanisms of biologic action, radiochemistry and radiation biochemistry, cellular radiobiology,
general and special radiation pathology, acute lethal and immunological effects of whole-body exposure, genetic effects of radiation, relative biological effectiveness (RBE) as a function of linear energy transfer (LET), recovery kinetics, radiation carcinogenesis and other late effects, and applications of radiobiology to clinical radiotherapy. (Enroll in Radiology 14)

2 units, winter, (Kaplan), T 1–3

255. Biophysical Measurements—A course covering the underlying theory, experimental procedures, and methods of interpretation of modern biophysical instruments and techniques including electron paramagnetic resonance, infrared spectroscopy, electrochemical measurements, chromatography, optical microscopy, microdensitometry, spectrofluorimetry, radioactive tracer methods, ultracentrifugation, ultraviolet spectroscopy, and computer techniques.

Any quarter, (Pattee, Staff), by arrangement


2 units, winter, (Pattee), by arrangement

300. Research.

Any quarter, (Staff), by arrangement

310. Literature of Biophysics—Intensive study of literature of any special topic in biophysics. Preparation of a report.

Any quarter, (Staff), by arrangement
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. Computation Center facilities are available to University staff members in connection with research work and to students in connection with Stanford courses. However, grants of computer time may not always be available on a computer of the user's choice.

The Computation Center and the Computer Science Division are housed principally in Pine Hall and Polya Hall in the Jordan Science Quadrangle. Equipment currently maintained by the Center includes the IBM 7090/1401 system, the Burroughs B5500 computer and a PDP-1 computer manufactured by the Digital Equipment Corporation. The PDP-1 and the 7090 are connected together and will be used for computer time-sharing research as well as other projects. Details about system configuration are available at the Center.

Computing languages used at Stanford include a variety of dialects of ALGOL, the international standard algorithmic language, as well as LISP, FORTRAN, IPL-V and others.

It is the aim of the Computation Center to render every assistance in use of the facilities. Advice and counsel in programming and computer problem-solving are generally available from staff members. It is nevertheless expected that all users will do their own programming and adapt any available programs to the solution of their own problems.

INSTRUCTION

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, 6, 126, and 136.
   
   Introduction to Electronic Data Processing—See Business 366.
FOOD RESEARCH INSTITUTE

Emeriti: Merrill Kelley Bennett, Karl Brandt, Joseph Stancliffe Davis, S. Daniel Neumark, E. Louise Peffer, Vladimir P. Timoshenko, Vernon D. Wickizer, Holbrook Working (Professors)

Director: William O. Jones
Professors: Helen Cherington Farnsworth, Roger Winks Gray, Bruce Foster Johnston, William O. Jones
Research Associate: John A. Jamison
Associate Statistician: Rosamond H. Peirce
Librarian: Charles C. Milford

OFFERINGS AND FACILITIES

The Food Research Institute endeavors to familiarize graduate students with both the methods and results of its long research into problems of food supply, distribution, and consumption. A number of specialized courses of instruction, some of them unique in character, are offered. In addition to the courses given in the Food Research Institute, students enrolled there are required to enroll in approved courses in other departments, and Ph.D. candidates are required to complete an approved program in the Department of Economics.

The Institute does not undertake supervision of studies leading to a Bachelor's degree, though certain of its courses may be counted toward a major in economics and in some special programs in other social sciences.

The graduate program is designed especially for students who plan careers in research into the economics of food and agriculture, whether in universities, governments, or private business. Students presenting evidence of high ability together with appropriate training, such as a Bachelor's degree or better, in economics or agricultural economics, may be accepted for graduate study in the Institute, leading to the degrees of Master of Arts and Doctor of Philosophy.

The Institute's specialized library contains some 50,000 items, including up-to-date series of rare periodicals from over fifty countries, and is open for reference to students and others.

The Institute publishes a journal, Food Research Institute Studies, three times a year, which serves primarily as an outlet for staff research in progress.

Master of Arts

The requirement for the Master's degree is the satisfactory completion of an approved program of study amounting to not less than 45 units of credit.

Doctor of Philosophy

Doctoral candidates are required to offer a minor in economics, statistics, or an approved equivalent.

A candidate must demonstrate a reading knowledge of two approved languages, other than English, or he must demonstrate a reading knowledge of one language and offer an approved 15-unit program in mathematics, statistics, or other area in lieu of the second foreign language.

FELLOWSHIPS AND SCHOLARSHIPS

The Food Research Institute has available a limited number of fellowships and scholarships for qualified students. University fellowships, in addition, are open to
all students. Applications for all fellowships and scholarships should be made to the Admissions Office, Stanford University.

**COURSES**

**103. Economics of Food Consumption** — 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 2:15–4:05*

**105. Commodity Futures Markets and Prices** — See Food Research 205.

**160. Economic Development of Tropical Africa** — Traditional organization of production and distribution, economic achievements under European rule, economic problems of political independence. Food and agricultural economies, internal and external trade, levels and standards of living, national accounts, development plans, and capital formation.

*5 units, winter, (Jones), MTWTh 11*

**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 4:15–6:05*


*3 units, spring, (Jamison), W 4:15–6:05*

**250. Methods of Analyzing Commodity Problems** — Sources and selection of basic data on commodity production, trade, stocks, utilization, and prices; rough tests of completeness and of comparability over time; methods of rough adjustment of commodity series; construction and use of “food balance sheets”; selected examples of economic problem-solving, with special reference to primary food commodities. Prerequisites: Economics 1 and Statistics 7 or equivalent of both.

*5 units, winter, (Farnsworth), MW 2:15–4:05*

**260. Seminar: Contemporary African Problems** — Reports and discussion of current research into economic problems of tropical Africa in the 1960’s. Seniors admitted with permission of the instructor.

*3 units, spring, (Jones), T 4:15–6:05*

**303. Seminar: Food Supply and Agriculture in Relation to Economic Growth** — Primarily for second-year graduate students in the Food Research Institute. Prerequisite: Food Research 203 or permission of the instructor.

*3 units, winter, (Johnston), by arrangement*

**305. Seminar: The Economic Theory of Futures Trading** — Consideration of conflicting theories of futures trading, the functions and performance of futures markets, and the evidence to support the theories.

*3 units, winter, (Gray), by arrangement*

**350. Seminar: National and International Grain Problems and Policies** — Prerequisite: permission of instructor.

*2 units, spring, (Farnsworth), by arrangement*
371, 372, 373, 374. Directed Reading and Research.
371. 3 units, autumn, (Staff), by arrangement
372. 3 units, winter, (Staff), by arrangement
373. 3 units, spring, (Staff), by arrangement
374. 3 units, summer, (Staff), by arrangement
401, 402, 403, 404. Advanced Directed Reading and Research.
401. 3 units, autumn, (Staff), by arrangement
402. 3 units, winter, (Staff), by arrangement
403. 3 units, spring, (Staff), by arrangement
404. 3 units, summer, (Staff), by arrangement
SPECIAL PH.D. PROGRAM

The Graduate Division Special Programs make provision for students whose plans for study toward the Ph.D. degree do not fall within the province of any one department. Such a program may be individually planned for an unusually well-qualified graduate student who has already been admitted to a department or school of the University and enrolled therein.

A student with a well-considered program not now provided for in the existing departments or special programs of the University may then approach a professor qualified to give him guidance. The professor, if he believes the program desirable, will gather a special committee consisting of at least three other members of the Academic Council who represent the student's various fields of interest. Included in the advisory committee must be professors from at least two departments of the University. Before the student embarks on the program, this committee will address a Declaration of Intention (Form G54) to the University Committee on the Graduate Division:

1. Defining the area of the special program, showing that the University is qualified to offer it, and proposing a title for the degree.
2. Outlining the program of study and research contemplated.
3. Indicating, if possible, the nature of the dissertation contemplated.

If this Declaration is approved by the University Committee on the Graduate Division, the special committee will supervise the candidate's work and sign the forms ordinarily transmitted by major departments. The chairman of the special committee will normally direct the dissertation. Students registering for special research under the guidance of their committee or for the Ph.D. dissertation should use the following course numbers:

400. Research.
   By arrangement

   By arrangement

COURSES FOR GRADUATE STUDENTS

337a, 337b, 337c. Seminar in Public Affairs—The core seminar in the University's Public Affairs Fellowship Program, focusing on the contemporary role of democratic government and the responsibilities of its leaders; the nature of democratic government and politics; the dynamics of social, economic, and political change; and critical emerging issues of public policy. Enrollment required of and limited to Public Affairs Fellows. Credit will be given only for completion of the entire sequence.

337a. 5 units, autumn, (Hutchinson), by arrangement
337b. 5 units, winter, (Hutchinson), by arrangement
337c. 5 units, spring, (Hutchinson), by arrangement

340. The Human Potentiality—An inquiry directed to the question what is the nature of man's highest potentiality and how does he move in the direction of its realization. Points of view taken from the fields of the biological and social sciences, dynamic psychology, parapsychology, literature and philosophy, and various religious
teachings will be compared and evaluated in group discussion. Enrollment limited to 15.

2 units, autumn, winter, spring, (Harman), MW 4:15-6:05

The following courses, though given within the departments listed, may be taken by any interested graduate students:

**Education**

217. Mental Hygiene.
308. Introduction to American Higher Education.
315. Cultural Transmission.

**English**

204. Advanced Exposition.
208. Introduction to Modern Linguistics.
270. Contemporary American Fiction.
278. Popular Ballad and Folksong.
303. Seminar in Tragedy.

**Food Research Institute**


**Geology**

287. Minerals, Politics, and Economics.

**Speech and Drama**

313. Seminar in Comedy.
360a. History of Dramatic Criticism.
360b. Contemporary Critical Techniques.

**REGIONAL STUDIES**

Interdisciplinary faculty committees on African Studies, East Asian Studies, and Latin American Studies, stand ready to counsel students wishing to emphasize one of these regions in their graduate studies. Virtually all area-related courses are offered by individual schools and departments. No Ph.D. is offered in area studies, but a qualified candidate will be assisted in designing a cross-disciplinary doctoral program focused on the area of his interest. Doctoral candidates in the disciplines who are emphasizing East Asia or Latin America may be assisted by special fellowship funds administered by the respective committees. A special A.M. program in Latin American Studies is described under that heading elsewhere in this Bulletin.

Inquiries about resources for the study of these three areas that are emphasized at Stanford should be addressed to the relevant committee, c/o Committee on International Studies, Room 205, Building 10A, Stanford University, Stanford, California.
HOOVER INSTITUTION
on WAR, REVOLUTION, and PEACE

Emeriti: Harold H. Fisher (Chairman); Joseph S. Davis, Edgar E. Robinson, Graham H. Stuart (Councilors)

Director: W. Glenn Campbell
Assistant Director and Associate Professor: Witold S. Sworakowski
Executive Assistant to the Director: E. M. Moore
International Political Studies Program Director: Stefan T. Possony
African Studies Program Director: Peter Duignan
Senior Staff Members: Milorad M. Drachkovitch, Roger A. Freeman
Research Fellows: Karl Brandt, Theodore Draper, Philip A. Ray, Bertram D. Wolfe
Secretary, Research and Publications Committee: Ward D. Smith
Editor: James E. McSherry
Head, Publications Department: Karol Maichel
Curators: Clarence C. Clendenen (Special Collections), Peter Duignan (Africa Collection), R. W. Lyman (Honorary Curator, British Labor Collection), Karol Maichel (Eastern European Collection), Boris R. Nicolaevsky (Nicolaevsky Collection), Agnes F. Peterson (Western European Collection), George W. Rentz (Middle East Collection), (East Asian Collection)

Archivist, Herbert Hoover Archives: Rita R. Campbell
Librarian, General Collections: Philip T. McLean
Assistant Librarian for Technical Services: Joseph Bingaman

Since its founding by Herbert Hoover in 1919 as a special collection dealing with the causes and consequences of World War I, the Institution has become a national and international center of documentation and research on problems of political, economic, and social change in the twentieth century.

The world-wide coverage of the Institution’s collections gives them special value in this period when so many problems are international in scope. While each of the major area collections (Western Europe, Eastern Europe, East Asia, Africa, and the Middle East) is in itself outstanding, the distinguishing feature of this Institution lies in the fact that it houses under one roof for convenient study the records of the major upheavals of the contemporary world.

The Institution’s holdings include government documents, files of newspapers and serials, manuscript memoirs, diaries and personal papers of men and women important in world affairs, publications of ephemeral societies and of resistance and underground movements, and the publications and records of national and international bodies, both official and unofficial, as well as books and pamphlets, many of them rare and irreplaceable.

The Institution has its own resident research staff of historians, economists, and political scientists as well as persons broadly trained and experienced in international law and the social sciences generally. The research program is concerned primarily with promoting basic research and documentary studies, which provide the 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 findings can make important contributions to national policy. Over the years 89 volumes have been published by the Institution and several major new projects are under way; for example, a history of the Communist International, studies of Communist activity in Africa, and monographs on Communist China as an economic power.

In addition to its own research staff, the Institution has been used continually by American and foreign scholars. Considering the value of the collections, every effort will be made to increase the use of Institution resources by providing more funds for predoctoral and postdoctoral fellowships.

In these ways, by acquisitions, by research, by publications, and by fellowships, the Institution carries out its functions of collecting the living documents of international affairs, organizing and making them available for use, fostering their utilization, and encouraging and aiding the spread of knowledge.

The Institution also offers a limited instructional program.

**SEMINARS**

141. **Eastern Europe Since 1945**—Analysis of events in the "Soviet sphere" since the collapse of Nazi domination; patterns of Communist conquest, domination of the area; comparative study of most important political, social, and economic problems of the area. Prerequisites: two background courses in modern European history or international relations. Seniors and graduate students by permission.

5 units, autumn, (Sworakowski)


5 units, winter, (Possony)

261. **Historical Background to Modern Africa**—After a brief survey of the period of pre-contact and early European contact, emphasis is given to the European penetration, conquest and administration of Africa.

4 units, winter, (Gann)

299. **Directed Reading and/or Special Research in Hoover Institution Fields**—Advanced individual work by arrangement.

Any quarter, (Staff or authorized faculty member)

For other courses offered by Hoover Institution staff members, see also History, Political Science, and Senior Colloquia.
COMMITTEE ON HYDROLOGY

Committee in Charge: Ray K. Linsley (Chairman), Norman H. Crawford, Stanley N. Davis, Joseph B. Franzini, Paul Kruger

PROGRAMS OF STUDY

The Committee on Hydrology which includes faculty from the Department 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>Hydrogeology</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 286</td>
<td>Development of Ground-water Resources</td>
<td>3</td>
</tr>
<tr>
<td>Stat. 110</td>
<td>Statistical Methods in Engineering or</td>
<td></td>
</tr>
<tr>
<td>Stat. 116</td>
<td>Theory of Probability</td>
<td>4</td>
</tr>
</tbody>
</table>

Total 22

In addition, the M.S. program will include 12 units of restricted electives from the following list and 11 units of free electives.

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Subject</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 206</td>
<td>Advanced Mechanics of Fluids</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 209</td>
<td>Hydraulics of Open Channels</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 262</td>
<td>Advanced Hydraulic Engineering</td>
<td>4</td>
</tr>
<tr>
<td>C.E. 265</td>
<td>Flow in Permeable Media</td>
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<tr>
<td>C.E. 273</td>
<td>Water Resources Chemistry</td>
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<td>C.E. 274</td>
<td>Water Resources Microbiology</td>
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</tr>
<tr>
<td>Geol. 70</td>
<td>Introduction to Geochemistry</td>
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<tr>
<td>Geol. 116</td>
<td>Physical Oceanography</td>
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<td>Geol. 133</td>
<td>Principles of Geomorphology</td>
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<td>Geol. 179</td>
<td>Physics of Underground Fluids</td>
<td>5</td>
</tr>
<tr>
<td>Geol. 361</td>
<td>Permafrost</td>
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<tr>
<td>Biol. 176</td>
<td>Limnology</td>
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<tr>
<td>C.S. 136</td>
<td>Introduction to Algorithmic Processes</td>
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<tr>
<td>Pet.E. 150a</td>
<td>Formation Evaluation</td>
<td>8</td>
</tr>
</tbody>
</table>

Doctor of Philosophy

Ph.D. programs will be determined by discussion with the Committee on Hydrology but will normally include all the required and most of the suggested electives of the M.S. program plus additional course work totaling at least 90 units. To become
a Ph.D. candidate the student must demonstrate proficiency in one foreign language, pass a qualifying examination specified by the Committee and have a grade point average in graduate work of at least 3.00. Minimum residence requirements for the Ph.D. are nine quarters (six semesters) of graduate study; at least six quarters must be at Stanford. Completion of all requirements including the dissertation is rarely accomplished within the minimum time requirement, and serious students should expect as much as one year beyond the minimum. A minor in Hydrology is not offered for Ph.D. programs in other departments of the University.
INTER-UNIVERSITY CENTER FOR JAPANESE STUDIES IN TOKYO

Administered by Stanford University

The Inter-University Center for Japanese Studies in Tokyo, Japan, is a co-operative enterprise of ten major academic institutions in the United States and Canada with Stanford University as the administrative agency. The purpose of the Center is to provide qualified graduate and undergraduate students with intensive audio-lingual Japanese language instruction, as well as to further the students' familiarity with Japanese texts and materials preparatory or leading to research in given disciplinary or professional fields. The location of the Center in Tokyo provides maximum opportunities for students to gain fluency in both the written and spoken language in a Japanese-speaking and Japanese cultural environment. Language study is carried on in small classes or in individual tutorial sessions by Japanese instructors. Advanced students are given opportunities for specialized work in the language, as well as other individual study, dependent upon their linguistic qualifications and their degree programs as established by their home institutions.

The academic year at the Center is equivalent to four full quarters, beginning in early September. Any student may apply for admission provided that (a) he is a student in good standing, and is a degree candidate at an accredited university or college; (b) he will have successfully completed prior to attendance a minimum of two years of Japanese or its equivalent at the college level; and (c) he takes a written and oral examination in the Japanese language distributed to applicants by the administering institution.

For further information please write to:

Graduate Overseas Centers and Special Programs
Room 207, Building 10A
Stanford University

INTER-UNIVERSITY PROGRAM FOR CHINESE LANGUAGE STUDIES IN TAIPEI

Administered by Stanford University

The Inter-University Program for Chinese Language Studies in Taipei, Taiwan, was established in September 1963, under the sponsorship of nine American universities, with Stanford University as the administrative agency. The Program is a cooperative effort drawing upon the accumulated experience of the profession in providing advanced language training in a Chinese cultural area and is not intended to be a substitute for strong language offerings at American institutions.

The purpose of the Program is to provide graduate and undergraduate students with intensive audio-lingual language instruction, as well as to further the students' familiarity with Chinese texts and materials preparatory or leading to research in given disciplinary or professional fields.

Undergraduate, graduate, or postdoctoral candidates are eligible to apply to the Program if they have successfully completed a minimum of two academic years, or its equivalent, of Chinese language study at the college level. Applicants must also pass a short written and oral examination in the Chinese language.

For further information please address your inquiries to:

Graduate Overseas Centers and Special Programs
Room 207, Building 10A
Stanford University
LIBRARIES

Emeriti: Elizabeth Hadden, Minna Stillman (Associate Librarians); Alice Charlton (Chief Catalog Librarian); Jeannette M. Hitchcock (Chief of Division of Special Collections); Margaret Wells (Education Librarian); Grace E. Stillson (Assistant Chief Catalog Librarian); Ruth Scibird (Curator of the Stanford Collection)

University Libraries:
Director: Rutherford D. Rogers
Associate Director: Elmer M. Grieder
Assistant Director: David C. Weber
Administrative Services: David Walker
Division Chiefs: Julius P. Barclay (Special Collections); Joseph A. Belloli (Humanities and Social Sciences); Jennette E. Hitchcock (Catalog); Jeanne B. North (Government Documents); Richard D. Johnson (Undergraduate Library Project); Jack Plotkin (Circulation); Jack Pooler (Science); Allen B. Veaner (Acquisition)
Resources Development Program: Gabor Erdelyi (Germanic Languages Specialist); Paul J. Kann (Romance Languages Specialist); Peter Kudrik (Slavic Languages Specialist)
Curators: Frederick E. Brasch (Frederick E. Brasch Collection on Sir Isaac Newton). Honorary: George T. Keating (Music Bibliography); Irving Whitmore Robbins, Jr. (Rare Books and Manuscripts); Elmer E. Robinson (American); Albert Sperisen (Typography)

Food Research Library:
Librarian: Charles Milford

Hoover Institution: See listing elsewhere in this catalog

Jackson Library of Business:
Director: Marion M. Smith
Reference Librarian: David A. Kuhner; Catalog Librarian: Elizabeth R. Carter; Librarian, International Center for the Advancement of Management Education: David Allen

Lane Medical Library:
Chief Librarian: Clara S. Manson
Reference Librarian: A. V. Hoen; Catalog Librarian: Virginia Foss

Law Library:
Law Librarian: J. Myron Jacobstein
Acquisition Librarian: Howard W. Sugarman; Head Catalog Librarian: Rosalee Long; Reference Librarian: George Torzsay-Biber

Linear Accelerator Center Library:
Chief Librarian: George Owens
Acquisitions: Louise Addis; Cataloging and Reference: Robert C. Gex

FACILITIES

All faculty, staff, and registered students of the University are entitled to use the University Libraries. Information is available in the booklet Your Libraries at Stanford University or in special leaflets about general borrowing regulations, book stack access, interlibrary loans, photocopies, microtext reading machines, the Listening Room, etc. Tours are given for the freshman students during autumn quarter as part of 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. Special permission must be secured to use the collections of the following libraries which have their own regulations and in some cases require payment of fees: Hoover Institution on War, Revolution, and Peace; Law Library; Lane Medical Library; Jackson Library of Business; Food Research Institute; and Linear Accelerator Center. Special regulations are in force for high school, college, or university students from other institutions, who may consult the Circulation Service Desk attendant or their own school librarians for information. Industrial firms wishing to use the Libraries should consult the Director of the Technical Information Service for information regarding subscriptions.

The Libraries of the University altogether contain about 2,500,000 volumes, 450,000 manuscripts, 95,000 sheet maps, 130,000 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 11:00 p.m. Hours of opening for other rooms and other libraries on the campus are listed in *Your Libraries at Stanford University*. The Main Library provides quarters for the following:

The Humanities and Social Sciences rooms, the center for reference service in the Main Library, contain reference and subject collections totaling about 34,000 volumes and current issues of more than 1,400 periodicals. The Library's Central Map Collection is located in the Shainwald Room for the social sciences. The Microtext and Newspaper Reading Room is in the basement.

Reserve Services for undergraduate courses are now located in the Western Civilization Library and Reserve Services Building, just south of the Education building. Listening facilities for music, drama, and literature are also housed here. Hours of service are Monday through Saturday from 8:00 a.m. to 11:00 p.m. and Sunday from 1:00 p.m. to 11:00 p.m.

The Government Documents Library brings together most of the Library's collection of municipal, state, federal, foreign, and international documents. It is especially strong in the publications of the United States, Great Britain, Canada, Australia, and the United Nations.

The Division of Special Collections, 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 important 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 British and American literature of the nineteenth and twentieth centuries (published works, first editions, variant editions, bibliographies, criticisms, and biographical material of selected authors, supplemented where possible with manuscripts, proofs, 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 Timoshenko Collection on engineering mechanics; and the Gunst Memorial Library, com-
posed of examples of fine printing and books on the history and the making of the printed book.

**Special Libraries in the Humanities and Social Sciences**

The Cubberley Library of Education, with three reading rooms on the second floor of the School of Education building, houses about 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: Asian Languages, Briggs Memorial (English), Classics, Communication, Graduate Program in Humanities, Latin 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, mathematics-statistics, and physics.

The Frederic M. Falconer Biology Library, located on the first floor of Jordan Hall, houses general publications in botany and zoology as well as specialized materials in the experimental fields of biology. Branches are the 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 Guggenheim Aeronautics Library, the Radioscience Laboratory Library, the Ryan Nuclear Technology Library, the Solid State Library, and the Engineering Economic Planning Library.

The Branner Geological Library, located in Room 333 of the Outer Quadrangle, houses collections on geology, mineralogy, paleontology, geophysics, mining and metallurgy, as well as geological maps and the U.S. Geological Survey topographical sheets. Specialized branch libraries include the Conchology Library, the Geophysics Library, the Micropaleontology Library, the Mineralogy Library, and the Permafrost Library.

The Mathematics-Statistics Library is located in Room 414 of the Sloan Mathematics Center. Its branch is the Computer Science Library, Room 170, Polya Hall. The Physics Library is located in Room 301 of the Varian Physics Laboratory. Its branch is the Hansen Microwave Laboratory Library, specializing in microwave physics and engineering.

**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 Busi-
ness in the daily preparation of their work. Other graduate students may use the library upon identification, but undergraduate students are requested to contact the Director for the Jackson Library to make special arrangements for use of material from the collection. The library contains over 80,000 cataloged items and additional miscellaneous pamphlets and reports. It maintains extensive holdings of corporate annual reports from the leading stock exchanges. It receives in excess of 1,300 trade, financial, labor, and general business periodicals. In addition, it subscribes to many of 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 50,000 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, 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), James E. Howell, Alan S. Manne (Graduate School of Business), Harvey M. Wagner (Graduate School of Business and Industrial Engineering)
Associate Professors: Charles P. Bonini, Peter R. Winters (Graduate School of Business), Fred Hillier, Arthur F. Veinott, Jr. (Industrial Engineering)
Assistant Professor: Roy E. Murphy (Economics)
Affiliated Faculty: Alex Bavelas, Henry B. Eyring, John Haldi, Yuji Ijiri, Robert K. Jaedicke, William F. Massy, Alexander A. Robichek, Richard D. Young (Graduate School of Business); Douglass J. Wilde (Chemical Engineering); John W. Fondahl (Civil Engineering); Marc Nerlove (Economics); Norman M. Abramson, Gene F. Franklin, William K. Linvill, Bernard Widrow (Electrical Engineering); Herman Chernoff, M. V. Johns, Jr., Herbert Solomon (Statistics)

OFFERINGS AND FACILITIES
The program in Operations Research was established in 1962 in recognition of the importance of quantitative analysis in industry, government, and the military. The function of the Committee is to promote advanced teaching and research, emphasizing the interdisciplinary nature of the subject. The affiliated faculty is drawn from the Departments of Economics, Electrical Engineering, Industrial Engineering, Mathematics, and Statistics, and from the Graduate School of Business.

PROGRAMS OF STUDY
A program leading to the degree of Doctor of Philosophy in Operations Research is offered. The curriculum recognizes the need for advanced training in quantitative methods as well as specialization in one or more subject areas including Business, Economics, Engineering, Mathematics, Psychology, and Statistics. Required courses will be drawn from these departments. In addition, the student must fulfill the University's basic requirements for the doctorate (residence, dissertation, examination, etc.), which are discussed in the section "Degrees" in this Bulletin. Graduate Record Examination scores are required for admission. Typical course requirements are listed below. The programs of individual students may be adjusted to satisfy previous course work deficiencies or the special interest of the student.

Students may also undertake a Master's program or a Doctor of Philosophy program emphasizing Operations Research in the Departments of Industrial Engineering, Statistics, and the Graduate School of Business. Interested students should consult the corresponding sections in Courses and Degrees and the Graduate School of Business Bulletin.

Course Requirements for the Ph.D. Degree in Operations Research

<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Statistics 116. Theory of Probability</td>
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</tr>
<tr>
<td>Statistics 119. Elementary Statistical Inference</td>
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</tr>
<tr>
<td>Statistics 120. Statistical Inference</td>
<td>4</td>
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<tr>
<td>Mathematics 44. Advanced Calculus I</td>
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</tr>
</tbody>
</table>
Mathematics 45. Advanced Calculus II .................................................. 3
Mathematics 46. Advanced Calculus III .................................................. 3
Economics. Microeconomics, equivalent of any one of the following:
Economics 202. Price and Allocation Theory I
Business 401. Microeconomics

Requirements
Statistics 217a. Introduction to Stochastic Processes .................................... 3
Statistics 217b. Introduction to Stochastic Processes .................................... 3
Operations Research 255. Linear Programming ........................................... 3
Operations Research 256. Inventory and Production Control .......................... 3
Mathematics 114a. Linear Algebra and Matrix Theory .................................... 3
Mathematics 114b. Linear Algebra and Matrix Theory .................................... 3
Mathematics 115. Fundamental Concepts of Analysis ..................................... 3
Mathematics 116. Fundamental Concepts of Analysis ..................................... 3
Operations Research 258. Queueing Theory .............................................. 3
Operations Research 439a, b, c. Management Science Workshop .................. 12

Either of the following two courses:
Business 368. Seminar in Business Decision Theory

One course from the following five:
Business 366. Introduction to Electronic Data Processing
Industrial Engineering 141. Utilization of Computers
Computer Science 136. Introduction to Algorithmic Processes .................... 3
Computer Science 137. Numerical Analysis
Computer Science 138. Numerical Analysis
Integrated courses in one or more related subject fields .................................. 30

Total Units of Requirements .......................................................... 84

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 January 15. Applications for research assistantship should be made to the Chairman, Committee on Operations Research.

COURSES

2 units, autumn, (Lieberman), TTh 4:15

253. Seminar in Operations Research—Case studies and papers appearing in the operations research literature. Student teams work in local industry on problems in
operations research. Special topics, including some presentations by guest specialists. (Enroll in I.E. 253.) Prerequisites: at least two courses in operations research.

3 units, spring, (Lieberman), MW 4:15-5:30


3 units, winter, (Wagner), TTh 10:45-12:00

255. Linear Programming—Fundamental theorems; variations of the simplex method; parametric programming; standard model formulations; quadratic programming; discussion of current developments. Prerequisite: Mathematics 114 or equivalent.

3 units, winter, (Manne), 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. (Enroll in Statistics 256.) Prerequisite: Statistics 116.

3 units, spring, (Veinott), MWF 3:15

257. Data Processing in Operations Research—Seminar in selected topics in the application of electronic computers to operations research activities. Emphasis on the use of simulation techniques. (Enroll in I.E. 257.) Prerequisites: I.E. 141 and at least two courses in operations research.

3 units, spring, (Wagner), MTW 3:15

258. Queueing Theory—A survey of queueing theory and its application. Birth-death process. Other useful models where the inter-arrival or the service-time distributions, or both, are non-exponential. Special service disciplines. Statistical estimation of model parameters. (Enroll in I.E. 258.) Prerequisites: Statistics 217a, b, or 116 and I.E. 252, or equivalent.

3 units, spring, (Hillier), TTh 4:15-5:30


5 units, autumn, (Staff)

439a, b, c. Management Science Workshop—Selected topics in management science drawn from current literature. (Enroll in Business 439a, b, c.) Prerequisite: consent of instructor.

4 units, autumn, winter, spring, (——, ———), by arrangement
PHYSICAL EDUCATION for MEN

Emeriti: Ernst Brandsten, Allen Henry Elward, Henry W. Maloney, Edward M. Twiggs, Harry Meiggs Wolter (Directors); C. Myron Sprague (Associate Director); Elwyn Bugge, Ernest Paul Hunt (Associate Professors)

Executive Head and Director of Physical Education and Athletics: Charles A. Taylor

Assistant Director of Athletics: Robert G. Young

Directors: Howard Dallmar (Basketball), William Paul Fehring (Baseball and Football), Charles E. Finger (Golf), James Gaughran (Swimming and Water Polo), John Gilmore (Gymnastics), Joseph Higgins (Intramurals and Aquatics), Payton Jordan (Track), Peter Kmetovic (Rugby), William Leland (Wrestling), Raymond E. Lunney, Jr. (Boxing and Weight Training), Fred J. Priddle (Soccer), John Ralston (Football), Robert Renker (Tennis), Colonel A. Sysin (Equitation)

Assistant Directors: Jerome Barland (Track), Clyde F. Devine (Swimming and Diving), Robert Gamhold (Football), Leon McLaughlin (Football), Rodney Rust (Football), William T. Turner (Basketball), Richard A. Vermeil (Football), William Walsh (Football), Michael White (Football), Ray J. Young (Baseball)

Professor: John E. Nixon (Director of Professional Education)

Associate Professor: Wesley K. Ruff (Coordinator of Physical Education and Intramurals)

OFFERINGS AND FACILITIES

Athletics

In keeping with our cultural heritage and American university tradition Stanford offers its students a wide variety of competitive opportunities in intercollegiate sports. Stanford has always managed to be vigorously competitive in all sports both within the Conference and on the National level. Our sports effort has, through the years, continually improved both in quantity and quality and we look ahead in anticipation of continued achievement. Through its membership in the National Collegiate Athletic Association, the Athletic Association of Western Universities, and other such organizations, Stanford meets teams of outstanding universities throughout America in a number of sports every year. The Indians usually schedule such teams on a home-and-home basis which means that Stanford athletes travel extensively to major cities throughout the United States. Sports for which the University grants the Stanford Sport Award are football, basketball, track and field, baseball, swimming, golf, tennis, boxing, wrestling, gymnastics, rugby, soccer, water polo, and cross country. Other sports which have regular schedules include, among others, crew and rifleshooting.

Physical Education and Intramurals

The Physical Education Program is designed to accommodate the interests and needs expressed by our students. Students may elect the activity of their choice and quality instruction with appropriate facilities can be expected. The Intramural Sports Program is designed to provide competitive sports opportunities for those men who desire competition but do not care to participate in the intercollegiate sports program. All students are encouraged to participate in their favorite sports activi-
ties. Proceeding on the theory that a sound mind and a healthy body go together, Stanford provides a vigorous and well-rounded program of physical education and intramural athletics. The necessity of physical fitness in a peacetime as well as a wartime United States is absolutely essential and the physical education program is geared to this purpose. All the sports included in the competitive program, listed above, and others are included in the instructional program. The intramural program varies, to fit itself to student interest but basically includes seven-man touch football, two- and six-man volleyball, bowling, table tennis, horseshoes, handball, wrestling, basketball, softball, tennis, swimming, boxing, gymnastics, and track and field. Those who are not interested in or do not have the physical qualifications for intercollegiate competition gain healthful exercise and stimulating experiences in this program.

Women's activities are conducted by the Department of Physical Education for Women. Activity courses, such as equitation, folk and square dancing, riflery, bowling, and archery are offered coeducationally.

Academic Degrees and Teaching Credentials in Physical Education for Men

The Department of Physical Education and Athletics for Men cooperates with the School of Education by providing faculty, facilities, and equipment necessary to the conduct of the Professional Physical Education Program for Men which leads to academic degrees and valid teaching credentials in the State of California. See the "School of Education" section of this Bulletin for details of requirements leading to:

Degrees—Men majoring in physical education may become candidates for the A.M., Ed.D. and the Ph.D. degrees in Education, with concentration in physical education. At the present time there is no A.B. degree with concentration in physical education.

Teaching Credentials—Men desiring to teach physical education classes and coach athletic teams at the secondary and junior college levels should minor in physical education beginning in either the sophomore or junior year in a program which continues through the first graduate year.

See Dr. John Nixon or Dr. Wesley Ruff for further information.

Facilities

Abundant space has been a factor in the development of an extensive athletic plant. Included in the facilities for men are:

The Stadium, seating 90,000 and enclosing a standard American football field encircled by a quarter-mile track with a 220-yard straightaway. 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.

Fees
Fees are charged for enrollment in bowling, equitation, rifle marksmanship, and scuba skin diving.

UNIVERSITY PHYSICAL EDUCATION REQUIREMENT

All undergraduate students except veterans, married students, and students over 24 years of age must participate in organized group activities as one of the requirements of the General Studies program, for a total of 6 non-credit units.

1. During each of the freshman and sophomore years at least one such unit of non-credit activity must be taken in a physical activity course, which may include varsity or freshman athletic teams, organized physical education classes, and other authorized physical activities listed in the Time Schedule.

2. The remaining 4 non-credit units may be fulfilled either in physical activity offerings, or in other types of group activities, as authorized by the General Studies Committee.

3. All six non-credit group activities may be taken in physical education.

4. Not more than two non-credit physical education courses may be taken in one Quarter.

5. In addition to non-credit group activity courses, a student may elect not more than 12 units of physical education classes for academic credit toward graduation. He may not enroll in more than two such courses per quarter.

6. A student may enroll in one group activity non-credit and in one credit course, in physical education, concurrently in any one quarter.

7. Enrollment in ROTC will be accepted, quarter for quarter, in satisfaction of all or part of this 6-unit non-credit requirement.

COURSES

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 Coordinator of Physical Education.

1 unit, autumn, winter, spring, (Ruff), three periods a week

1 unit, autumn, winter, spring, (Turner), MWF 10, 11, or 1:15

11a. Basketball, Freshmen.
1 unit, autumn, winter, (Turner), MWF 10, 11, or 1:15

1 unit, autumn, winter, spring, (Lunny), MWF 10, 2:15, or 3:15

14a. Football, Freshmen.
1 unit, autumn, (Walsh), MTWThF 4:15

1 unit, autumn, winter, spring, (Finger), MF or TTh 11 or 1:15, and nine holes additional
<table>
<thead>
<tr>
<th>Course</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Instructor</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15a. Golf, Freshmen.</td>
<td></td>
<td></td>
<td></td>
<td>(Finger)</td>
<td>MTWThF 3:15-5:30</td>
</tr>
<tr>
<td>16. Gymnastics, Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Gilmore)</td>
<td>MWF 3:15</td>
</tr>
<tr>
<td>17. Volleyball.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MWF 11 or 2:15</td>
</tr>
<tr>
<td>17b. Volleyball and Team Games.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MWF 2:15</td>
</tr>
<tr>
<td>19. Bowling.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MW or TTh 11 or 2:15</td>
</tr>
<tr>
<td>20. Swimming, Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MWF 11</td>
</tr>
<tr>
<td>20a. Swimming, Freshman.</td>
<td></td>
<td></td>
<td></td>
<td>(Gaughran)</td>
<td>MTWThF 4:15</td>
</tr>
<tr>
<td>21. Tennis Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MWF 10, 11, 1:15, 2:15, or TTh 2:15</td>
</tr>
<tr>
<td>21a. Tennis, Freshmen.</td>
<td></td>
<td></td>
<td></td>
<td>(Renker)</td>
<td>MTWThF 3:15-5:05</td>
</tr>
<tr>
<td>22. Track, Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Barland)</td>
<td>MWF 10, or TTh 10</td>
</tr>
<tr>
<td>23. Wrestling, Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MWF 3:15</td>
</tr>
<tr>
<td>24. Diving, Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>TTh 11</td>
</tr>
<tr>
<td>27. Crew, Elementary.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MTWThF 4:15 and S 9</td>
</tr>
<tr>
<td>29. Water Polo.</td>
<td></td>
<td></td>
<td></td>
<td>(Higgins)</td>
<td>TTh 2:15</td>
</tr>
<tr>
<td>30a. Baseball, Freshmen.</td>
<td></td>
<td></td>
<td></td>
<td>(Young)</td>
<td>MTWThF 3:15-5:30</td>
</tr>
<tr>
<td>39a. Soccer, Freshmen.</td>
<td></td>
<td></td>
<td></td>
<td>(Pridelle)</td>
<td>MTWThF 4:15</td>
</tr>
<tr>
<td>41. Physical Conditioning.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>MWF 4:15</td>
</tr>
<tr>
<td>111a. Basketball, Varsity.</td>
<td></td>
<td></td>
<td></td>
<td>(Dallmar)</td>
<td>MTWThF 4:15-6:05</td>
</tr>
<tr>
<td>112. Boxing, Advanced.</td>
<td></td>
<td></td>
<td></td>
<td>(Lunny)</td>
<td>MTTh 4:15</td>
</tr>
<tr>
<td>113. Judo.</td>
<td></td>
<td></td>
<td></td>
<td>(Staff)</td>
<td>TTh 11</td>
</tr>
<tr>
<td>114a. Football, Varsity.</td>
<td></td>
<td></td>
<td></td>
<td>(Ralston)</td>
<td>MTWThF 3:15-5:30</td>
</tr>
<tr>
<td>115. Golf, Advanced.</td>
<td></td>
<td></td>
<td></td>
<td>(Finger)</td>
<td>MTWThF and by arrangement</td>
</tr>
<tr>
<td>115a. Golf, Varsity.</td>
<td></td>
<td></td>
<td></td>
<td>(Finger)</td>
<td>MTWThF 3:15-5:30</td>
</tr>
<tr>
<td>116a. Gymnastics, Advanced.</td>
<td></td>
<td></td>
<td></td>
<td>(Gilmore)</td>
<td>MWF 4:15</td>
</tr>
<tr>
<td>118. Life Saving.</td>
<td></td>
<td></td>
<td></td>
<td>(Gaughran)</td>
<td>TTh 2:15</td>
</tr>
<tr>
<td>119. Swimming, Intermediate.</td>
<td></td>
<td></td>
<td></td>
<td>(Higgins)</td>
<td>MWF 2:15</td>
</tr>
<tr>
<td>120. Swimming, Advanced.</td>
<td></td>
<td></td>
<td></td>
<td>(Higgins)</td>
<td>MWF 3:15</td>
</tr>
<tr>
<td>120a. Swimming, Varsity.</td>
<td></td>
<td></td>
<td></td>
<td>(Gaughran)</td>
<td>MTWThF 4:15</td>
</tr>
</tbody>
</table>
121. Tennis, Advanced.
   1 unit, autumn, winter, spring, (Staff), MWF 2:15 or 4:15, or TTh 2:15 or 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, (Leland), MTTh 4:15
123a. Wrestling, Varsity.
   1 unit, autumn, winter, (Leland), MTWThF 4:15–6:05
124. Diving, Advanced.
   1 unit, autumn, spring, (Staff), TTh 11
124a. Diving, Varsity.
   1 unit, autumn, winter, (Devin), MTWThF 4:15
   1 unit, autumn, winter, spring, (Staff), MTWThF 4:15 and S 10
128. Water Safety Instruction, Part I.
   1 unit, spring, (Gaughran), MTWThF 3:15
128b. Water Safety Instruction, Part II.
   1 unit, spring, (Gaughran, Staff), MTWThF 3:15
129a. Water Polo.
   1 unit, autumn, spring, (Gaughran), MTWThF 4:15
130. Baseball, Junior Varsity.
   1 unit, spring, (Turner), MTWThF 3:15–5:05
130a. Baseball, Varsity.
   1 unit, autumn, winter, spring, (Fehring, Young), MTWThF 3:15–5:05
139. Soccer, Beginning.
   1 unit, autumn, winter, spring, (Priddle), MWF 4:15
139a. Soccer, Varsity.
   1 unit, autumn, winter, spring, (Priddle), MTWThF 4:15
140. Rugby, Beginning.
   1 unit, winter, (Kmetovic), MWThS 4:15
140a. Rugby, Varsity.
   1 unit, winter, (Kmetovic), MWThS 4:15
142. Skin Diving.
   1 unit, autumn, winter, spring, (Gaughran, Higgins), TTh 2:15
142b. Scuba Diving.
   1 unit, autumn, winter, spring, (Gaughran, Higgins), TTh 2:15
151. 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, (Staff), MWF 11, 1:15, 2:15, 3:15 or 4:15
192, 193, 194. Techniques of Athletic Management.
   1 unit, autumn, winter, spring, (Taylor, Staff), by arrangement

Coeducational classes are offered as listed under Physical Education for Women.
PHYSICAL EDUCATION for WOMEN

Emeriti: Maud L. Knapp (Professor), Margaret C. Barr (Associate Professor)
Sylvia P. Cain (Instructor)

Executive Head: Luell W. Guthrie
Associate Professor: Luell W. Guthrie
Assistant Professors: Carroll S. Gordon, Miriam B. Lidster, Marian S. Ruch, Pamela L. Strathairn
Instructors: Judith R. Book, Mary Margaret Neal, Margaret F. Newport, Inga Weiss-Lepnis

OFFERINGS AND FACILITIES

The aims of the physical education program for women are threefold—to provide an opportunity for participation in a variety of physical activities; to afford specialization in one or more areas of activity; and to provide instruction for all levels of competency.

The program is designed: (1) to increase understanding of the value and role of physical education activities in developing and maintaining total fitness throughout life; (2) to encourage continued participation, both during and after college, in physical activity appropriate to health status as well as interest; and, (3) to develop leadership skills which have particular application to community service, volunteer agencies, recreation groups, and domestic and foreign Peace Corps.

Each student is afforded the opportunity for developing interest in many kinds of physical activity and for developing competency in selected activities in order that future participation is more readily selected for recreational purposes. Instructional, recreational, creative, and several forms of competitive experiences are provided in the variety of aquatic, dance, sports, and other physical education activities. Homogeneous skill groupings for instruction in most activities enable the student, beginner through advanced performer, to achieve success within the limits of her capabilities. The program also includes instruction and recreation for coeducational groups.

Competitive and Recreational Opportunities

Recreational and competitive events in the intramural and intercollegiate programs are offered in cooperation with the Women's Recreation Association.

The intramural and intercollegiate programs include: archery, badminton, basketball, bowling, fencing, field hockey, golf, swimming, tennis, and volleyball. A planned co-recreational program includes badminton, bowling, golf, swimming, tennis, and volleyball. Special events offered include ballet, folk and square dancing, modern dance, synchronized swimming, and other activities of current interest.

The Department is affiliated with the Girls' and Women's Sports Division of the American and California Associations for Health, Physical Education and Recreation, the Women's National Officials Rating Committee, the National Association for Physical Education of College Women, and the Western Society for Physical Education of College Women. The Women's Recreation Association is a member of the National and Pacific Southwest Regional Athletic and Recreation Federation for College Women.

Policy governing women's participation in intercollegiate competition is formed by the Department and the Women's Recreation Association in keeping with policies of affiliated organizations 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 non-credit units will be counted in any one quarter.
2. Students enrolling in 2 physical education courses may count both toward the requirement or may receive 1 unit of credit for each of the courses. A maximum of 12 such units will be accepted toward graduation.

COURSES FOR PHYSICAL ACTIVITY

The following physical education courses may be taken 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.

COEDUCATIONAL 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, (Book)
   Autumn, spring, (Book)
   Autumn, winter, spring, (Staff)
   Autumn, winter, spring, (Weiss-Lepnis)
Co63. Ballet, Elementary.
   Autumn, (Weiss-Lepnis)
Co64. Ballet, Intermediate.
   Winter, spring, (Weiss-Lepnis)
Co68. Social Dance, Elementary.
   Autumn, winter, spring, (Lidster)
Co69. Social Dance, Intermediate.
   Autumn, winter, spring, (Lidster)
Co70. Ethnic Dance, Elementary.
   Winter, (Lidster)
   Spring, (Lidster)
Co72. Folk Dance, Elementary.
   Autumn, winter, spring, (Lidster)
Co73. Folk Dance, Intermediate.
   Winter, spring, (Lidster)
Co140. Archery, Advanced.
   Autumn, spring, (Book)
Co148. Equitation, Elementary—English and Western.
   Equitation, Intermediate—English and Western.
   Advanced—English.
   Jumping.
   Autumn, winter, spring, (Sysin)
Co151. Rifle and Pistol Marksmanship—(Enroll in Physical Education for Men Co151.)
Co161. Modern Dance, Advanced.
   Autumn, winter, spring, (Weiss-Lepnis)
Co165. Improvisation and Fundamentals of Composition.
   Autumn, winter, spring, (Weiss-Lepnis)
Co166. Choreography and Dance Forms.
   Autumn, winter, spring, (Weiss-Lepnis)
Co167. Choreography and Production.
   Autumn, winter, spring, (Weiss-Lepnis)
Co172. Folk Dance, Advanced.
   Autumn, winter, spring, (Lidster)
Co173. Folk Dance, Exhibition.
   Winter, spring, (Lidster)
Co177. Historic Dance: Primitive and Ancient.
   Autumn, (Lidster)
Co178. Historic Dance: Court Forms.
   Winter, (Lidster)
Co179. Contemporary Dance.
   Spring, (———)

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, (Book)
   Autumn, winter, spring, (Book)
   Spring, (Strathairn)
   Autumn, winter, spring, (Neal, Newport)
   Autumn, winter, spring, (Neal, Newport)
   Autumn, winter, spring, (——)

   Autumn, winter, spring, (——)

W15. Tennis, Elementary.
   Autumn, winter, spring, (Guthrie, Neal, Newport)

   Autumn, winter, spring, (Guthrie, Neal, Newport)

   Winter, (Strathairn)

W23. Field Hockey, Elementary.
   Autumn, spring, (Book)

   Autumn, spring, (Book)

W25. Softball.
   Spring, (Staff)

W27. Volleyball.
   Autumn, winter, (Staff)

   Autumn, spring, (Ruch, Strathairn)

   Autumn, spring, (Ruch, Strathairn)

W33. Diving, Elementary.
   Spring, (Strathairn)

W35. Lifesaving and Water Safety, A.R.C.
   Winter, spring, (Strathairn)

W36. Aquatic Art, Elementary.
   Autumn, spring, (Ruch, Strathairn)

W37. Aquatic Art, Intermediate.
   Autumn, spring, (Ruch, Strathairn)

W42. Bowling, Elementary.
   Autumn, winter, spring, (Staff)

   Autumn, winter, spring, (Staff)

W44. Golf, Elementary.
   Autumn, winter, spring, (Gordon)

   Autumn, winter, spring, (Gordon)

W51. Modern Dance, Elementary.
   Autumn, winter, spring, (——)

W110. Badminton, Advanced.
   Winter, spring, (Neal, Newport)

W112. Fencing, Advanced.
   Autumn, winter, spring, (——)

W113. Fencing, Tournament.
   Autumn, winter, spring, (——)

W114. Tennis, Advanced.
   Autumn, winter, spring, (Guthrie, Neal, Newport)

W115. Tennis, Tournament.
   Autumn, winter, spring, (Guthrie, Newport)

W120. Basketball, Advanced.
   Winter, (Strathairn)

W121. Basketball, Tournament.
   Winter, (Strathairn)

W130. Swimming, Advanced.
   Autumn, spring, (Ruch, Strathairn)
PHYSICAL EDUCATION

W131. Swimming, Competitive.
   Autumn, spring, (Strathairn)

W132. General Aquatics.
   Summer, (Staff)

W134. Diving, Competitive.
   Autumn, spring, (Strathairn)

W135a. Water Safety Instructor's Course, Part I, A.R.C.
   Spring, (Strathairn)

W135b. Water Safety Instructor's Course, Part II, A.R.C.
   Spring, (Strathairn)

W136. Aquatic Art, Advanced.
   Spring, (Ruch)

Archery, Advanced—(See Co40)

W143. Bowling, Tournament.
   Autumn, winter, spring, (Staff)

W144. Golf, Advanced.
   Autumn, winter, spring, (Gordon)

W145. Golf, Tournament.
   Autumn, spring, (Gordon)

Archery, Elementary—See Co40
Archery, Intermediate—See Co41

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
Equitation—See Co148

Modern Dance, Advanced—See Co161

Choreography—See Co165, Co166, Co167

Folk Dance, Advanced—See Co172

Folk Dance, Exhibition—See Co173

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)

Co138. Aquatics Officiating.
   Autumn, (Strathairn)

Co181. Golf Tournament Organization.
   Autumn, (Gordon)

Co182. Tennis Tournament Organization.
   Winter, spring, (Guthrie)
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 Honors programs in Humanities, and in Social Thought and Institutions. The Colloquia listed below will be offered during the current year unless otherwise indicated.

The Senior Colloquia are limited to 15 students each and are built around subjects or issues of continuing importance, or a basic document of enduring significance. They are designed to stimulate serious thought rather than to impart information for its own sake. Thus the emphasis is on discussion and analysis, not lectures.

In most cases students are not admitted to a Colloquium being taught by a staff member of their major department. This can be determined by consulting the Time Schedule. No more than two Senior Colloquia can be taken for credit.

Descriptions and reading lists can be found in the current General Studies Bulletin.

#1. The Mystery of Being.
   2 units, autumn, (Reinhardt, Modern European Languages), W 2:15-4:05

#3. Is Industrialization the Panacea for Underdeveloped Countries?
   2 units, summer, (White, Geography), M 3:15-5:05

#4. The Peace Corps in Cultural Perspective.
   2 units, autumn, (Textor, Comparative Education and Anthropology), Th 4:15-6:05

#5. The Meaning of Death in Western Culture.
   2 units, autumn, (Black, General Studies), W 7:30-9:30 p.m.

#7. Canada, Nation or State?
   2 units, spring, (Allyn, Graduate School of Business), to be given in 1966-67

   2 units, autumn, (Peck, Communication), T 8-10 p.m.

#12. Shakespeare.
   2 units, spring, (Rebhols, English), T 2:15-4:05

#13. Tax Reform and Expenditure Policy.
   2 units, autumn, (Freeman, Hoover Institution), T 4:15-6:05

   2 units, spring, (Feldman, Simon, Medical School), W 7-9 p.m.

#21. Anthropology and Epistemology.
   2 units, winter, (Cancian, Anthropology), Th 2:15-4:05

   2 units, spring, (Sokol, Political Science), T 4:15-6:05

   2 units, winter, (R. Campbell, Hoover Institution), T 2:15-4:05

#28. The Destiny of Europe.
   2 units, autumn, winter, (Hilton, Modern European Languages), W 4:15-6:05

#29. The Doctor's Dilemma.
   2 units, autumn, (Creger, Medical School), Th 7:30-9:30 p.m.

#31. The Individual in Soviet Society.
   2 units, winter, (Blumenthal, Political Science), Th 2:15-4:05

   2 units, spring, (Bark, History), W 2:15-4:05
#34. Contemporary Germany: Aspects of Its Culture.
2 units, spring, (Lohnes, Modern European Languages), to be given in 1966-67

#35. Theories of War.
2 units, autumn, (Holsti, Political Science), T 2:15-4:05

2 units, autumn, (Terry, Geography), T 4:15-6:05

#44. An Anthropocentric View of Evolution.
2 units, summer, (Baxter, Biological Sciences), M 2:15-4:05

#46. The Place of Aircraft, Missiles, and Spacecraft in Twentieth Century Civilization.
2 units, winter, (Hoff, Aeronautics and Astronautics), T 2:15-4:05

#51. Geography and Contemporary World Problems.
2 units, autumn, winter, spring, (Williams, Geography), M 4:15-6:05

#53. Personal Values and Behavior—(Open also to B.S. candidates.)
2 units, spring, (Tuttle, Electrical Engineering), T 7:45-9:45 p.m.

#55. Simulation in International Relations.
2 units, spring, (Dunn, Electrical Engineering), M 4:15-6:05

#56. Language and the Construction of Thought.
2 units, autumn, (Rolfe, Linguistics), T 4:15-6:05

#58. The Neo-Aristotelian Critics.
2 units, winter, (Lohn, Modern European Languages), W 4:15-6:05

2 units, spring, (Parks, Chemistry), T 4:15-6:05

#60. The Literature and History of the Organ.
2 units, autumn, (Nanney, Music), W 2:15-4:05

#61. Communication, Thought and Learning.
2 units, winter, (Ritson, Physics), W 2:15-4:05

#64. Existential Phenomenology and Existential Psychiatry.
2 units, winter, (Reinhardt, Modern European Languages), W 4:15-6:05

#67. The Human Condition.
2 units, summer, (Reinhardt, Modern European Languages), W 4:15-6:05

#71. Plants and Their Relation to History.
2 units, spring, (Thomas, Biological Sciences), T 2:15-4:05

#72. Contemporary Music.
2 units, spring, (Kuhn, Music), W 2:15-4:05

#74. Sex Roles in American Culture.
2 units, winter, (Stolz, Psychology), T 2:15-4:05

#75. Masterpieces of Choral Literature.
2 units, winter, (Schmidt, Music), T 2:15-4:05

#77. Problems and Politics of Modern Germany.
2 units, winter, (Sokol, Political Science), T 4:15-6:05

#78. Man-Machine Decision Responsibility.
2 units, spring, (Bennigson, Naval Science), T 4:15-6:05

#79. Leisure in Modern Life.
2 units, winter, (Guthrie, Physical Education), T 4:15-6:05

#80. Virgil: Free Will and Predestination.
2 units, spring, (Otis, Classics), T 8-10 p.m.

#82. Dance in Patterns of Culture.
2 units, autumn, (Lidster, Physical Education), W 2:15-4:05

#85. The History of the Book.
2 units, autumn, spring, (Lenkey, Library), T 4:15-6:05

#86. The Concept of Freedom.
2 units, autumn, (Mothershead, Philosophy), T 2:15-4:05

#88. Manuscripts, Archives, and Research.
2 units, winter, (Hansen, Library), T 4:15-6:05
SENIOR COLLOQUIA

#90. Current Controversies Over American Education.
   2 units, spring, (Thomas, Education), W 4:15–6:05

#91. Rhetorical Humor.
   2 units, winter, (Schrader, Hastings, Speech and Drama), Th 2:15–4:05

#92. Bach and Bartok.
   2 units, spring, (Salgo, Music), to be given in 1966–67

#93. The Tragic Sense of Life in Unamuno.
   2 units, autumn, (Schevill, Modern European Languages), W 4:15–6:05

#94. Civil Disobedience.
   2 units, autumn, (Schrader, Speech and Drama), Th 2:15–4:05

#95. A Case Study in Early American Policy Toward the Middle East.
   2 units, spring, (Harris, Political Science), W 2:15–4:05

   2 units, winter, (Steiner, Political Science), T 4:15–6:05

#98. Utopias.
   2 units, autumn, (Hastings, Speech and Drama), T 2:15–4:05

#99. Ceremony and Symbol in Religion and Society.
   2 units, spring, (Minto, Chaplain of the University), Th 2:15–4:05

#100. The Mind of Jesus.
   2 units, autumn, winter, spring, (Rathbun, Law School), W 7:30–9:30 p.m.

#101. Problems and Politics of Southeast Asia.
   2 units, autumn, (Sokol, Political Science), T 4:15–6:05

#105. Sociology of the Academic Profession.
   2 units, winter, (Zelditch, Sociology), T 4:15–6:05

#106. Civilization and Its Discontents.
   2 units, winter, (Anderson, Sociology), W 2:15–4:05

#107. Commitment to and Dependence Upon Social Action.
   2 units, winter, (Beck, Sociology), Th 7:30–9:30 p.m.

#108. Professionals and Bureaucracies.
   2 units, autumn, (Dornbusch, Sociology), W 2:15–4:05

#110. Man as a Factor in Evolution.
   2 units, winter, (Holm, Biological Sciences), Th 2:15–4:05

#113. Lenin-Stalin-Khrushchev.
   2 units, autumn, spring, (Drachkovitch, Political Science), Th 4:15–6:05

#114. The Greek Historian Thucydides.
   2 units, winter, (Raubitschek, Classics), Th 2:15–4:05

#115. Marxist Ethics.
   2 units, autumn, (Nivison, Philosophy), W 2:15–4:05

#119. Pseudoscience in Modern Society.
   2 units, autumn, (Davis, Geology), T 2:15–4:05

#120. Characterization, Self-Revelation, and Disguise in Biographical Writing.
   2 units, autumn, (Fifer, English), T 2:15–4:05

#122. William Faulkner.
   2 units, spring, (Appel, English), W 4:15–6:05

#123. Voltaire and Johnson: Contrasting Spokesmen for the Enlightenment.
   2 units, winter, (Loftis, English), W 2:15–4:05

#124. The Manipulation of Human Behavior.
   2 units, winter, (Cooper, Psychology), T 2:15–4:05

#126. The Negro and the Novel.
   2 units, spring, (Levin, English), W 2:15–4:05

#129. Pessimism in Philosophy and Art.
   2 units, autumn, (Foulkes, Modern European Languages), W 2:15–4:05

#130. T. S. Eliot: Four Quartets.
   2 units, winter, spring, (Meads, Modern European Languages), W 4:15–6:05
#131. The Place of Women in Different Civilizations.
2 units, summer, (Sokol, Political Science), T 4:15-6:05
#132. Goethe's Faust.
2 units, winter, (Foulkes, Modern European Languages) W 2:15-4:05
#134. Goethe: The Sorrows of Young Werther.
2 units, winter, (Lillyman, Modern European Languages), M 7-9 p.m.
#138. Frank Lloyd Wright.
2 units, autumn, (Thompson, Architecture), Th 4:15-6:05
#139. Modern French Painting.
2 units, autumn, spring, (Faulkner, Art), Th 2:15-4:05
#140. Philosophy of Mathematics.
2 units, autumn, (Kreisel, Philosophy), Th 2:15-4:05
#141. Foreign Policies of the Soviet Union.
2 units, autumn, (Fisher, Hoover Institution), W 4:15-6:05
#142. Communism and the American Response.
2 units, spring, (Fisher, Hoover Institution), W 4:15-6:05
#143. Soviet-American Relations.
2 units, winter, (Fisher, Hoover Institution), W 4:15-6:05
#146. Mystics and Mysticism.
2 units, spring, (Watkins, Political Science), T 2:15-4:05
#148. Great Biographies.
2 units, winter, (Miller, History), to be given in 1966-67
#150. Creativity in Art, Science, and Everyday Life.
2 units, winter, (Tuttle, Electrical Engineering), Th 7:45-9:45 p.m.
#153. Freedom of Speech.
2 units, winter, spring, (Donner, Communication), T 4:15-6:05
#154. Franz Kafka.
2 units, spring, (Boeninger, Modern European Languages), T 2:15-4:05
#155. Social Classes in American Society.
2 units, autumn, (Wallin, Sociology), M 4:15-6:05
#159. The Pattern of Cities.
2 units, winter, (Sanders, Planning and Architecture), W 7:30-9:30 p.m.
#161. Science, Values, and Anti-Intellectualism.
2 units, spring, (Krauskopf, Geology), M 2:15-4:05
#162. The Technological Order.
2 units, autumn, (Evans, General Studies), M 8-10 p.m.
#167. Music and Words.
2 units, autumn, (Crosten, Music), to be given in 1966-67
#168. The Great Novels of China.
2 units, spring, (Chan, Asian Languages), T 2:15-4:05
#170. Deterrence, Arms Control, and Disarmament.
2 units, winter, (Holsti, Political Science), T 4:15-6:05
#171. Hypnosis and Personality.
2 units, spring, (Hilgard, Psychology), M 2:15-4:05
#172. The Psychology of Mark Twain.
2 units, spring, (Sears, Psychology), T 4:15-6:05
#174. Soren Kierkegaard.
2 units, spring, (Reinhardt, Modern European Languages), W 2:15-4:05
#177. An Introduction to Contemporary India.
2 units, autumn, winter, (Walia, Communication), M 4:15-6:05
#178. The Writing of Albert Camus.
2 units, autumn, (Cohn, French and Italian), M 4:15-6:05
#179. The Artist and Society.
2 units, spring, (Naughton, French and Italian), Th 2:15-4:05
#180. International Communism.
2 units, winter, (Sworakowski, Hoover Institution), T 2:15-4:05
#183. Christian Impact on Africa.
2 units, winter, (Minto, Chaplain of the University), Th 2:15–4:05

#184. Theological Atheism.
2 units, winter, (Clebsch, Religion), T 4:15–6:05

#188. Alternatives to War.
2 units, autumn, (Leppert, Mechanical Engineering), M 7:45–9:45 p.m.

#190. Human Nature.
2 units, spring, (Landauer, Psychology), T 2:15–4:05

#195. Social Science Approaches to Music.
2 units, autumn, (Farnsworth, Psychology), T 2:15–4:05

#200. Psychiatry for Amateur Psychiatrists.
2 units, autumn, winter, (Paulsen, Health Service and Medical School), T 7:30–9:30 p.m.
The Stanford Linear Accelerator Center (SLAC) is devoted to experimental and theoretical research in elementary-particle physics. The major experimental facility of the Center will be a two-mile-long linear electron accelerator which is now being constructed on the campus under contract with the United States Atomic Energy Commission. When completed, the Center will be operated by Stanford as a national facility. At this national facility, qualified scientists from Stanford and from other universities and research centers throughout the country and the world will carry out very high energy physics research.

At present, experimental elementary-particle research is being carried out by the SLAC faculty and staff at the Stanford High Energy Physics Laboratory and at the high energy physics facilities of the Lawrence Radiation Laboratory and the Brookhaven National Laboratory. Theoretical elementary-particle research is being carried out at the Center.

In addition to its research activities, SLAC offers a number of regular lecture series in topics of high energy and elementary-particle physics covering both experimental and theoretical subjects. These are announced at the beginning of the academic year.

Graduate students may participate in the work of the Center by arrangement with departments at Stanford or at other universities cooperating with the Center.

Research assistantships are available for qualified students in the various research programs at SLAC by arrangement with individual faculty members. There also exist openings for qualified graduate students to obtain summer positions assisting in the programs of the research groups at the Center. Interested students should apply to the Office of the Director.

The Center is located on 480 acres of Stanford property, west of the main campus, parallel to and south of Sand Hill Road. Several buildings are complete and occupied. When finished, the building complex will house the nearly 1000-man staff required to operate and maintain the Center. The accelerator itself is under construction and will be operational in 1966-67. It will provide an electron beam with a maximum energy of 20 Bev. Facilities are being incorporated to permit later doubling of the beam energy.
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